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Publications:

EEG Based Inference of Spatio-Temporal Brain Dynamics
Electroencephalography (EEG) provides a measure of brain activity and has improved our understanding of the brain immensely. However, there is still much to be learned and the full potential of EEG is yet to be realized. In this thesis we suggest to improve the information gain of EEG using three different approaches; 1) by recovery of the EEG sources, 2) by representing and inferring the propagation path of EEG sources, and 3) by combining EEG with functional magnetic resonance imaging (fMRI). The common goal of the methods, and thus of this thesis, is to improve the spatial dimension of EEG.

The main topic of this thesis is the localization of the EEG generators. This entails solving both a forward and an inverse problem. The inverse problem maps the EEG signal recorded on the scalp to its origin in the brain. It is a highly ill-posed problem which we tackle by employing a sparsity promoting ‘spike and slab’ like method augmented with physiologically relevant source priors. The incorporated temporal and spatial priors exploit coherence between neighboring time samples and between neighboring source locations, respectively. We show that these augmentations effectively increase the source recovery ability.

The forward problem describes the propagation of neuronal activity in the brain to the EEG electrodes on the scalp. The geometry and conductivity of the head layers are normally required to model this path. We propose a framework for inferring forward models which is based on the EEG signal and a low dimensional representation of forward models. The representation is built by principal component analysis of a corpus of forward models. The method can be used to recover subject-specific forward models when structural scans and/or conductivity estimations are not available.

Finally we investigate the extraction of EEG components having bandpower dynamics correlated with fMRI components. We show that adding anatomical information to the inference scheme improves the recovery of correlated components compared to only using functional information. The anatomical information is incorporated through the EEG forward model and assumes that the activity of the fMRI component overlaps spatially with the origin of the coupled EEG component.

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We performed simultaneous recordings of electroencephalography (EEG) from multiple students in a classroom, and measured the inter-subject correlation (ISC) of activity evoked by a common video stimulus. The neural reliability, as quantified by ISC, has been linked to engagement and attentional modulation in earlier studies that used high-grade equipment in laboratory settings. Here we reproduce many of the results from these studies using portable low-cost equipment, focusing on the robustness of using ISC for subjects experiencing naturalistic stimuli. The present data shows that stimulus-evoked neural responses, known to be modulated by attention, can be tracked for groups of students with synchronized EEG acquisition. This is a step towards real-time inference of engagement in the classroom.
From Raw Data to Social Systems - Separating the Signal from the Noise in Smartphone Sensor Measurements

Digital tools for communication and information exchange have been ingrained in our lives. We google our information and we skype our parents. We use the Internet to shop for groceries, do banking, and study. We play massively multiplayer online games, belong to online communities, and date online. However, this does not mean that our lives have really moved to the digital domain. Even though the Internet makes it possible to exist without ever leaving the confines of bedrooms, we still choose to meet our friends in person or to travel through physical, rather than virtual, space. There is a richness to personal contact and direct experience that has not yet been replaced by the digital services. Until this shift happens, we continue to analyze and investigate our offline lives in the pursuit for deepening our understanding of human nature. Digital breadcrumbs, which we leave behind with every online action, are relatively easy to collect. Capturing our offline behaviors, on the other hand, is not trivial. Scientists often rely on data that approximates only one aspect of our lives. For example, mobile operator logs reveal who we call, but not who we meet. An alternative approach is to derive proxies of certain behaviors from smartphone sensor readings. Copenhagen Networks Study (CNS) employs this method, among others, to build the biggest dataset of the kind available to researchers in academia. The thesis shows a path from collecting raw smartphone data for CNS, through extracting increasingly meaningful information, to gaining novel insights into human behavior. Step by step, I turn a cryptic and seemingly uninteresting collection of hardware identifiers and received signal strengths into a detailed record of people’s lives: where they go, who they encounter, who they become friends with. I compare their offline activities and social ties to their online representations and find a surprisingly small overlap. The methods I propose in this thesis constitute a more privacy-aware alternative to currently employed social sensing approaches. I show how to track the mobility and interactions of participants without sharing the results with third parties inadvertently. At the same time, the findings presented in this thesis emphasize the fragility of our privacy: the data we today consider safe to share today, tomorrow might prove to carry rich information about our lives.

Inferring human intentions from the brain data

The human brain is a massively complex organ composed of approximately a hundred billion densely interconnected, interacting neural cells. The neurons are not wired randomly - instead, they are organized in local functional assemblies. It is believed that the complex patterns of dynamic electric discharges across the neural tissue are responsible for emergence of high cognitive function, conscious perception and voluntary action. The brain's capacity to exercise free will, or internally generated free choice, has long been investigated by philosophers, psychologists and neuroscientists. Rather than assuming a causal power of conscious will, the neuroscience of volition is based on the premise that "mental states rest on brain processes", and hence by measuring spatial and temporal correlates of volition in carefully controlled experiments we can infer about their underlying mind processes, including concepts as intriguing as "free will", "agency"
and "consciousness". Recent developments in electrophysiology and neuroimaging methods allow for increasingly more accurate estimation of spatial and temporal characteristics of decision processes.

The work presented in this thesis is intended to contribute to our understanding of the dynamics of voluntary decision processes about prospective action. In the two presented studies we probe different types of decisions and compare them in terms of behavioral and EEG characteristics. We show that decision processes are manifested by complex, broadband modulation of brain oscillatory patterns, primarily in Alpha (8-12 Hz) and Beta (16-30 Hz) ranges. Our results suggest that decisions about whether to act or not, what type of action to perform, and about the timing of the action have distinct dynamic representations, and thus are to some extent mediated by different neural components. Furthermore, free action can be partially explained by low level behavioral preferences, especially in contexts where no explicit incentive favors one action over another.

Apart from the investigation of volition, considerable part of the work presented in this thesis is dedicated to experiment design methodology and efficient EEG processing methods. We have developed a dedicated, flexible Virtual Reality Environment (VRE) platform, suitable for investigation of volition and action preparation processes with range of modalities, including electroencephalography (EEG), functional magnetic resonance (fMRI), eye-tracking (ET) and behavioral measures. By providing ecologically valid, semi-realistic experience we aimed at reinforcing the natural decision processes and minimize the problem of random-sequence generation and fatigue in participants undergoing highly repeatable cognitive experiments. Other methodological contributions presented in the thesis are related to efficient, automatized and highly data-preserving methods for processing of EEG data, based on minimal number of arbitrarily selected parameters.

Probabilistic models for structured sparsity
Sparsity has become an increasingly popular choice of regularization in machine learning and statistics. The sparsity assumption for a matrix $X$ means that most of the entries in $X$ are equal to exactly zero. Structured sparsity is generalization of sparsity and assumes that the set of locations of the non-zero coefficients in $X$ contains structure that can be exploited. This thesis deals with probabilistic models for structured sparsity for regularization of ill-posed problems. The aim of the thesis is two-fold; to construct sparsity promoting prior distributions for structured sparsity and to derive efficient inference algorithms for these distributions. The work explores a class of models that uses Gaussian processes (Rasmussen and Williams, 2006) as a latent representation of the structure of sparsity patterns. This representation allows prior knowledge of the structure of the sparsity patterns to be encoded using generic covariance functions through the Gaussian process. This thesis focuses on two specific instances of ill-posed problems: linear inverse problems and time-varying covariance estimation. The first part of the thesis deals with probabilistic models for finding structured sparse solutions to linear inverse problems. In this part, the sparsity promoting prior known as the spike-and-slab prior (Mitchell and Beauchamp, 1988) is generalized to the structured sparsity setting. An expectation propagation algorithm is derived for approximate posterior inference. The proposed model and the associated inference algorithm are studied and evaluated using a set of numerical experiments, which include phase transition experiments, compressed sensing, phoneme classification and electroencephalography (EEG) source localization. The second part of the thesis deals with the problem of time-varying covariance estimation. A hierarchical model for a set of non-stationary time series with time-varying covariance matrices is proposed. The model is tailored to address the problem of dynamic functional connectivity in neuroimaging and it assumes that the instantaneous covariance matrix of each time series is decomposed into a non-
negative linear combination of elements from a dictionary of shared covariance matrix components. A variational Bayes algorithm is derived for approximate posterior inference. The proposed model is validated using a functional magnetic resonance imaging (fMRI) dataset.

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Two subgroups of antipsychotic-naive, first-episode schizophrenia patients identified with a Gaussian mixture model on cognition and electrophysiology
Deficits in information processing and cognition are among the most robust findings in schizophrenia patients. Previous efforts to translate group-level deficits into clinically relevant and individualized information have, however, been non-successful, which is possibly explained by biologically different disease subgroups. We applied machine learning algorithms on measures of electrophysiology and cognition to identify potential subgroups of schizophrenia. Next, we explored subgroup differences regarding treatment response. Sixty-six antipsychotic-naive first-episode schizophrenia patients and sixty-five healthy controls underwent extensive electrophysiological and neurocognitive test batteries. Patients were assessed on the Positive and Negative Syndrome Scale (PANSS) before and after 6 weeks of monotherapy with the relatively selective D2 receptor antagonist, amisulpride (280.3±159 mg per day). A reduced principal component space based on 19 electrophysiological variables and 26 cognitive variables was used as input for a Gaussian mixture model to identify subgroups of patients. With support vector machines, we explored the relation between PANSS subscores and the identified subgroups. We identified two statistically distinct subgroups of patients. We found no significant baseline psychopathological differences between these subgroups, but the effect of treatment in the groups was predicted with an accuracy of 74.3% (P=0.003). In conclusion, electrophysiology and cognition data may be used to classify subgroups of schizophrenia patients. The two distinct subgroups, which we identified, were psychopathologically inseparable before treatment, yet their response to dopaminergic blockade was predicted with significant accuracy. This proof of principle encourages further endeavors to apply data-driven, multivariate and multimodal models to facilitate progress from symptom-based psychiatry toward individualized treatment regimens.

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Data driven estimation of imputation error—a strategy for imputation with a reject option

Missing data is a common problem in many research fields and is a challenge that always needs careful considerations. One approach is to impute the missing values, i.e., replace missing values with estimates. When imputation is applied, it is typically applied to all records with missing values indiscriminately. We note that the effects of imputation can be strongly dependent on what is missing. To help make decisions about which records should be imputed, we propose to use a machine learning approach to estimate the imputation error for each case with missing data. The method is thought to be a practical approach to help users using imputation after the informed choice to impute the missing data has been made. To do this all patterns of missing values are simulated in all complete cases, enabling calculation of the "true error" in each of these new cases. The error is then estimated for each case with missing values by weighing the "true errors" by similarity. The method can also be used to test the performance of different imputation methods. A universal numerical threshold of acceptable error cannot be set since this will differ according to the data, research question, and analysis method. The effect of threshold can be estimated using the complete cases. The user can set an a priori relevant threshold for what is acceptable or use cross validation with the final analysis to choose the threshold. The choice can be presented along with argumentation for the choice rather than holding to conventions that might not be warranted in the specific dataset.
Data-driven forward model inference for EEG brain imaging

Electroencephalography (EEG) is a flexible and accessible tool with excellent temporal resolution but with a spatial resolution hampered by volume conduction. Reconstruction of the cortical sources of measured EEG activity partly alleviates this problem and effectively turns EEG into a brain imaging device. The quality of the source reconstruction depends on the forward model which details head geometry and conductivities of different head compartments. These person-specific factors are complex to determine, requiring detailed knowledge of the subject’s anatomy and physiology. In this proof-of-concept study, we show that, even when anatomical knowledge is unavailable, a suitable forward model can be estimated directly from the EEG. We propose a data-driven approach that provides a low-dimensional parametrization of head geometry and compartment conductivities, built using a corpus of forward models. Combined with only a recorded EEG signal, we are able to estimate both the brain sources and a person-specific forward model by optimizing this parametrization. We thus not only solve an inverse problem, but also optimize over its specification. Our work demonstrates that personalized EEG brain imaging is possible, even when the head geometry and conductivities are unknown.

Data-driven forward model inference for EEG brain imaging

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Forward Models can be Inferred from EEG Data

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Modelling Digital Media Objects
The goal of this thesis is to investigate two relevant issues regarding computational representation and classification of digital multi-media objects. With a special focus on music, a model for representation of objects comprising multiple heterogeneous data types is investigated. Necessary to this work are considerations regarding integration of multiple diverse data modalities and evaluation of the resulting concept representation.

Regarding modelling of data exhibiting certain sequential structure, a number of theoretical and empirical results are presented. These are results related to model parameter estimation and the use of sequence models in a classification scenario. The latter being of importance in various digital multimedia navigation and retrieval tasks.

In the fields of topic modelling and multi-modal integration, we formulate a model to describe entities composed of multiple aspects. The particular aspects considered in the publications are sound, song lyrics, and user-provided metadata. This model integrates the diverse data types comprising the objects and defines concrete unified representations in a joint “semantic” space. Within the context of this model, general measures of similarity between such multi-modal objects are investigated.

In the fields of method of moments and sequence modelling, we increase practical applicability of a certain moment based parameter estimation method for Hidden Markov models by showing how to use full-length sequences in the estimation process. Consequently, this impacts the quality of the estimated model parameters.

Subsequently, we show how to perform time series classification using a composite likelihood formulated from third order moments defined by the Hidden Markov model. Compared to the conventional likelihood based method, our contribution is less computationally expensive, while retaining the level of classification performance.

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Neural Markers of Responsiveness to the Environment in Human Sleep

Sleep is characterized by a loss of behavioral responsiveness. However, recent research has shown that the sleeping brain is not completely disconnected from its environment. How neural activity constrains the ability to process sensory information while asleep is yet unclear. Here, we instructed human volunteers to classify words with lateralized hand responses while falling asleep. Using an electroencephalographic (EEG) marker of motor preparation, we show how responsiveness is modulated across sleep. These modulations are tracked using classic event-related potential analyses complemented by Lempel-Ziv complexity (LZc), a measure shown to track arousal in sleep and anesthesia. Neural activity related to the semantic content of stimuli was conserved in light non-rapid eye movement (NREM) sleep. However, these processes were suppressed in deep NREM sleep and, importantly, also in REM sleep, despite the recovery of wake-like neural activity in the latter. In NREM sleep, sensory activations were counterbalanced by evoked down states, which, when present, blocked further processing of external information. In addition, responsiveness markers correlated positively with baseline complexity, which could be related to modulation in sleep depth. In REM sleep, however, this relationship was reversed. Therefore propose that, in REM sleep, endogenously generated processes compete with the processing of external input. Sleep can thus be seen as a self-regulated process in which external information can be processed in lighter stages but suppressed in deeper stages. Last, our results suggest drastically different gating mechanisms in NREM and REM sleep.
Predicting the emotions expressed in music
With the ever-growing popularity and availability of digital music through streaming services and digital download, making sense of the millions of songs, is ever more pertinent. However the traditional approach of creating music systems has treated songs like items in a store, like books and movies. However music is special, having origins in a number of evolutionary adaptations. The fundamental needs and goals of a users use of music, was investigated to create the next generation of music systems. People listen to music to regulate their mood and emotions was found to be the most important fundamental reason. (Mis)matching peoples mood with the emotions expressed in music was found to be an essential underlying mechanism, people use to regulate their emotions. This formed the basis and overall goal of the thesis, to investigate how to create a predictive model of emotions expressed in music. To use in the next generation of music systems.

The thesis was divided into three main topics involved in creating a predictive model 1) Elicitation of emotion, 2) Audio representation and 3) Modelling framework, associating the emotion and audio representation, allowing to predict the emotions expressed in music.

The traditional approach of quantifying musical stimuli on the valence and arousal representation of emotions using continuous or likert scales was questioned. An outline of a number of bias and the so-called confidence effect when using bipolar scales led to the use of relative scales in the form of pairwise comparisons. One issue with pairwise comparisons is the scaling, this was solved using an active learning approach through a Gaussian Process model.

Traditional audio representation disregards all temporal information in audio features used for modelling the emotions.
expressed in music. Therefore a probabilistic feature representation framework was introduced enabling both temporal and non-temporal aspects to be coded in discrete and continuous features. Generative models are estimated for each feature time-series and used in a discriminative setting using the Probability Product Kernel (PPK) allowing the use of this approach in any kernel machine.

To model the pairwise comparisons directly, a Generalized Linear Model, a kernel extension and a Gaussian Process model were used. These models can predict the ranking of songs on the valence and arousal dimensions directly. Furthermore use of the PPK allowed to find optimal combinations of both feature and feature representation using Multiple Kernel Learning.

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Spatio-temporal reconstruction of brain dynamics from EEG with a Markov prior
Electroencephalography (EEG) can capture brain dynamics in high temporal resolution. By projecting the scalp EEG signal back to its origin in the brain also high spatial resolution can be achieved. Source localized EEG therefore has potential to be a very powerful tool for understanding the functional dynamics of the brain. Solving the inverse problem of EEG is however highly ill-posed as there are many more potential locations of the EEG generators than EEG measurement points. Several well-known properties of brain dynamics can be exploited to alleviate this problem. More short ranging connections exist in the brain than long ranging, arguing for spatially focal sources. Additionally, recent work (Delorme et al., 2012) argues that EEG can be decomposed into components having sparse source distributions. On the temporal side both short and long term stationarity of brain activation are seen. We summarize these insights in an inverse solver, the so-called "Variational Garrote" (Kappen and Gómez, 2013). Using a Markov prior we can incorporate flexible degrees of temporal stationarity. Through spatial basis functions spatially smooth distributions are obtained. Sparsity of these are inherent to the Variational Garrote solver. We name our method the MarkoVG and demonstrate its ability to adapt to the temporal smoothness and spatial sparsity in simulated EEG data. Finally a benchmark EEG dataset is used to demonstrate MarkoVG's ability to recover non-stationary brain dynamics.

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The Center for Integrated Molecular Brain Imaging (Cimbi) database
We here describe a multimodality neuroimaging containing data from healthy volunteers and patients, acquired within the Lundbeck Foundation Center for Integrated Molecular Brain Imaging (Cimbi) in Copenhagen, Denmark. The data is of particular relevance for neurobiological research questions related to the serotonergic transmitter system with its normative data on the serotonergic subtype receptors 5-HT₁A, 5-HT₁B, 5-HT₂A, and 5-HT₄ and the 5-HT transporter (5-HTT), but can easily serve other purposes.

The Cimbi database and Cimbi biobank were formally established in 2008 with the purpose to store the wealth of Cimbi-acquired data in a highly structured and standardized manner in accordance with the regulations issued by the Danish Data Protection Agency as well as to provide a quality-controlled resource for future hypothesis-generating and hypothesis-driven studies. The Cimbi database currently comprises a total of 1100 PET and 1000 structural and functional MRI scans and it holds a multitude of additional data, such as genetic and biochemical data, and scores from 17 self-reported questionnaires and from 11 neuropsychological paper/computer tests.

The database associated Cimbi biobank currently contains blood and in some instances saliva samples from about 500 healthy volunteers and 300 patients with e.g., major depression, dementia, substance abuse, obesity, and impulsive aggression. Data continue to be added to the Cimbi database and biobank.

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EEG Source Reconstruction Performance as a Function of Skull Conductance Contrast

Through simulated EEG we investigate the effect of the forward model's applied skull:scalp conductivity ratio on the source reconstruction performance. We show that having a higher conductivity ratio generally leads to improvement of the solution. Additionally we see a clear connection between higher conductivity ratios and lower coherence, thus a reduction of the ill-posedness of the EEG inverse problem. Finally we show on real EEG data the stability of the strongest source recovered across conductivity ratios.

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Fusing Simultaneous EEG and fMRI Using Functional and Anatomical Information
Simultaneously measuring electro physical and hemodynamic signals has become more accessible in the last years and the need for modeling techniques that can fuse the modalities is growing. In this work we augment a specific fusion method, the multimodal Source Power Co-modulation (mSPoC), to not only use functional but also anatomical information. The goal is to extract correlated source components from electroencephalography (EEG) and functional magnetic resonance imaging (fMRI). Anatomical information enters our proposed extension to mSPoC via the forward model, which relates the activity on cortex level to the EEG sensors. The augmented mSPoC is shown to outperform the original version in realistic simulations where the signal to noise ratio is low or where training epochs are scarce.

How Many Separable Sources? Model Selection In Independent Components Analysis
Unlike mixtures consisting solely of non-Gaussian sources, mixtures including two or more Gaussian components cannot be separated using standard independent components analysis methods that are based on higher order statistics and independent observations. The mixed Independent Components Analysis/Principal Components Analysis (mixed ICA/PCA) model described here accommodates one or more Gaussian components in the independent components analysis model and uses principal components analysis to characterize contributions from this inseparable Gaussian subspace. Information theory can then be used to select from among potential model categories with differing numbers of Gaussian components. Based on simulation studies, the assumptions and approximations underlying the Akaike Information Criterion do not hold in this setting, even with a very large number of observations. Cross-validation is a suitable, though computationally intensive alternative for model selection. Application of the algorithm is illustrated using Fisher’s iris data set and Howells’ craniometric data set. Mixed ICA/PCA is of potential interest in any field of scientific investigation where the authenticity of blindly separated non-Gaussian sources might otherwise be questionable. Failure of the Akaike Information Criterion in model selection also has relevance in traditional independent components analysis where all sources are assumed non-Gaussian.
Multiview Bayesian Correlated Component Analysis

Correlated component analysis as proposed by Dmochowski, Sajda, Dias, and Parra (2012) is a tool for investigating brain process similarity in the responses to multiple views of a given stimulus. Correlated components are identified under the assumption that the involved spatial networks are identical. Here we propose a hierarchical probabilistic model that can infer the level of universality in such multiview data, from completely unrelated representations, corresponding to canonical correlation analysis, to identical representations as in correlated component analysis. This new model, which we denote Bayesian correlated component analysis, evaluates favorably against three relevant algorithms in simulated data. A well-established benchmark EEG data set is used to further validate the new model and infer the variability of spatial representations across multiple subjects.

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Statistical learning for predictive targeting in online advertising

The focus in this thesis is investigation of machine learning methods with applications in computational advertising. Computational advertising is the broad discipline of building systems which can reach audiences browsing the Internet with targeted advertisements. At the core of such systems, algorithms are needed for making decisions. It is in one such particular instance of computational advertising, namely in web banner advertising, that we investigate machine learning methods to assist and make decisions in order to optimize the placements of ads.

The industrial partner in this work is Adform, an international online advertising technology partner. This also means that the analyses and methods in this work are developed with particular use-cases within Adform in mind and thus need also to be applicable in Adform’s technology stack. This implies extra thought on scalability and performance.

The particular use-case which is used as a benchmark for our results, is clickthrough rate prediction. In this task one aims to predict the probability that a user will click on an advertisement, based on attributes about the user, the advertisement the context, and other signals, such as time. This has its main application in real-time bidding ad exchanges, where each advertiser is given a chance to place bids for showing their ad while the page loads, and the winning bid gets to display their banner.

The contributions of this thesis entail application of a hybrid model of explicit and latent features for learning probabilities of clicks, which is a methodological extension of the current model in production at Adform. Our findings confirm that latent features can increase predictive performance in the setup of click-through rate prediction. They also reveal a tedious process for tuning the model for optimal performance.

We also present variations of Bayesian generative models for stochastic blockmodeling for inference of structure based on browsing patterns. Applying this structural information to improve click-through rate prediction becomes a two-step procedure; 1) learn user and URL profiles from browsing patterns, 2) use the profiles as additional features in a click-through rate prediction model. The assumption we implicitly make is reasonable: Users and URLs that are grouped together based on browsing patterns will have similar responses to ads, e.g., can be used as predictors of clicks. We report successful examples of applying this approach in practice.

Finally, we introduce the multiple-networks stochastic blockmodel (MNSBM), a model for efficient overlapping community detection in complex networks which can be assumed to be an aggregation of multiple block-structured subnetworks.

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Testing Multimodal Integration Hypotheses with Application to Schizophrenia Data

Multimodal data sets are getting more and more common. Integrating these data sets, the information from each modality can be combined to improve performance in classification problems. Fusion/integration of modalities can be done at several levels. The most appropriate fusion level is related to the conditional dependency between modalities. A varying degree of inter-modality dependency can be present across the modalities. A method for assessing the conditional dependency structure of the modalities and their relationship to intra-modality dependencies in each modality is therefore needed. The aim of the present paper is to propose a method for assessing these inter-modality dependencies. The approach is based on two permutations of an analyzed data set, each exploring different dependencies between and within modalities. The method was tested on the Kaggle MLSP 2014 Schizophrenia Classification Challenge data set which is composed of features from functional magnetic resonance imaging (MRI) and structural MRI. The results support the use of a permutation strategy for testing conditional dependencies between modalities in a multimodal classification problem.

A regularized matrix factorization approach to induce structured sparse-low-rank solutions in the EEG inverse problem

We consider the estimation of the Brain Electrical Sources (BES) matrix from noisy electroencephalographic (EEG) measurements, commonly named as the EEG inverse problem. We propose a new method to induce neurophysiological meaningful solutions, which takes into account the smoothness, structured sparsity, and low rank of the BES matrix. The method is based on the factorization of the BES matrix as a product of a sparse coding matrix and a dense latent source matrix. The structured sparse-low-rank structure is enforced by minimizing a regularized functional that includes the $\ell_{21}$-norm of the coding matrix and the squared Frobenius norm of the latent source matrix. We develop an alternating optimization algorithm to solve the resulting nonsmooth-nonconvex minimization problem. We analyze the convergence of the optimization procedure, and we compare, under different synthetic scenarios, the performance of our method with respect to the Group Lasso and Trace Norm regularizers when they are applied directly to the target matrix.
Bayesian Correlated Component Analysis for inference of joint EEG activation

We propose a probabilistic generative multi-view model to test the representational universality of human information processing. The model is tested in simulated data and in a well-established benchmark EEG dataset.

**Bibliographical note**

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**Bayesian Correlated Component Analysis for inference of joint EEG activation**

We propose a probabilistic generative multi-view model to test the representational universality of human information processing. The model is tested in simulated data and in a well-established benchmark EEG dataset.

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Authors: Poulsen, A. T. (Intern), Kamrønn, S. D. (Intern), Parra, L. (Ekstern), Hansen, L. K. (Intern)
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Bayesian Inference for Structured Spike and Slab Priors

Sparse signal recovery addresses the problem of solving underdetermined linear inverse problems subject to a sparsity constraint. We propose a novel prior formulation, the structured spike and slab prior, which allows to incorporate a priori knowledge of the sparsity pattern by imposing a spatial Gaussian process on the spike and slab probabilities. Thus, prior information on the structure of the sparsity pattern can be encoded using generic covariance functions. Furthermore, we provide a Bayesian inference scheme for the proposed model based on the expectation propagation framework. Using numerical experiments on synthetic data, we demonstrate the benefits of the model.

Brain Network Modelling

Three main topics are presented in this thesis. The first and largest topic concerns network modelling of functional Magnetic Resonance Imaging (fMRI) and Diffusion Weighted Imaging (DWI). In particular nonparametric Bayesian methods are used to model brain networks derived from resting state fMRI data. The models used are the Infinite Relational Model (IRM), Bayesian Community Detection (BCD), and Infinite Diagonal Model (IDM). The models have different constraints on how they cluster nodes. IRM is flexible in the sense that it allows for complex interactions between clusters of nodes. BCD conforms to the definition of community structure in the sense that it forces clusters of nodes to have larger density of internal connections than external connections. IDM models only the linking within a cluster and treats linking between clusters as background noise. The models are evaluated for their ability to reproduce node clustering and predict unseen data. Comparing the models on whole brain networks, BCD and IRM showed better reproducibility and predictability than IDM, suggesting that resting state networks exhibit community structure. This also points to the importance of using models, which allow for complex interactions between all pairs of clusters. In addition, it is demonstrated how the IRM can be used for segmenting brain structures into functionally coherent clusters.

A new nonparametric Bayesian network model is presented. The model builds upon the IRM and can be used to infer shared clustering structure across different types of networks. The model is used to jointly model fMRI and DWI networks. However, results show only a limited amount of sharing across fMRI and DWI networks. Using the model within the same modality can reveal the clustering consistency across scans. A high consistency was found between DWI networks and an intermediate level of consistency was found between fMRI networks. The model is of interest for other applications, for instance in finding dissimilarity between network structure in case-control studies.

The second topic of the thesis concerns local functional connectivity. In particular the local functional connectivity is studied in patients with multiple sclerosis (MS). The functional connectivity in a small neighborhood was estimated using Kendall’s Coefficient of Concordance (KCC). By generating voxelwise KCC maps, MS patients were compared with healthy controls. MS patients had reduced KCC in cerebellum and KCC correlated negatively with disease progression. Lesion load of the left cerebellar peduncles correlated negatively with KCC suggesting that the reduced local connectivity
in MS is caused by disrupted inputs to the cerebellum.

The final topic of this thesis concerns model selection for Gaussian Kernel Principal Component Analysis (KPCA) denoising. KPCA can be used for non-linear denoising by mapping data to feature space using a non-linear map. By projecting data onto a subspace in feature space and mapping this projection back to input space noise in data is (hopefully) removed. However, two important parameters must be set, namely the scale of the Gaussian kernel and the subspace dimensionality. A principled method for selecting these two parameters is presented. The method is based on maximizing the signal energy in feature space. When testing on synthetic and real data, the method outperformed a number of other heuristics in terms of signal to noise ratio of the denoised data.
Denoising by semi-supervised kernel PCA preimaging

Kernel Principal Component Analysis (PCA) has proven a powerful tool for nonlinear feature extraction, and is often applied as a pre-processing step for classification algorithms. In denoising applications Kernel PCA provides the basis for dimensionality reduction, prior to the so-called pre-image problem where denoised feature space points are mapped back into input space. This problem is inherently ill-posed due to the non-bijective feature space mapping. We present a semi-supervised denoising scheme based on kernel PCA and the pre-image problem, where class labels on a subset of the data points are used to improve the denoising. Moreover, by warping the Reproducing Kernel Hilbert Space (RKHS) we also account for the intrinsic manifold structure yielding a Kernel PCA basis that also benefit from unlabeled data points.

Our two main contributions are; (1) a generalization of Kernel PCA by incorporating a loss term, leading to an iterative algorithm for finding orthonormal components biased by the class labels, and (2) a fixed-point iteration for solving the pre-image problem based on a manifold warped RKHS. We prove viability of the proposed methods on both synthetic data and images from The Amsterdam Library of Object Images (Geusebroek et al., 2005) [7].
EEG Source Reconstruction using Sparse Basis Function Representations

State of the art performance of 3D EEG imaging is based on reconstruction using spatial basis function representations. In this work we augment the Variational Garrote (VG) approach for sparse approximation to incorporate spatial basis functions. As VG handles the bias variance trade-off with cross-validation this approach is more automated than competing approaches such as Multiple Sparse Priors (Friston et al., 2008) or Champagne (Wipf et al., 2010) that require manual selection of noise level and auxiliary signal free data, respectively. Finally, we propose an unbiased estimator of the reproducibility of the reconstructed activation time course based on a split-half resampling protocol.

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Fast sampling from a Hidden Markov Model posterior for large data

Hidden Markov Models are of interest in a broad set of applications including modern data driven systems involving very large data sets. However, approximate inference methods based on Bayesian averaging are precluded in such applications as each sampling step requires a full sweep over the data. We show that Approximate Bayesian Computation offers an interesting alternative for approximate sampling from the posterior distribution. In particular we use recent advances in moment based methods for HMM estimation to generate summary statistics for Approximate Bayesian Computation for large data sets offering fast access to approximate posterior samples. In a specific example we see that the new scheme is a hundred times faster than conventional Markov Chain Monte Carlo sampling using the Forward-backward method.

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Frontal alpha oscillations distinguish leaders from followers: Multivariate decoding of mutually interacting brains

Successful social interactions rely upon the abilities of two or more people to mutually exchange information in real-time, while simultaneously adapting to one another. The neural basis of social cognition has mostly been investigated in isolated individuals, and more recently using two-person paradigms to quantify the neuronal dynamics underlying social interaction. While several studies have shown the relevance of understanding complementary and mutually adaptive processes, the neural mechanisms underlying such coordinative behavioral patterns during joint action remain largely unknown. Here, we employed a synchronized finger-tapping task while measuring dual-EEG from pairs of human participants who either mutually adjusted to each other in an interactive task or followed a computer metronome. Neurophysiologically, the interactive condition was characterized by a stronger suppression of alpha and low-beta oscillations over motor and frontal areas in contrast to the non-interactive computer condition. A multivariate analysis of two-brain activity to classify interactive versus non-interactive trials revealed asymmetric patterns of the frontal alpha-suppression in each pair, during both task anticipation and execution, such that only one member showed the frontal component. Analysis of the behavioral data showed that this distinction coincided with the leader-follower relationship in 8/9 pairs, with the leaders characterized by the stronger frontal alpha-suppression. This suggests that leaders invest more resources in prospective planning and control. Hence our results show that the spontaneous emergence of leader-follower relationships in dyadic interactions can be predicted from EEG recordings of brain activity prior to and during interaction. Furthermore, this emphasizes the importance of investigating complementarity in joint action.

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Non-parametric Bayesian graph models reveal community structure in resting state fMRI

Modeling of resting state functional magnetic resonance imaging (rs-fMRI) data using network models is of increasing interest. It is often desirable to group nodes into clusters to interpret the communication patterns between nodes. In this study we consider three different nonparametric Bayesian models for node clustering in complex networks. In particular, we test their ability to predict unseen data and their ability to reproduce clustering across datasets. The three generative models considered are the Infinite Relational Model (IRM), Bayesian Community Detection (BCD), and the Infinite Diagonal Model (IDM). The models define probabilities of generating links within and between clusters and the difference between the models lies in the restrictions they impose upon the between-cluster link probabilities. IRM is the most flexible model with no restrictions on the probabilities of links between clusters. BCD restricts the between-cluster link probabilities to be strictly lower than within-cluster link probabilities to conform to the community structure typically seen in social networks. IDM only models a single between-cluster link probability, which can be interpreted as a background noise probability. These probabilistic models are compared against three other approaches for node clustering, namely Infomap, Louvain modularity, and hierarchical clustering. Using 3 different datasets comprising healthy volunteers’ rs-fMRI we found that the BCD model was in general the most predictive and reproducible model. This suggests that rs-fMRI data exhibits community structure and furthermore points to the significance of modeling heterogeneous between-cluster link probabilities.

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Smartphones as pocketable labs: Visions for mobile brain imaging and neurofeedback

Mobile brain imaging solutions, such as the Smartphone Brain Scanner, which combines low cost wireless EEG sensors with open source software for real-time neuroimaging, may transform neuroscience experimental paradigms. Normally subject to the physical constraints in labs, neuroscience experimental paradigms can be transformed into dynamic environments allowing for the capturing of brain signals in everyday contexts. Using smartphones or tablets to access text or images may enable experimental design capable of tracing emotional responses when shopping or consuming media, incorporating sensorimotor responses reflecting our actions into brain machine interfaces, and facilitating neurofeedback training over extended periods. Even though the quality of consumer neuroheadsets is still lower than laboratory equipment and susceptible to environmental noise, we show that mobile neuroimaging solutions, like the Smartphone Brain Scanner, complemented by 3D reconstruction or source separation techniques may support a range of neuroimaging applications and thus become a valuable addition to high-end neuroimaging solutions.
The Smartphone Brain Scanner: A Portable Real-Time Neuroimaging System

Combining low-cost wireless EEG sensors with smartphones offers novel opportunities for mobile brain imaging in an everyday context. Here we present the technical details and validation of a framework for building multi-platform, portable EEG applications with real-time 3D source reconstruction. The system – Smartphone Brain Scanner – combines an off-the-shelf neuroheadset or EEG cap with a smartphone or tablet, and as such represents the first fully portable system for real-time 3D EEG imaging. We discuss the benefits and challenges, including technical limitations as well as details of real-time reconstruction of 3D images of brain activity. We present examples of brain activity captured in a simple experiment involving imagined finger tapping, which shows that the acquired signal in a relevant brain region is similar to
that obtained with standard EEG lab equipment. Although the quality of the signal in a mobile solution using an off-the-shelf consumer neuroheadset is lower than the signal obtained using high-density standard EEG equipment, we propose mobile application development may offset the disadvantages and provide completely new opportunities for neuroimaging in natural settings.

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A Hierarchical Bayesian M/EEG Imaging Method Correcting for Incomplete Spatio-Temporal Priors

In this paper we present a hierarchical Bayesian model, to tackle the highly ill-posed problem that follows with MEG and EEG source imaging. Our model promotes spatiotemporal patterns through the use of both spatial and temporal basis functions. While in contrast to most previous spatio-temporal inverse M/EEG models, the proposed model benefits of consisting of two source terms, namely, a spatiotemporal pattern term limiting the source configuration to a spatio-temporal subspace and a source correcting term to pick up source activity not covered by the spatio-temporal prior belief. Both artificial data and real EEG data is used to demonstrate the efficacy of the model.

Dimensionality reduction for click-through rate prediction: Dense versus sparse representation

In online advertising, display ads are increasingly being placed based on real-time auctions where the advertiser who wins gets to serve the ad. This is called real-time bidding (RTB). In RTB, auctions have very tight time constraints on the order of 100ms. Therefore mechanisms for bidding intelligently such as clickthrough rate prediction need to be sufficiently fast. In this work, we propose to use dimensionality reduction of the user-website interaction graph in order to produce simplified features of users and websites that can be used as predictors of clickthrough rate. We demonstrate that the Infinite Relational Model (IRM) as a dimensionality reduction offers comparable predictive performance to conventional dimensionality reduction schemes, while achieving the most economical usage of features and fastest computations at run-time. For applications such as real-time bidding, where fast database I/O and few computations are key to success, we thus recommend using IRM based features as predictors to exploit the recommender effects from bipartite graphs.
EEG Sequence Imaging: A Markov Prior for the Variational Garrote

We propose the following generalization of the Variational Garrote for sequential EEG imaging: A Markov prior to promote sparse, but temporally smooth source dynamics. We derive a set of modified Variational Garrote updates and analyze the role of the prior's hyperparameters. An experimental evaluation is given in simulated data and in a benchmark EEG data set.

Expansion of the Variational Garrote to a Multiple Measurement Vectors Model

The recovery of sparse signals in underdetermined systems is the focus of this paper. We propose an expanded version of the Variational Garrote, originally presented by Kappen (2011), which can use multiple measurement vectors (MMVs) to further improve source retrieval performance. We show its superiority compared to the original formulation and demonstrate its ability to correctly estimate both the sources' location and their magnitude. Finally evidence is given of the high performance of the proposed algorithm compared to other MMV models.
FindZebra: A search engine for rare diseases

Background: The web has become a primary information resource about illnesses and treatments for both medical and non-medical users. Standard web search is by far the most common interface for such information. It is therefore of interest to find out how well web search engines work for diagnostic queries and what factors contribute to successes and failures. Among diseases, rare (or orphan) diseases represent an especially challenging and thus interesting class to diagnose as each is rare, diverse in symptoms and usually has scattered resources associated with it.

Methods: We use an evaluation approach for web search engines for rare disease diagnosis which includes 56 real life diagnostic cases, state-of-the-art evaluation measures, and curated information resources. In addition, we introduce FindZebra, a specialized (vertical) rare disease search engine. FindZebra is powered by open source search technology and uses curated freely available online medical information.

Results: FindZebra outperforms Google Search in both default setup and customised to the resources used by FindZebra. We extend FindZebra with specialized functionalities exploiting medical ontological information and UMLS medical concepts to demonstrate different ways of displaying the retrieved results to medical experts.

Conclusions: Our results indicate that a specialized search engine can improve the diagnostic quality without compromising the ease of use of the currently widely popular web search engines. The proposed evaluation approach can be valuable for future development and benchmarking. The FindZebra search engine is available at http://www.findzebra.com/.

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How about a Bayesian M/EEG imaging method correcting for incomplete spatio-temporal priors

In this contribution we present a hierarchical Bayesian model, sAquavit, to tackle the highly ill-posed problem that follows with MEG and EEG source imaging. Our model facilitates spatio-temporal patterns through the use of both spatial and temporal basis functions. While in contrast to most previous spatio-temporal inverse M/EEG models, the proposed model benefits of consisting of two source terms, namely, a spatio-temporal pattern term limiting the source configuration to a spatio-temporal subspace and a source correcting term to pick up source activity not covered by the spatio-temporal prior belief.

We have tested the model on both artificial data and real EEG data in order to demonstrate the efficacy of the model. The model was tested at different SNRs (-10.0,-5.2, -3.0, -1.0, 0, 0.8, 3.0 dB) using white noise. At all SNRs the sAquavit performs best in AUC measure, e.g. at SNR=0dB AUC is, 0.985 (sAquavit) and 0.857 (Bolstad et al., 2009).

Our results demonstrate that the sAquavit model is capable in balancing spatio-temporal prior guidance and source correction estimation to obtain superior estimates relative to current inverse methods.
Kernel Methods for Machine Learning with Life Science Applications

Kernel methods refer to a family of widely used nonlinear algorithms for machine learning tasks like classification, regression, and feature extraction. By exploiting the so-called kernel trick straightforward extensions of classical linear algorithms are enabled as long as the data only appear as innerproducts in the model formulation. This dissertation presents research on improving the performance of standard kernel methods like kernel Principal Component Analysis and the Support Vector Machine. Moreover, the goal of the thesis has been two-fold.

The first part focuses on the use of kernel Principal Component Analysis for nonlinear denoising. In this context stable solution of the inverse and inherently ill-posed pre-image problem constitutes the main challenge. It is proposed to stabilize the estimation by augmenting the cost function with either an \(1\)-or \(2\)-norm penalty, and solution schemes are derived for both approaches. The methods are experimentally validated on several biomedical data sets. Furthermore, frameworks for exploiting label information for improved denoising in the semisupervised case are proposed.

The second part of the thesis examines the effect of variance inflation in kernel methods. Variance inflation occurs in high-dimensional problems when the training data are insufficient to describe the entire signal manifold. Thereby leading to a potential mismatch between the subspaces spanned by the training and test data, respectively. It is shown how this effect extends from linear models to kernel learning, and means for restoring the generalizability in both kernel Principal Component Analysis and the Support Vector Machine are proposed. Viability is proved on a wide range of benchmark machine learning data sets.

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Feature extraction and dimensionality reduction are important tasks in many fields of science dealing with signal processing and analysis. The relevance of these techniques is increasing as current sensory devices are developed with ever higher resolution, and problems involving multimodal data sources become more common. A plethora of feature extraction methods are available in the literature collectively grouped under the field of multivariate analysis (MVA). This article provides a uniform treatment of several methods: principal component analysis (PCA), partial least squares (PLS), canonical correlation analysis (CCA), and orthonormalized PLS (OPLS), as well as their nonlinear extensions derived by means of the theory of reproducing kernel Hilbert spaces (RKHSs). We also review their connections to other methods for classification and statistical dependence estimation and introduce some recent developments to deal with the extreme cases of large-scale and low-sized problems. To illustrate the wide applicability of these methods in both classification and regression problems, we analyze their performance in a benchmark of publicly available data sets and pay special attention to specific real applications involving audio processing for music genre prediction and hyperspectral satellite image processing for Earth and climate monitoring.

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Large-scale Machine Learning in High-dimensional Datasets
Over the last few decades computers have gotten to play an essential role in our daily life, and data is now being collected in various domains at a faster pace than ever before. This dissertation presents research advances in four machine learning fields that all relate to the challenges imposed by the analysis of big data.

In the field of kernel methods, we present an information-based denoising technique based on semi-supervised kernel Principal Component Analysis (PCA), that incorporates label information into the kernel PCA objective. Effectively, this guides the low-rank representation towards relevant components, while exploiting intrinsic manifold structures exposed by the data. In the same field, we also introduce a scalable randomized heuristic for optimizing kernel hyperparameters, that is based on maximizing the Minimum Enclosing Ball (MEB) of the class means in the associated Reproducing Kernel Hilbert Space (RKHS).

In the field of spectral methods, we introduce semi-supervised eigenvectors of a graph Laplacian, that inherit many of the properties that characterize the global eigenvectors, but by using side-information in the form of a seed set, the semi-supervised eigenvectors are better at modeling local heterogeneities.

In the field of machine learning for neuroimaging, we introduce learning protocols for real-time functional Magnetic Resonance Imaging (fMRI) that allow for dynamic intervention in the human decision process. Specifically, the model exploits the structure of fMRI data by incorporating a temporal Gaussian Process (GP) smoothness prior, which reduces model degeneracy caused by mislabeled data samples.

Finally, in the field of topic modeling, we introduce a Graphics Processing Unit (GPU) accelerated framework for co-clustering in large-scale sparse bipartite networks. By implementing the Infinite Relational Model (IRM) in this framework we achieve speedups of two orders of magnitude compared to estimation based on conventional processors.

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Learning the solution sparsity of an ill-posed linear inverse problem with the Variational Garrote

The Variational Garrote is a promising new approach for sparse solutions of ill-posed linear inverse problems (Kappen and Gomez, 2012). We reformulate the prior of the Variational Garrote to follow a simple Binomial law and assign a Beta hyper-prior on the parameter. With the new prior the Variational Garrote, we show, has a wide range of parameter values for which it at the same time provides low test error and high retrieval of the true feature locations. Furthermore, the new form of the prior and associated hyper-prior leads to a simple update rule in a Bayesian variational inference scheme for its hyperparameter. As a second contribution we provide evidence that the new procedure can improve on cross-validation of the parameters and we find that the new formulation of the prior outperforms the original formulation when both are cross-validated to determine hyperparameters.

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Mobile real-time EEG imaging Bayesian inference with sparse, temporally smooth source priors

EEG based real-time imaging of human brain function has many potential applications including quality control, in-line experimental design, brain state decoding, and neuro-feedback. In mobile applications these possibilities are attractive as elements in systems for personal state monitoring and well-being, and in clinical settings were patients may need imaging under quasi-natural conditions. Challenges related to the ill-posed nature of the EEG imaging problem escalate in mobile real-time systems and new algorithms and the use of meta-data may be necessary to succeed. Based on recent work (Delorme et al., 2011) we hypothesize that solutions of interest are sparse. We propose a new Markovian prior for temporally sparse solutions and a direct search for sparse solutions as implemented by the so-called “variational garrote” (Kappen, 2011). We show that the new prior and inference scheme leads to improved solutions over competing sparse Bayesian schemes based on the “multiple measurement vectors” approach.

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Sparse Source EEG Imaging with the Variational Garrote

EEG imaging, the estimation of the cortical source distribution from scalp electrode measurements, poses an extremely ill-posed inverse problem. Recent work by Delorme et al. (2012) supports the hypothesis that distributed source solutions are sparse. We show that direct search for sparse solutions as implemented by the Variational Garrote (Kappen, 2011) provides excellent estimates compared with other widely used schemes, is computationally attractive, and by its separation of 'where' and 'what' degrees of freedom paves the road for the introduction of genuine prior information.

Spatio temporal media components for neurofeedback

A class of Brain Computer Interfaces (BCI) involves interfaces for neurofeedback training, where a user can learn to self-regulate brain activity based on real-time feedback. These particular interfaces are constructed from audio-visual components and temporal settings, which appear to have a strong influence on the ability to control brain activity. Therefore, identifying the different interface components and exploring their individual effects might be key for constructing new interfaces that support more efficient neurofeedback training. We discuss experiments involving two different designs of neurofeedback interfaces and suggest further research to clarify the influence of different audiovisual components and temporal settings on neurofeedback effect.
Towards a universal representation for audio information retrieval and analysis

A fundamental and general representation of audio and music which integrates multi-modal data sources is important for both application and basic research purposes. In this paper we address this challenge by proposing a multi-modal version of the Latent Dirichlet Allocation model which provides a joint latent representation. We evaluate this representation on the Million Song Dataset by integrating three fundamentally different modalities, namely tags, lyrics, and audio features. We show how the resulting representation is aligned with common 'cognitive' variables such as tags, and provide some evidence for the common assumption that genres form an acceptable categorization when evaluating latent representations of music. We furthermore quantify the model by its predictive performance in terms of genre and style, providing benchmark results for the Million Song Dataset.

Variance inflation in high dimensional Support Vector Machines

Many important machine learning models, supervised and unsupervised, are based on simple Euclidean distance or orthogonal projection in a high dimensional feature space. When estimating such models from small training sets we face the problem that the span of the training data set input vectors is not the full input space. Hence, when applying the model to future data the model is effectively blind to the missed orthogonal subspace. This can lead to an inflated variance of hidden variables estimated in the training set and when the model is applied to test data we may find that the hidden
variables follow a different probability law with less variance. While the problem and basic means to reconstruct and deflate are well understood in unsupervised learning, the case of supervised learning is less well understood. We here investigate the effect of variance inflation in supervised learning including the case of Support Vector Machines (SVMS) and we propose a non-parametric scheme to restore proper generalizability. We illustrate the algorithm and its ability to restore performance on a wide range of benchmark data sets.

**General information**

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Scopus rating (2002): SJR 0.764 SNIP 1.35
Scopus rating (2001): SJR 0.827 SNIP 1.27
A Cross-Platform Smartphone Brain Scanner
We describe a smartphone brain scanner with a low-cost wireless 14-channel Emotiv EEG neuroheadset interfacing with multiple mobile devices. This personal informatics system enables minimally invasive and continuous capturing of brain imaging data in natural settings. The system applies an inverse Bayesian framework to spatially visualize the activation of neural sources real-time in a 3D brain model or to visualize the power of brainwaves within specific frequencies. We describe the architecture of the system and discuss initial experiments.

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A Hold-out method to correct PCA variance inflation
In this paper we analyze the problem of variance inflation experienced by the PCA algorithm when working in an ill-posed scenario where the dimensionality of the training set is larger than its sample size. In an earlier article a correction method based on a Leave-One-Out (LOO) procedure was introduced. We propose a Hold-out procedure whose computational cost is lower and, unlike the LOO method, the number of SVD's does not scale with the sample size. We analyze its properties from a theoretical and empirical point of view. Finally we apply it to a real classification scenario.

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An Evaluation of EEG Scanner's Dependence on the Imaging Technique, Forward Model Computation Method, and Array Dimensionality
EEG source reconstruction involves solving an inverse problem that is highly ill-posed and dependent on a generally fixed forward propagation model. In this contribution we compare a low and high density EEG setup's dependence on correct
forward modeling. Specifically, we examine how different forward models affect the source estimates obtained using four inverse solvers Minimum-Norm, LORETA, Minimum-Variance Adaptive Beamformer, and Sparse Bayesian Learning.

Archetypal analysis for machine learning and data mining
Archetypal analysis (aa) proposed by Cutler and Breiman (1994) [7] estimates the principal convex hull (pch) of a data set. As such aa favors features that constitute representative 'corners' of the data, i.e., distinct aspects or archetypes. We currently show that aa enjoys the interpretability of clustering – without being limited to hard assignment and the uniqueness of svd – without being limited to orthogonal representations. In order to do large scale aa, we derive an efficient algorithm based on projected gradient as well as an initialization procedure we denote FurthestSum that is inspired by the FurthestFirst approach widely used for k-means (Hochbaum and Shmoys, 1985 [14]). We generalize the aa procedure to kernel-aa in order to extract the principal convex hull in potential infinite Hilbert spaces and derive a relaxation of aa when the archetypes cannot be represented as convex combinations of the observed data. We further demonstrate that the aa model is relevant for feature extraction and dimensionality reduction for a large variety of machine learning problems taken from computer vision, neuroimaging, chemistry, text mining and collaborative filtering leading to highly interpretable representations of the dynamics in the data. Matlab code for the derived algorithms is available for download from www.mortenmorup.dk.
Attention: A Machine Learning Perspective
We review a statistical machine learning model of top-down task driven attention based on the notion of ‘gist’. In this framework we consider the task to be represented as a classification problem with two sets of features — a gist of coarse grained global features and a larger set of low-level local features. Attention is modeled as the choice process over the low-level features given the gist. The model takes its departure in a classical information theoretic framework for experimental design. This approach requires the evaluation over marginalized and conditional distributions. By implementing the classifier within a Gaussian Discrete mixture it is straightforward to marginalize and condition, hence, we obtained a relatively simple expression for the feature dependent information gain — the top-down saliency. As the top-down attention mechanism is modeled as a simple classification problem, we can evaluate the strategy simply by estimating error rates on a test data set. We illustrate the attention mechanism on a simple simulated visual domain in which the choice is over nine patches in which a binary pattern has to be classified. The performance of the classifier equipped with the attention mechanism is almost as good as one that has access to all low-level features and clearly
Cognitive semantic networks: emotional verbs throw a tantrum but don’t bite

Neuroimaging studies have over the past decades established that language is grounded in sensorimotor areas of the brain. The same neuronal circuits seem involved whether we literally pick up a ball or in a phrase refer to grasping an idea. However recent findings have demonstrated that not only leg, hand and face related but also emotional action verbs activate premotor systems in the brain. Hypothesizing that the force and spatial parameters which define action based language might also be reflected in the latent semantics of words, we select motor and emotion related verbs and apply latent semantic analysis, multidimensional scaling, hierarchical clustering and network graph analysis to quantify their interaction and identify parameters of force and spatial differentiation which we propose cognitively relate emotions to sensorimotor action schemas.

Decoding Complex Cognitive States Online by Manifold Regularization in Real-Time fMRI

Human decision making is complex and influenced by many factors on multiple time scales, reflected in the numerous brain networks and connectivity patterns involved as revealed by fMRI. We address mislabeling issues in paradigms involving complex cognition, by considering a manifold regularizing prior for modeling a sequence of neural events leading to a decision. The method is directly applicable for online learning in the context of real-time fMRI, and our experimental results show that the method can efficiently avoid model degeneracy caused by mislabeling.
Detecting Hierarchical Structure in Networks

Many real-world networks exhibit hierarchical organization. Previous models of hierarchies within relational data have focused on binary trees; however, for many networks it is unknown whether there is hierarchical structure, and if there is, a binary tree might not account well for it. We propose a generative Bayesian model that is able to infer whether hierarchies are present or not from a hypothesis space encompassing all types of hierarchical tree structures. For efficient inference we propose a collapsed Gibbs sampling procedure that jointly infers a partition and its hierarchical structure. On synthetic and real data we demonstrate that our model can detect hierarchical structure leading to better link-prediction than competing models. Our model can be used to detect if a network exhibits hierarchical structure, thereby leading to a better comprehension and statistical account the network.

Functional Brain Imaging by EEG: A Window to the Human Mind

This thesis presents electroencephalography (EEG) brain imaging by covering topics as empirical evaluation of source confusion, probabilistic inverse methods, and source analysis performed on infant EEG data. In terms of source confusion we inspect how current sources within the brain may be confused with each other as noise is present in the EEG recordings. Moreover, we examine how errors in the forward model affect the source confusion.

The primary aim of this thesis is to provide sharper EEG brain images by improving current inverse methods. In this relation we focus the attention on two topics in EEG source reconstruction, namely, the forward proagation model (describing the mapping from the current sources within the brain to the sensors at the scalp) and the temporal patterns present in the EEG.

As forward models may suffer from a number of errors including the geometrical representation of the human head, the
tissue conductivity distribution, and electrode positions, we propose an algorithm which consider forward model uncertainties. Bayesian graphical models provide a powerful means of incorporating prior assumptions that narrow the solution space and lead to tractable posterior distributions over the unknown sources given the observed data. Here, we propose a hierarchical Bayesian model that attempts to minimize the influence of uncertainties associated with the forward model on the source estimates.

Similarly, we develop a hierarchical spatio-temporal Bayesian model that accommodates the principled computation of sparse spatial and smooth temporal EEG source reconstructions consistent with neurophysiological assumptions in a variety of event-related imaging paradigms.

Get Mobile – The Smartphone Brain Scanner
This demonstration will provide live-interaction with a smartphone brain scanner consisting of a low-cost wireless 14-channel EEG headset (Emotiv Epoc) and a mobile device. With our system it is possible to perform real-time functional brain imaging on a smartphone device, including stimulus delivery, data acquisition, logging, brain state decoding, and 3D visualization of the cortical EEG sources. Implementation of the smartphone brain scanner is based on the Qt framework and benefits from the cross-platform support of multiple hardware platforms (smartphones, tablet devices, netbooks and PCs) that are based on Linux operating systems. Thus our system runs on multiple platforms, including Maemo/MeeGo based smartphones, Android-based smartphones and tablet devices.
groupings found are symmetric between hemispheres indicating that the model is able to group voxels across hemispheres, which are involved in the same neural computations. The reproducibility of the groupings found are assessed by calculating mutual information between half splits of the subject sample for various hyperparameter values. Finally, the model's ability to predict unobserved links is assessed by randomly treating links and non-links in the graphs as missing. We find that the model is performing well above chance for all subjects.

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Identifying modular relations in complex brain networks
We evaluate the infinite relational model (IRM) against two simpler alternative nonparametric Bayesian models for identifying structures in multi subject brain networks. The models are evaluated for their ability to predict new data and infer reproducible structures. Prediction and reproducibility are measured within the data driven NPAIRS split-half framework. Using synthetic data drawn from each of the generative models we show that the IRM model outperforms the two competing models when data contain relational structure. For data drawn from the other two simpler models the IRM does not overfit and obtains comparable reproducibility and predictability. For resting state functional magnetic resonance imaging data from 30 healthy controls the IRM model is also superior to the two simpler alternatives, suggesting that brain networks indeed exhibit universal complex relational structure in the population.

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Integration of top-down and bottom-up information for audio organization and retrieval

The increasing availability of digital audio and music calls for methods and systems to analyse and organize these digital objects. This thesis investigates three elements related to such systems focusing on the ability to represent and elicit the user's view on the multimedia object and the system output. The aim is to provide organization and processing, which aligns with the understanding and needs of the users.

Audio and music is often characterized by the large amount of heterogenous information. The rst aspect investigated is the integration of such multi-variate and multi-modal information sources based on latent Dirichlet allocation (LDA). The model is used to integrate bottom-up features (reflecting timbre, loudness, tempo and chroma), meta-data aspects (lyrics) and top-down aspects, namely user generated open vocabulary tags. The model and representation is evaluated on the auxiliary task of genre and style classification.

Eliciting the subjective representation and opinion of users is an important aspect in building personalized systems. The thesis contributes with a setup for modelling and elicitation of preference and other cognitive aspects with focus on audio applications. The setup is based on classical regression and choice models placed in the framework of Gaussian processes, which provides flexible non-parametric Bayesian models. The setup consist of a number of likelihood functions suitable for modelling both absolute ratings (direct scaling) and comparative judgements (indirect scaling). Inference is performed by analytical and simulation based methods, including the Laplace approximation and expectation propagation. In order to minimize the cost of the often expensive and lengthy experimentation, sequential experiment design or active learning is supported. The setup is applied in the eld of music emotion modelling and optimization of a parametric audio system with high-dimensional input spaces.

The final aspect, considered in the thesis, concerns the general context of users, such as location and social context. This is important in understanding user behavior and in determining the users current information needs. The thesis investigates the predictability of the user context, in particular location, based on information theoretic bounds and a particular experimental approach based on context sensing using the ubiquitous mobile phone.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Cognitive Systems
Authors: Jensen, B. S. (Intern), Larsen, J. (Intern), Hansen, L. K. (Intern)
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phd291_Jensen_BS.pdf
Publication: Research › Ph.D. thesis – Annual report year: 2013

Joint Modelling of Structural and Functional Brain Networks

Functional and structural magnetic resonance imaging have become the most important noninvasive windows to the human brain. A major challenge in the analysis of brain networks is to establish the similarities and dissimilarities between functional and structural connectivity. We formulate a non-parametric Bayesian network model which allows for joint modelling and integration of multiple networks. We demonstrate the model’s ability to detect vertices that share structure across networks jointly in functional MRI (fMRI) and diffusion MRI (dMRI) data. Using two fMRI and dMRI scans per subject, we establish significant structures that are consistently shared across subjects and data splits. This provides an unsupervised approach for modeling of structure-function relations in the brain and provides a general framework for multimodal integration.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Cognitive Systems, Image Analysis & Computer Graphics, Copenhagen University Hospital
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Number of pages: 7
Modelling dense relational data
Relational modelling classically consider sparse and discrete data. Measures of influence computed pairwise between temporal sources naturally give rise to dense continuous-valued matrices, for instance p-values from Granger causality. Due to asymmetry or lack of positive definiteness they are not naturally suited for kernel K-means. We propose a generative Bayesian model for dense matrices which generalize kernel K-means to consider off-diagonal interactions in matrices of interactions, and demonstrate its ability to detect structure on both artificial data and two real data sets.

Model selection for Gaussian kernel PCA denoising
We propose kernel Parallel Analysis (kPA) for automatic kernel scale and model order selection in Gaussian kernel PCA. Parallel Analysis [1] is based on a permutation test for covariance and has previously been applied for model order selection in linear PCA, we here augment the procedure to also tune the Gaussian kernel scale of radial basis function based kernel PCA. We evaluate kPA for denoising of simulated data and the US Postal data set of handwritten digits. We find that kPA outperforms other heuristics to choose the model order and kernel scale in terms of signal-to-noise ratio (SNR) of the denoised data.
Model sparsity and brain pattern interpretation of classification models in neuroimaging

Interest is increasing in applying discriminative multivariate analysis techniques to the analysis of functional neuroimaging data. Model interpretation is of great importance in the neuroimaging context, and is conventionally based on a 'brain map' derived from the classification model. In this study we focus on the relative influence of model regularization parameter choices on both the model generalization, the reliability of the spatial patterns extracted from the classification model, and the ability of the resulting model to identify relevant brain networks defining the underlying neural encoding of the experiment. For a support vector machine, logistic regression and Fisher's discriminant analysis we demonstrate that selection of model regularization parameters has a strong but consistent impact on the generalizability and both the reproducibility and interpretable sparsity of the models for both ℓ2 and ℓ1 regularization. Importantly, we illustrate a trade-off between model spatial reproducibility and prediction accuracy. We show that known parts of brain networks can be overlooked in pursuing maximization of classification accuracy alone with either ℓ2 and/or ℓ1 regularization. This supports the view that the quality of spatial patterns extracted from models cannot be assessed purely by focusing on prediction accuracy. Our results instead suggest that model regularization parameters must be carefully selected, so that the model and its visualization enhance our ability to interpret the brain.
Neuroimaging, NPAIRS resampling, Classification, Regularization, Model interpretation, Kernel methods, Sparsity, Pattern analysis

Nonlinear Denoising and Analysis of Neuroimages With Kernel Principal Component Analysis and Pre-Image Estimation

We investigate the use of kernel principal component analysis (PCA) and the inverse problem known as pre-image estimation in neuroimaging: i) We explore kernel PCA and pre-image estimation as a means for image denoising as part of the image preprocessing pipeline. Evaluation of the denoising procedure is performed within a data-driven split-half evaluation framework. ii) We introduce manifold navigation for exploration of a nonlinear data manifold, and illustrate how pre-image estimation can be used to generate brain maps in the continuum between experimentally defined brain states/classes. We base these illustrations on two fMRI BOLD data sets — one from a simple finger tapping experiment and the other from an experiment on object recognition in the ventral temporal lobe.

General information
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Organisations: Department of Informatics and Mathematical Modeling
Authors: Rasmussen, P. M. (Intern), Abrahamsen, T. J. (Intern), Madsen, K. H. (Intern), Hansen, L. K. (Intern)
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BFI (2015): BFI-level 2
Scopus rating (2015): SJR 4.48 SNIP 1.84 CiteScore 6.71
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 4.201 SNIP 2.029 CiteScore 6.9
Web of Science (2014): Indexed yes
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Scopus rating (2013): SJR 4.376 SNIP 2.026 CiteScore 7.06
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Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 3.922 SNIP 1.937 CiteScore 6.86
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 3.626 SNIP 1.81 CiteScore 6.31
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Scopus rating (2010): SJR 3.573 SNIP 1.866
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Web of Science (2009): Indexed yes
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Scopus rating (2008): SJR 4.094 SNIP 1.765
On an emotional node: modeling sentiment in graphs of action verbs

Neuroimaging studies have over the past decades established that language is grounded in sensorimotor areas of the brain. Not only action verbs related to face and hand motion but also emotional expressions activate premotor systems in the brain. Hypothesizing that patterns of neural activation might be reflected in the latent semantics of words, we apply hierarchical clustering and network graph analysis to quantify the interaction of emotion and motion related action verbs based on two large-scale text corpora. Comparing the word topologies to neural networks we suggest that the co-activation of associated word forms in the brain resemble the latent semantics of action verbs, which may in turn reflect parameters of force and spatial differentiation underlying action based language.

Probabilistic M/EEG source imaging from sparse spatio-temporal event structure

While MEG and EEG source imaging methods have to tackle a severely ill-posed problem their success can be stated as their ability to constrain the solutions using appropriate priors. In this paper we propose a hierarchical Bayesian model facilitating spatio-temporal patterns through the use of both spatial and temporal basis functions. We demonstrate the
efficacy of the model on both artificial data and real EEG data.

**General information**
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling, Convex Imaging, Visual Computing Group, Microsoft Research Asia, University of California, San Francisco
Authors: Stahlhut, C. (Intern), Attias, H. T. (Ekstern), Wipf, D. (Ekstern), Hansen, L. K. (Intern), Nagarajan, S. S. (Ekstern)
Number of pages: 7
Publication date: 2012
Main Research Area: Technical/natural sciences
M/EEG, Spatio-temporal patterns, Variational Bayes
Electronic versions:
StahlhutEtAl2012 - Probabilistic MEEG source imaging from sparse spatio-temporal event structure.pdf
Source: dtu
Source-ID: u::6708
Publication: Research - peer-review › Paper – Annual report year: 2012

Restoring the Generalizability of SVM Based Decoding in High Dimensional Neuroimage Data
Variance inflation is caused by a mismatch between linear projections of test and training data when projections are estimated on training sets smaller than the dimensionality of the feature space. We demonstrate that variance inflation can lead to an increased neuroimage decoding error rate for Support Vector Machines. However, good generalization may be recovered in part by a simple renormalization procedure. We show that with proper renormalization, cross-validation based parameter optimization leads to the acceptance of more non-linearity in neuroimage classifiers than would have been obtained without renormalization.

**General information**
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Authors: Abrahamsen, T. J. (Intern), Hansen, L. K. (Intern)
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Workshop: International Workshop on Machine Learning and Interpretation in Neuroimaging (MLINI 2011), Granada, Spain, 16/12/2011 - 16/12/2011
Support Vector Machines, Generalizability, Variance inflation, Imbalanced data
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Structured Sparsity Regularization Approach to the EEG Inverse Problem
Localization of brain activity involves solving the EEG inverse problem, which is an undetermined ill-posed problem. We propose a novel approach consisting in estimating, using structured sparsity regularization techniques, the Brain Electrical Sources (BES) matrix directly in the spatio-temporal source space. We use proximal splitting optimization methods, which are efficient optimization techniques, with good convergence rates and with the ability to handle large nonsmooth convex problems, which is the typical scenario in the EEG inverse problem. We have evaluated our approach under a simulated scenario, consisting in estimating a synthethic BES matrix with 5124 sources. We report results using \( r_1 \) (LASSO), \( r_1/r_2 \) (Group LASSO) and \( r_1 + r_1/r_2 \) (Sparse Group LASSO) regularizers.

**General information**
Temporal constraints on visual perception: A psychophysical investigation of the relation between attention capture and the attentional blink

While the richness of our visual perceptions is nearly boundless, the rate with which we can perceive information is limited. For instance when we are required to perceive two consecutive target objects following briefly after each other, the accuracy with which we can report the second target is often reduced in the first half second. This phenomenon is known as the attentional blink (Raymond, Shapiro & Arnell, 1992) and as suggests by the name is assumed to pertain to how fast attention can be reallocated. Bottleneck models suggest that the attentional blink is caused by limited capacity in processing targets, which effectively causes a perceptual bottleneck (Chun & Potter, 1995). According to bottleneck models, making the first target easier to perceive should improve processing in the bottleneck and reduce the attentional blink. However, recent studies suggest that an attentional blink may be triggered by attention capture to the first object (Folk, Leber & Egeth, 2008) and that if making the first target easier to perceive increase its saliency this may increase the attentional blink (Chua, 2005).

This thesis examines the attention capture hypothesis with focus on empirical investigations and a theoretical review. Specifically this work presents studies in which first target contrast is varied in two different attentional blink paradigms, while potential influences from bottleneck effects are controlled. Publication 1 describes findings using the two-target paradigm (Duncan, Ward & Shapiro, 1994) where two masked targets are presented in different locations. Here we find that the attentional blink increases with first target contrast, however, only when no mask follows the first target. To further examine the effect of first target contrast, we disentangle the potential influence of bottleneck effects and vary first target contrast while maintaining target difficulty constant. Again we find that first target contrast increases the attention blink. Publication describes finding using the rapid serial visual presentation paradigm (Potter & Levy, 1969), in which two targets are presented centrally in the same location embedded in a stream of distractor objects. These findings replicate those from Publication 1, and suggest that the effect is not entirely spatial, since the rapid serial visual presentation paradigm does not require a spatial shift of attention to a new location. In addition to the findings in Publication 1, Publication 2 shows that the effect of first target contrast can be cancelled by the opposing effect of second target contrast. Thus the results presented here are consistent with an attention capture hypothesis and suggest that the first target can trigger an attentional blink, and that the size of the blink increases with first target contrast.
Visualization of Nonlinear Classification Models in Neuroimaging - Signed Sensitivity Maps

Classification models are becoming increasing popular tools in the analysis of neuroimaging data sets. Besides obtaining good prediction accuracy, a competing goal is to interpret how the classifier works. From a neuroscientific perspective, we are interested in the brain pattern reflecting the underlying neural encoding of an experiment defining multiple brain states. In this relation there is a great desire for the researcher to generate brain maps, that highlight brain locations of importance to the classifiers decisions. Based on sensitivity analysis, we develop further procedures for model visualization. Specifically we focus on the generation of summary maps of a nonlinear classifier, that reveal how the classifier works in different parts of the input domain. Each of the maps includes sign information, unlike earlier related methods. The sign information allows the researcher to assess in which direction the individual locations influence the classification. We illustrate the visualization procedure on a real data from a simple functional magnetic resonance imaging experiment.

General information
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Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Rasmussen, P. M. (Intern), Schmah, T. (Ekstern), Madsen, K. H. (Intern), Lund, T. E. (Ekstern), Yourganov, G. (Ekstern), Strother, S. C. (Ekstern), Hansen, L. K. (Intern)
Pages: 254-263
Publication date: 2012
A Cure for Variance Inflation in High Dimensional Kernel Principal Component Analysis

Small sample high-dimensional principal component analysis (PCA) suffers from variance inflation and lack of generalizability. It has earlier been pointed out that a simple leave-one-out variance renormalization scheme can cure the problem. In this paper we generalize the cure in two directions: First, we propose a computationally less intensive approximate leave-one-out estimator, secondly, we show that variance inflation is also present in kernel principal component analysis (kPCA) and we provide a non-parametric renormalization scheme which can quite efficiently restore generalizability in kPCA. As for PCA our analysis also suggests a simplified approximate expression. © 2011 Trine J. Abrahamsen and Lars K. Hansen.
A Randomized Heuristic for Kernel Parameter Selection with Large-scale Multi-class Data

Over the past few years kernel methods have gained a tremendous amount of attention as existing linear algorithms can easily be extended to account for highly non-linear data in a computationally efficient manner. Unfortunately most kernels require careful tuning of intrinsic parameters to correctly model the distribution of the underlying data. For large-scale problems the multiplicative scaling in time complexity imposed by introducing free parameters in a crossvalidation setup will prove computationally infeasible, often leaving pure ad-hoc estimates as the only option. In this contribution we investigate a novel randomized approach for kernel parameter selection in large-scale multi-class data. We fit a minimum enclosing ball to the class means in Reproducing Kernel Hilbert Spaces (RKHS), and use the radius as a quality measure of the space, defined by the kernel parameter. We apply the developed algorithm to a computer vision paradigm where the objective is to recognize 72,000 objects among 1,000 classes. Compared to other distance metrics in the RKHS we find that our randomized approach provides better results together with a highly competitive time complexity.

A Smartphone Interface for a Wireless EEG Headset with Real-Time 3D Reconstruction

We demonstrate a fully functional handheld brain scanner consisting of a low-cost 14-channel EEG headset with a wireless connection to a smartphone, enabling minimally invasive EEG monitoring in naturalistic settings. The smartphone provides a touch-based interface with real-time brain state decoding and 3D reconstruction.
Demonstration: A smartphone 3D functional brain scanner

We demonstrate a fully portable 3D real-time functional brain scanner consisting of a wireless 14-channel 'Neuroheadset' (Emotiv EPOC) and a Nokia N900 smartphone. The novelty of our system is the ability to perform real-time functional brain imaging on a smartphone device, including stimulus delivery, data acquisition, logging, brain state decoding, and 3D visualization of the cortical EEG sources. Custom-made software realized in Qt has been implemented on the phone, which allow for either the phone to process the EEG data locally or transmit it to a server when more advanced machine learning tools are preferred. Source localization is implemented locally on the phone with a 3D brain model consisting of 1,028 vertices and 2,048 triangles stored in the mobile application.

Our system design benefits from the possibility of being able to integrate with multiple hardware platforms (smartphones, tablet computers, and netbooks) that are based on Linux operating systems.

General information

State: Published
Organisations: Department of Applied Mathematics and Computer Science, Cognitive Systems
Authors: Stahlhut, C. (Intern), Stopczynski, A. (Intern), Larsen, J. E. (Intern), Petersen, M. K. (Intern), Hansen, L. K. (Intern)
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Links:
http://milab.imm.dtu.dk/nips2011demo
Source: PublicationPreSubmission
Source-ID: 101280785
Publication: Research › Conference abstract for conference – Annual report year: 2011

Emotional nodes among lines of lyrics

Recent neuroscience studies have shown that it is possible to predict how concrete objects are represented in the brain based on the semantic relations of words defining the corresponding concepts. Whether we read the word 'smile' or
recognize the same expression in a face, the mental processes captured as event related potentials in EEG brain imaging appear indistinguishable. As both low-level semantics and our affective responses can be encoded in words, we propose a simplified cognitive approach to model how we emotionally perceive media. Representing song texts in a vector space of reduced dimensionality using LSA, we define distances between lines of lyrics and frequently used emotional last.fm tags, that constrain the latent semantics according to the psychological dimensions of valence and arousal. We compare the LSA derived emotions from texts with the user annotated tag clouds describing the corresponding songs at last.fm, and suggest the retrieved patterns may provide a sparse representation of how we perceive the emotional content in media.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Petersen, M. K. (Intern), Hansen, L. K. (Intern)
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Frequency Constrained ShiftCP Modeling of Neuroimaging Data
The shift invariant multi-linear model based on the CandeComp/PARAFAC (CP) model denoted ShiftCP has proven useful for the modeling of latency changes in trial based neuroimaging data[17]. In order to facilitate component interpretation we presently extend the shiftCP model such that the extracted components can be constrained to pertain to predefined frequency ranges such as alpha, beta and gamma activity. To infer the number of components in the model we propose to apply automatic relevance determination by imposing priors that define the range of variation of each component of the shiftCP model and learning the hyper-parameters of these priors during model estimation.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems, Copenhagen University Hospital
Authors: Mørup, M. (Intern), Hansen, L. K. (Intern), Madsen, K. H. (Ekstern)
Pages: 127-131
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Main Research Area: Technical/natural sciences
DOIs: 10.1109/ACSSC.2011.6189969
Links: http://www.asilomarsc.org/

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(c) 2012 IEEE. Personal use of this material is permitted. Permission from IEEE must be obtained for all other users, including reprinting/ republishing this material for advertising or promotional purposes, creating new collective works for resale or redistribution to servers or lists, or reuse of any copyrighted components of this work in other works.
**Good Friends, Bad News - Affect and Virality in Twitter**

The link between affect, defined as the capacity for sentimental arousal on the part of a message, and virality, defined as the probability that it be sent along, is of significant theoretical and practical importance, e.g. for viral marketing. The basic measure of virality in Twitter is the probability of retweet and we are interested in which dimensions of the content of a tweet leads to retweeting. We hypothesize that negative news content is more likely to be retweeted, while for non-news tweets positive sentiments support virality. To test the hypothesis we analyze three corpora: A complete sample of tweets about the COP15 climate summit, a random sample of tweets, and a general text corpus including news. The latter allows us to train a classifier that can distinguish tweets that carry news and non-news information. We present evidence that negative sentiment enhances virality in the news segment, but not in the non-news segment. Our findings may be summarized ‘If you want to be cited: Sweet talk your friends or serve bad news to the public’.

**General information**

State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling, University of Milan, Copenhagen Business School
Authors: Hansen, L. K. (Intern), Arvidsson, A. (Ekstern), Nielsen, F. Á. (Intern), Colleoni, E. (Ekstern), Etter, M. (Ekstern)
Publication date: 2011

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http://arxiv.org/abs/1101.0510
http://www.ftrg.org/futuretech2011/
Source: orbit
Source-ID: 279236
Publication: Research - peer-review › Article in proceedings – Annual report year: 2011
Infinite multiple membership relational modeling for complex networks

Learning latent structure in complex networks has become an important problem fueled by many types of networked data originating from practically all fields of science. In this paper, we propose a new non-parametric Bayesian multiple-membership latent feature model for networks. Contrary to existing multiplemembership models that scale quadratically in the number of vertices the proposed model scales linearly in the number of links admitting multiple-membership analysis in large scale networks. We demonstrate a connection between the single membership relational model and multiple membership models and show on “real” size benchmark network data that accounting for multiple memberships improves the learning of latent structure as measured by link prediction while explicitly accounting for multiple membership result in a more compact representation of the latent structure of networks.

Large scale topic modeling made practical

Topic models are of broad interest. They can be used for query expansion and result structuring in information retrieval and as an important component in services such as recommender systems and user adaptive advertising. In large scale applications both the size of the database (number of documents) and the size of the vocabulary can be significant challenges. Here we discuss two mechanisms that can make scalable solutions possible in the face of large document databases and large vocabularies. The first issue is addressed by a parallel distributed implementation, while the vocabulary problem is reduced by use of large and carefully curated term set. We demonstrate the performance of the proposed system and in the process break a previously claimed ‘world record’ announced April 2010 both by speed and size of problem. We show that the use of a WordNet derived vocabulary can identify topics at par with a much larger case specific vocabulary.
Modeling Latency and Shape Changes in Trial Based Neuroimaging Data

To overcome poor signal-to-noise ratios in neuroimaging, data sets are often acquired over repeated trials that form a three-way array of spacetimetrial. As neuroimaging data contain multiple inter-mixed signal components blind signal separation and decomposition methods are frequently invoked for exploratory analysis and as a preprocessing step for signal detection. Most previous component analyses have avoided working directly with the tri-linear structure, but resorted to bi-linear models such as ICA, PCA, and NMF. Multi-linear decomposition can exploit consistency over trials and contrary to bi-linear decomposition render unique representations without additional constraints. However, they can degenerate if data does not comply with the given multi-linear structure, e.g., due to time-delays. Here we extend multi-linear decomposition to account for general temporal modeling within a convolutonal representation. We demonstrate how this alleviates degeneracy and helps to extract physiologically plausible components. The resulting convolutive multi-linear decomposition can model realistic trial variability as demonstrated in EEG and fMRI data.
infinite number of clusters. To reach large scale applications of co-clustering we exploit that parameter inference for co-clustering is well suited for parallel computing. We develop a generic GPU framework for efficient inference on large scale sparse bipartite networks and achieve a speedup of two orders of magnitude compared to estimation based on conventional CPUs. In terms of scalability we find for networks with more than 100 million links that reliable inference can be achieved in less than an hour on a single GPU. To efficiently manage memory consumption on the GPU we exploit the structure of the posterior likelihood to obtain a decomposition that easily allows model estimation of the co-clustering problem on arbitrary large networks as well as distributed estimation on multiple GPUs. Finally we evaluate the implementation on real-life large scale collaborative filtering data and web scale text corpora, demonstrating that latent mesoscale structures extracted by the co-clustering problem as formulated by the Infinite Relational Model (IRM) are consistent across consecutive runs with different initializations and also relevant for interpretation of the underlaying processes in such large scale networks.

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Authors: Hansen, T. J. (Intern), Mørup, M. (Intern), Hansen, L. K. (Intern)
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Main Research Area: Technical/natural sciences
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Links:
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Source: orbit
Source-ID: 286982
Publication: Research - peer-review › Article in proceedings – Annual report year: 2011

Regularized Pre-image Estimation for Kernel PCA De-noising: Input Space Regularization and Sparse Reconstruction
The main challenge in de-noising by kernel Principal Component Analysis (PCA) is the mapping of de-noised feature space points back into input space, also referred to as “the pre-image problem”. Since the feature space mapping is typically not bijective, pre-image estimation is inherently illposed. As a consequence the most widely used estimation schemes lack stability. A common way to stabilize such estimates is by augmenting the cost function by a suitable constraint on the solution values. For de-noising applications we here propose Tikhonov input space distance regularization as a stabilizer for pre-image estimation, or sparse reconstruction by Lasso regularization in cases where the main objective is to improve the visual simplicity. We perform extensive experiments on the USPS digit modeling problem to evaluate the stability of three widely used pre-image estimators. We show that the previous methods lack stability in the is non-linear regime, however, by applying our proposed input space distance regularizer the estimates are stabilized with a limited sacrifice in terms of de-noising efficiency. Furthermore, we show how sparse reconstruction can lead to improved visual quality of the estimated pre-image.

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Authors: Abrahamsen, T. J. (Intern), Hansen, L. K. (Intern)
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Ratings:
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
Semantic Approaches for Knowledge Discovery and Retrieval in Biomedicine

This thesis discusses potential applications of semantics to the recent literature-based informatics systems to facilitate knowledge discovery, hypothesis generation, and literature retrieval in the domain of biomedicine. The approaches presented herein make use of semantic information extracted from biomedical texts by natural language processing systems supported by biomedical ontologies. The thesis is divided into two main parts: First, a field of literature-based discovery is introduced, with a review of recent approaches of the field; second, literature retrieval in the domain of neuroimaging (neuroscience) is discussed with the emphasis put on the coordinate-based searching of related publications. My own contribution to the first part is a novel literature-based 'discovery browsing' methodology incorporating semantic predications, graph theory and path analysis for guiding researchers through the relevant literature on a user-specified biomedical phenomenon. Moreover, the additional analyses of the methodology show its potential application as a support for the recent probabilistic retrieval methods. In the second part of the thesis, I present the BredeQuery plugin which integrates a coordinate-based literature retrieval system with the common in neuroimaging statistical analysis environment. It is followed by the detailed description of a prototype of context-dependent neuroscientific literature retrieval methodology, which thanks to the employment of ontologies, allows the user to define context of interest for a search. The peer reviewed research articles, included in the appendices, discuss further the details of the presented methods, case studies, and provide other related information.
Simultaneous EEG Source and Forward Model Reconstruction (SOFOMORE) using a Hierarchical Bayesian Approach

We present an approach to handle forward model uncertainty for EEG source reconstruction. A stochastic forward model representation is motivated by the many random contributions to the path from sources to measurements including the tissue conductivity distribution, the geometry of the cortical surface, and electrode positions. We first present a hierarchical Bayesian framework for EEG source localization that jointly performs source and forward model reconstruction (SOFOMORE). Secondly, we evaluate the SOFOMORE approach by comparison with source reconstruction methods that use fixed forward models. Analysis of simulated and real EEG data provide evidence that reconstruction of the forward model leads to improved source estimates.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Stahlhut, C. (Intern), Mørup, M. (Intern), Winther, O. (Intern), Hansen, L. K. (Intern)
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Scopus rating (2016): SJR 0.226 SNIP 0.625 CiteScore 0.78
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.228 SNIP 0.639 CiteScore 0.7
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.292 SNIP 1 CiteScore 0.99
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.27 SNIP 0.858 CiteScore 0.97
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.281 SNIP 0.869 CiteScore 1.04
ISI indexed (2012): ISI indexed yes
Smartphones Get Emotional: Mind Reading Images and Reconstructing the Neural Sources

Combining a 14 channel neuroheadset with a smartphone to capture and process brain imaging data, we demonstrate the ability to distinguish among emotional responses reflected in different scalp potentials when viewing pleasant and unpleasant pictures compared to neutral content. Clustering independent components across subjects we are able to remove artifacts and identify common sources of synchronous brain activity, consistent with earlier findings based on conventional EEG equipment. Applying a Bayesian approach to reconstruct the neural sources not only facilitates differentiation of emotional responses but may also provide an intuitive interface for interacting with a 3D rendered model of brain activity. Integrating a wireless EEG set with a smartphone thus offers completely new opportunities for modeling the mental state of users as well as providing a basis for novel bio-feedback applications.

General information
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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Petersen, M. K. (Intern), Stahlhut, C. (Intern), Stopczynski, A. (Intern), Larsen, J. E. (Intern), Hansen, L. K. (Intern)
Pages: 578-587
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Mobile EEG, Affective computing, Source reconstruction, ICA clustering
Sparse non-linear denoising: Generalization performance and pattern reproducibility in functional MRI

We investigate sparse non-linear denoising of functional brain images by kernel Principal Component Analysis (kernel PCA). The main challenge is the mapping of denoised feature space points back into input space, also referred to as "the pre-image problem". Since the feature space mapping is typically not bijective, pre-image estimation is inherently illposed. In many applications, including functional magnetic resonance imaging (fMRI) data which is the application used for illustration in the present work, it is of interest to denoise a sparse signal. To meet this objective we investigate sparse pre-image reconstruction by Lasso regularization. We find that sparse estimation provides better brain state decoding accuracy and a more reproducible pre-image. These two important metrics are combined in an evaluation framework which allow us to optimize both the degree of sparsity and the non-linearity of the kernel embedding. The latter result provides evidence of signal manifold non-linearity in the specific fMRI case study.

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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Abrahamsen, T. J. (Intern), Hansen, L. K. (Intern)
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Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 0.976 SNIP 2.105 CiteScore 2.87
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 0.797 SNIP 2.211 CiteScore 2.72
Web of Science (2014): Indexed yes
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Scopus rating (2013): SJR 0.838 SNIP 2.616 CiteScore 2.86
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 0.719 SNIP 2.4 CiteScore 2.57
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 0.738 SNIP 2.009 CiteScore 2.56
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 0.832 SNIP 1.998
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
The Role of Top-down Attention in the Cocktail Party: Revisiting Cherry's Experiment after Sixty Years

We investigate the role of top-down task drive attention in the cocktail party problem. In a recently proposed computational model of top-down attention it is possible to simulate the cocktail party problem and make predictions about sensitivity to confounders under different levels of attention. Based on such simulations we expect that under strong top-down attention pattern recognition is improved as the model can compensate for noise and confounders. We next investigate the role of temporal and spectral overlaps and speech intelligibility in humans, and how the presence of a task influences their relation. For this purpose, we perform behavioral experiments inspired by Cherry's classic experiments carried out almost sixty years ago. We make participants listen to a mono signal consisting of two different narratives pronounced by a speech synthesizer under two different conditions. In the first case, participants listen with no specific task, while in the second one they are asked to follow one of the stories. Participants report the words they heard by choosing from a list which also includes terms not present in any of the narratives. We define temporal and spectral overlaps using the ideal binary mask (IBMs) as a gauge. We analyze the correlation between overlaps and the amount of reported words. We observe a significant negative correlation when there is no task, while no correlation is detected when a task is involved. Hence, results that are well aligned with the simulation results in our computational top-down attention model.

General information
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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling, Center for Microbial Biotechnology, Department of Systems Biology, Department of Planning
Authors: Marchegiani, L. (Intern), Karadogan, S. (Intern), Andersen, T. (Intern), Larsen, J. N. (Intern), Hansen, L. K. (Intern), Xue-wen Chen (Ekstern), Dillon, T. (Ekstern), Ishbuchi, H. (Ekstern), Jian Pei (Ekstern), Haixun Wang (Ekstern), Wani, A. M. (Ekstern)
Publication date: 2011

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Source: dtu
Source-ID: n:oai:DTIC-ART:inspec/321043790::15088
Publication: Research - peer-review › Article in proceedings – Annual report year: 2012
The Role of Top-Down Attention in the Cocktail Party: Revisiting Cherry's Experiment after Sixty Years

We investigate the role of top-down task drive attention in the cocktail party problem. In a recently proposed computational model of top-down attention it is possible to simulate the cocktail party problem and make predictions about sensitivity to confounders under different levels of attention. Based on such simulations we expect that under strong top-down attention pattern recognition is improved as the model can compensate for noise and confounders. We next investigate the role of temporal and spectral overlaps and speech intelligibility in humans, and how the presence of a task influences their relation. For this purpose, we perform behavioral experiments inspired by Cherry's classic experiments carried out almost sixty years ago. We make participants listen to a mono signal consisting of two different narratives pronounced by a speech synthesizer under two different conditions. In the first case, participants listen with no specific task, while in the second one they are asked to follow one of the stories. Participants report the words they heard by choosing from a list which also includes terms not present in any of the narratives. We define temporal and spectral overlaps using the ideal binary mask (IBMs) as a gauge. We analyze the correlation between overlaps and the amount of reported words. We observe a significant negative correlation when there is no task, while no correlation is detected when a task is involved. Hence, results that are well aligned with the simulation results in our computational top-down attention model.

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Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Marchegiani, L. (Intern), Karadogan, S. (Intern), Andersen, T. (Intern), Larsen, J. (Intern), Hansen, L. K. (Intern)
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Top-down attention with features missing at random
In this paper we present a top-down attention model designed for an environment in which features are missing completely at random. Following (Hansen et al., 2011) we model top-down attention as a sequential decision making process driven by a task - modeled as a classification problem - in an environment with random subsets of features missing, but where we have the possibility to gather additional features among the ones that are missing. Thus, the top-down attention problem is reduced to finding the answer to the question what to measure next? Attention is based on the top-down saliency of the missing features given as the estimated difference in classification confusion (entropy) with and without the given feature. The difference in confusion is computed conditioned on the available set of features. In this work, we make our attention model more realistic by also allowing the initial training phase to take place with incomplete data. Thus, we expand the model to include a missing data technique in the learning process. The top-down attention mechanism is implemented in a Gaussian Discrete mixture model setting where marginals and conditionals are relatively easy to compute. To illustrate the viability of expanded model, we train the mixture model with two different datasets, a synthetic data set and the well-known Yeast dataset of the UCI database. We evaluate the new algorithm in environments characterized by different amounts of incompleteness and compare the performance with a system that decides next feature to be measured at random. The proposed top-down mechanism clearly outperforms random choice of the next feature.

General information
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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Karadogan, S. (Intern), Marchegiani, L. (Intern), Larsen, J. (Intern), Hansen, L. K. (Intern)
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Visualization of nonlinear kernel models in neuroimaging by sensitivity maps

There is significant current interest in decoding mental states from neuroimages. In this context kernel methods, e.g., support vector machines (SVM) are frequently adopted to learn statistical relations between patterns of brain activation and experimental conditions. In this paper we focus on visualization of such nonlinear kernel models. Specifically, we investigate the sensitivity map as a technique for generation of global summary maps of kernel classification models. We illustrate the performance of the sensitivity map on functional magnetic resonance (fMRI) data based on visual stimuli. We show that the performance of linear models is reduced for certain scan labelings/categorizations in this data set, while the nonlinear models provide more flexibility. We show that the sensitivity map can be used to visualize nonlinear versions of kernel logistic regression, the kernel Fisher discriminant, and the SVM, and conclude that the sensitivity map is a versatile and computationally efficient tool for visualization of nonlinear kernel models in neuroimaging.

General information
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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling, Aarhus University Hospital
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Scopus rating (2015): SJR 4.48 SNIP 1.84 CiteScore 6.71
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 4.201 SNIP 2.029 CiteScore 6.9
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 4.376 SNIP 2.026 CiteScore 7.06
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 3.922 SNIP 1.937 CiteScore 6.86
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
What to measure next to improve decision making? On top-down task driven feature saliency

Top-down attention is modeled as decision making based on incomplete information. We consider decisions made in a sequential measurement situation where initially only an incomplete input feature vector is available, however, where we are given the possibility to acquire additional input values among the missing features. The procedure thus poses the question what to do next? We take an information theoretical approach implemented for generality in a generative mixture model. The framework allows us reduce the decision about what to measure next in a classification problem to the estimation of a few onedimensional integrals per missing feature. We demonstrate the viability of the framework on four well-known classification problems.
Modeling media as latent semantics based on cognitive components

Though one might think of media as an audiovisual stream of consciousness, we frequently encode frames of video sequences and waves of sound into strings of text. Language allows us to both share the internal representations of what we perceive as mental concepts, as well as categorizing them as distinct states in the continuous ebb and flow of emotions underlying consciousness. Whether it being a soundscape of structured peaks or tiny black characters lined up across a page, we rely on syntax for parsing sequences of symbols, which based on hierarchically nested structures allow us to express and share the meaning contained within a sentence or a melodic phrase. As both low-level semantic structure of texts and our affective responses can be encoded in words, a simplified cognitive model can be constructed which uses LSA latent semantic analysis to emulate how we perceive the emotional context of media based on lyrics, synopses, subtitles, blogs or web pages associated with the content. In the proposed model the bottom-up generated sensory input is a matrix of tens of thousands of words co-occurring within multiple contexts, that are in turn represented as vectors in a semantic space of reduced dimensionality. While top-down, patterns of emotional categorization emerge by defining term vector distances to affective adjectives, that constrain the latent semantic structures according to the neurophysiological dimensions of valence and arousal. The thesis thus combines elements of machine learning with aspects of cognitive linguistics that potentially could be utilized in applications ranging from information retrieval and media personalization, to emotional brand building or neuroscientific modeling of syntax and semantics.

On the time required for identification of visual objects

The starting point for this thesis is a review of Bundesen’s theory of visual attention. This theory has been widely accepted as an appropriate model for describing data from an important class of psychological experiments known as whole and partial report. Analysing data from this class of experiments with the help of the theory of visual attention – have proven to be an effective approach to examine cognitive parameters that are essential for a broad range of different patient groups. The theory of visual attention relies on a psychometric function that describes the ability to identify a stimulus as a function of exposure duration. An important contribution of the thesis is that it investigates whether other psychometric functions than the one originally used with the theory of visual attention could be more appropriate at describing data. The thesis points to two psychometric functions that seem more appropriate. Further the thesis shows that it is possible to incorporate any desired psychometric into the theory of visual attention. Common to the two psychometric functions suggested is that they both have a hazard function that is non-monotonic; a neural argument for this is also presented in the thesis. For the psychometric function it is further investigated how this depends on stimulus contrast. In this respect, we find that the type of psychometric function is independent of contrast, but that the parameters for the psychometric function vary systematically as a function of contrast. An analysis of the psychometric function for the individual letters of the alphabet shows that there are significant differences in the parameters of the psychometric function depending on letter identity. Here we should note that in many cases (also for Bundesen’s theory of visual attention) it has been customary to average performance over the entire set of stimuli, consisting for instance of the 26 alphabetic letters. The fact that each letter is perceived in a different way possibly reflects that each letter is represented differently in our brain. This might have to do with a difference in the set of features representing the individual letters. It is possible that some features are processed...
Corrections in clinical Magnetic Resonance Spectroscopy and SPECT: Motion correction in MR spectroscopy Downscatter correction in SPECT

The quality of medical scanner data is often compromised by several mechanisms. This can be caused by both the subject to be measured and the scanning principles themselves. In this PhD project the problem of subject motion was addressed for Single Voxel MR Spectroscopy in a cohort study of preterm infants. In Iodine-123 SPECT the problem of downscatter was addressed. This thesis is based on two papers. Paper I deals with the problem of motion in Single Voxel Spectroscopy. Two novel methods for the identification of outliers in the set of repeated measurements were implemented and compared to the known mean and median filtering. The data comes from non-anesthetized preterm infants, where motion during scanning is a common problem. Both the novel outlier identification and the independent component analysis (ICA) perform satisfactory and better than the common mean and median filtering. The data comes from non-anesthetized preterm infants, where motion during scanning is a common problem. Both the novel outlier identification and the independent component analysis (ICA) perform satisfactory and better than the common mean and median filtering. ICA performed best in the sense that it recovered most of the lost peak height in the spectra. The ICA motion correction algorithm described in paper I and in this thesis was applied to a quantitative analysis of the Single Voxel Spectroscopy data from the cohort study of preterm infants. This analysis revealed that differences between term and preterm infants are not to be found in the concentration of Lactate (caused by inflammation or hypoxia-ischemia) and/or NAA (caused by hypoxia-ischemia) as hypothesized before the cohort study. Instead choline levels were decreased in the preterm infants, which might indicate a detrimental effect of the extra-uterine environment on brain development. Paper II describes a method to correct for downscatter in low count Iodine-123 SPECT with a broad energy window above the normal imaging window. Both spatial dependency and weight factors were measured. As expected, the implicitly assumed weight factor of one for energy windows with equal width is slightly too low, due the presence of a backscatter peak in the energy spectrum coming from high-energy photons. The effect on the contrast was tested in 10 subjects and revealed a 20% increase in the specific binding ratio of the striatum due to downscatter correction. This makes the difference between healthy subjects and patients more profound. Downscatter in Iodine-123 SPECT is not the only deteriorating mechanism. Normal scatter compromises the images quality as well. Since scatter correction of SPECT-images also can be performed by the subtraction of an energy window, a method was developed to perform scatter and downscatter correction simultaneously. A phantom study has been performed, where the in paper II described downscatter correction was extended with scatter correction. This new combined correction was compared to the known Triple Energy Window (TEW) correction method. Results were satisfying and indicate that TEW is more correct from the physics point of view, while the in paper II described method extended with scatter correction gives reasonable results, but is far less noise sensitive than TEW.
A Fast Kernel Based Searchlight Heuristic for Real-time fMRI

Archetypal Analysis for Machine Learning

Archetypal analysis (AA) proposed by Cutler and Breiman in [1] estimates the principal convex hull of a data set. As such AA favors features that constitute representative 'corners' of the data, i.e. distinct aspects or archetypes. We will show that AA enjoys the interpretability of clustering - without being limited to hard assignment and the uniqueness of SVD - without being limited to orthogonal representations. In order to do large scale AA, we derive an efficient algorithm based on projected gradient as well as an initialization procedure inspired by the FURTHESTFIRST approach widely used for K-means [2]. We demonstrate that the AA model is relevant for feature extraction and dimensional reduction for a large variety of machine learning problems taken from computer vision, neuroimaging, text mining and collaborative filtering.

Archetypal Analysis for Machine Learning

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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
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Source-ID: 267382
Publication: Research - peer-review › Article in proceedings – Annual report year: 2010
BredeQuery: Coordinate-Based Meta-analytic Search of Neuroscientific Literature from the SPM Environment

Large amounts of neuroimaging studies are collected and have changed our view on human brain function. By integrating multiple studies in meta-analysis a more complete picture is emerging. Brain locations are usually reported as coordinates with reference to a specific brain atlas, thus some of the databases offer so-called coordinate-based searching to the users (e.g. Brede, BrainMap). For such search, the publications, which relate to the brain locations represented by the user coordinates, are retrieved. We present BredeQuery – a plugin for the widely used SPM data analytic pipeline. BredeQuery offers a direct link from SPM to the Brede Database coordinate-based search engine. BredeQuery is able to ‘grab’ brain location coordinates from the SPM windows and enter them as a query for the Brede Database. Moreover, results of the query can be displayed in a MATLAB window and/or exported directly to some popular bibliographic file formats (BibTeX, Reference Manager, etc).

General information
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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Wilkowski, B. (Intern), Szewczyk, M. M. (Intern), Rasmussen, P. M. (Intern), Hansen, L. K. (Intern), Nielsen, F. Å. (Intern)
Pages: 314-324
Publication date: 2010

Estimating Human Predictability From Mobile Sensor Data

Quantification of human behavior is of prime interest in many applications ranging from behavioral science to practical applications like GSM resource planning and context-aware services. As proxies for humans, we apply multiple mobile phone sensors all conveying information about human behavior. Using a recent, information theoretic approach it is demonstrated that the trajectories of individual sensors are highly predictable given complete knowledge of the infinite past. We suggest using a new approach to time scale selection which demonstrates that participants have even higher predictability of non-trivial behavior on smaller timer scale than previously considered.

General information
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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Jensen, B. S. (Intern), Larsen, J. E. (Intern), Jensen, K. (Intern), Larsen, J. (Intern), Hansen, L. K. (Intern)
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Infinite Multiple Membership Relational Modeling for Complex Networks

General information
Infinite Multiple Membership Relational Modeling for Complex Networks

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Authors: Mørup, M. (Intern), Schmidt, M. N. (Intern), Hansen, L. K. (Intern)
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Main Research Area: Technical/natural sciences

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Infinite Relational Modeling of Functional Connectivity in Resting State fMRI

Functional magnetic resonance imaging (fMRI) can be applied to study the functional connectivity of the neural elements which form complex network at a whole brain level. Most analyses of functional resting state networks (RSN) have been based on the analysis of correlation between the temporal dynamics of various regions of the brain. While these models can identify coherently behaving groups in terms of correlation they give little insight into how these groups interact. In this paper we take a different view on the analysis of functional resting state networks. Starting from the definition of resting state as functional coherent groups we search for functional units of the brain that communicate with other parts of the brain in a coherent manner as measured by mutual information. We use the infinite relational model (IRM) to quantify functional coherent groups of resting state networks and demonstrate how the extracted component interactions can be used to discriminate between functional resting state activity in multiple sclerosis and normal subjects.

**General information**

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Organisations: Department of Informatics and Mathematical Modeling
Authors: Mørup, M. (Intern), Madsen, K. H. (Ekstern), Dogonowski, A. M. (Ekstern), Siebner, H. (Ekstern), Hansen, L. K. (Intern)
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Large Scale GPU Based Inference for the Infinite Relational Model

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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling, Copenhagen University Hospital
Authors: Mørup, M. (Intern), Madsen, K. H. (Ekstern), Dogonowski, A. M. (Ekstern), Siebner, H. (Ekstern), Hansen, L. K. (Intern)
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Publication: Research - peer-review › Article in proceedings – Annual report year: 2010
**Latent semantics as cognitive components**

Cognitive component analysis, defined as an unsupervised learning of features resembling human comprehension, suggests that the sensory structures we perceive might often be modeled by reducing dimensionality and treating objects in space and time as linear mixtures incorporating sparsity and independence. In music as well as language the patterns we come across become part of our mental workspace when the bottom-up sensory input raises above the background noise of core affect, and top-down trigger distinct feelings reflecting a shift of our attention. And as both low-level semantics and our emotional responses can be encoded in words, we propose a simplified cognitive approach to model how we perceive media. Representing song lyrics in a vector space of reduced dimensionality using LSA, we combine bottom-up defined term distances with affective adjectives, that top-down constrain the latent semantics according to the psychological dimensions of valence and arousal. Subsequently we apply a Tucker tensor decomposition combined with re-weighted L1 regularization and a Bayesian ARD automatic relevance determination approach to derive a sparse representation of complementary affective mixtures, which we suggest might function as cognitive components for perceiving the underlying structure in lyrics.

**Modeling lyrics as emotional semantics**

**MuZeeker - Adapting a music search engine for mobile phones**

We describe MuZeeker, a search engine with domain knowledge based on Wikipedia. MuZeeker enables the user to refine a search in multiple steps by means of category selection. In the present version we focus on multimedia search related to music and we present two prototype search applications (web-based and mobile) and discuss the issues...
involved in adapting the search engine for mobile phones. A category based filtering approach enables the user to refine a search through relevance feedback by category selection instead of typing additional text, which is hypothesized to be an advantage in the mobile MuZeeker application. We report from two usability experiments using the think aloud protocol, in which N=20 participants performed tasks using MuZeeker and a customized Google search engine. In both experiments web-based and mobile user interfaces were used. The experiment shows that participants are capable of solving tasks slightly better using MuZeeker, while the "inexperienced" MuZeeker users perform slightly slower than experienced Google users. This was found in both the web-based and the mobile applications. It was found that task performance in the mobile search applications (MuZeeker and Google) was 2—2.5 times lower than the corresponding web-based search applications (MuZeeker and Google).

Predictability of Mobile Phone Associations
Prediction and understanding of human behavior is of high importance in many modern applications and research areas ranging from context-aware services, wireless resource allocation to social sciences. In this study we collect a novel dataset using standard mobile phones and analyze how the predictability of mobile sensors, acting as proxies for humans, change with time scale and sensor type such as GSM and WLAN. Applying recent information theoretic methods, it is demonstrated that an upper bound on predictability is relatively high for all sensors given the complete history (typically above 90%). The relation between time scale and the predictability bound is examined for GSM and WLAN sensors, and both are found to have predictable and non-trivial behavior even on quite short time scales. The analysis provides valuable insight into aspects such as time scale and spatial quantization, state representation, and general behavior. This is of vital interest in the development of context-aware services which rely on forecasting based on mobile phone sensors.

Probabilistic Algorithm for Electromagnetic Brain Imaging with Spatio-Temporal and Forward Model Priors

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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling, University of California, San Francisco, Convex Imaging
Semi-Supervised Kernel PCA

We present three generalisations of Kernel Principal Components Analysis (KPCA) which incorporate knowledge of the class labels of a subset of the data points. The first, MV-KPCA, penalises within class variances similar to Fisher discriminant analysis. The second, LSKPCA is a hybrid of least squares regression and kernel PCA. The final LR-KPCA is an iteratively reweighted version of the previous which achieves a sigmoid loss function on the labeled points. We provide a theoretical risk bound as well as illustrative experiments on real and toy data sets.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Walder, C. (Intern), Henao, R. (Intern), Mørup, M. (Intern), Hansen, L. K. (Intern)
Publication date: 2010

Spariness in predictive models is associated with reduced pattern reproducibility

General information
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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling, University of Copenhagen
Authors: Rasmussen, P. M. (Intern), Hansen, L. K. (Intern), Madsen, K. H. (Ekstern)
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Sparse Spatio-temporal Inference of Electromagnetic Brain Sources

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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling, Golden Metallic Inc., University of California, San Francisco
Authors: Stahlhut, C. (Intern), Attias, H. T. (Ekstern), Wipf, D. (Ekstern), Hansen, L. K. (Intern), Nagarajan, S. S. (Ekstern)
Pages: 157-164
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Journal: Lecture Notes in Computer Science
underdetermined inverse problems, M/EEG source reconstruction, probabilistic graphical models, variational Bayes, ARD

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Publication: Research - peer-review › Conference article – Annual report year: 2010
Visualization of nonlinear kernel models in neuroimaging by sensitivity maps

General information
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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling, Copenhagen University Hospital
Authors: Rasmussen, P. M. (Intern), Hansen, L. K. (Intern), Madsen, K. H. (Ekstern)
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Main Research Area: Technical/natural sciences
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Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2010

Context based multimedia information retrieval
The large amounts of digital media becoming available require that new approaches are developed for retrieving, navigating and recommending the data to users in a way that reflects how we semantically perceive the content. The thesis investigates ways to retrieve and present content for users with the help of contextual knowledge. Our approach to model the context of multimedia is based on unsupervised methods to automatically extract meaning. We investigate two paths of context modelling. The first part extracts context from the primary media, in this case broadcast news speech, by extracting topics from a large collection of the transcribed speech to improve retrieval of spoken documents. The context modelling is done using a variant of probabilistic latent semantic analysis (PLSA), to extract properties of the textual sources that reflect how humans perceive context. We perform PLSA through an approximation based on non-negative matrix factorisation NMF. The second part of the work tries to infer the contextual meaning of music based on extra-musical knowledge, in our case gathered from Wikipedia. The semantic relations between artists are inferred using linking structure of Wikipedia, as well as text-based semantic similarity. The final aspect investigated is how to include some of the structured data available in Wikipedia to include temporal information. We show that a multiway extension of PLSA makes it possible to extract temporally meaningful topics, better than using a stepwise PLSA approach to topic extraction.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Mølgaard, L. L. (Intern), Hansen, L. K. (Intern), Larsen, J. (Intern)
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Adaptive Text Entry for Mobile Devices
The reduced size of many mobile devices makes it difficult to enter text with them. The text entry methods are often slow or complicated to use. This affects the performance and user experience of all applications and services on the device. This work introduces new easy-to-use text entry methods for mobile devices and a framework for adaptive context-aware language models. Based on analysis of current text entry methods, the requirements to the new text entry methods are established. Transparent User guided Prediction (TUP) is a text entry method for devices with one dimensional touch input. It can be touch sensitive wheels, sliders or similar input devices. The interaction design of TUP is done with a combination of high level task models and low level models of human motor behaviour. Three prototypes of TUP are designed and evaluated by more than 30 users. Observations from the evaluations are used to improve the models of human motor behaviour. TUP-Key is a variant of TUP, designed for 12 key phone keyboards. It is introduced in the thesis but has not been implemented or evaluated. Both text entry methods support adaptive context-aware language models. YourText is a framework for adaptive context-aware language models that is introduced in the thesis. YourText enables different language models to be combined to a new common language model. The framework is designed so it can be adapted to different text entry methods, thereby enabling the language model to be transferred between devices. YourText is evaluated with a corpus of mobile text messages. The corpus is created by collecting all sent and received messages
from 12 persons in four weeks. The corpus contains 25,000 messages. A model of text entry speed for TUP is created from the observations in the evaluations. The model is used to predict the performance of TUP, used together with different YourText language models.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Proschowsky, M. S. (Intern), Schultz, N. (Intern), Hansen, L. K. (Intern)
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Modelling Strategies for Functional Magnetic Resonance Imaging
This thesis collects research done on several models for the analysis of functional magnetic resonance neuroimaging (fMRI) data. Several extensions for unsupervised factor analysis type decompositions including explicit delay modelling as well as handling of spatial and temporal smoothness and generalisations to higher order arrays are considered. Additionally, an application of the natural conjugate prior for supervised learning in the general linear model to efficiently incorporate prior information for supervised analysis is presented. Further extensions include methods to model nuisance effects in fMRI data thereby suppressing noise for both supervised and unsupervised analysis techniques.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Madsen, K. H. (Intern), Sidaros, K. (Intern), Hansen, L. K. (Intern)
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Publication: Research › Ph.D. thesis – Annual report year: 2009

Structure Learning in Audio
By having information about the setting a user is in, a computer is able to make decisions proactively to facilitate tasks for the user. Two approaches are taken in this thesis to achieve more information about an audio environment. One approach is that of classifying audio, and a new approach using pitch dynamics is suggested. The other approach is finding structures between the mixings of multiple sources based on an assumption of statistical independence of the sources. Three different audio classification tasks have been investigated. Audio classification into three classes, music, noise and speech, using novel features based on pitch dynamics. Within instrument classification two different harmonic models have been compared. Finally voiced/unvoiced segmentation of popular music is done based on MFCC’s and AR coefficients. The structures in the mixings of multiple sources have been investigated. A fast and computationally simple approach that compares recordings and classifies if they are from the same audio environment have been developed, and shows very high accuracy and the ability to synchronize recordings in the case of recording devices which are not connected. A more general model is proposed based on Independent Component Analysis. It is based on sequential pruning of the parameters in the mixing matrix and a version based on a fixed source distribution as well as a parameterized distribution is found. The parameterized version has the advantage of modeling both sub- and super-Gaussian source distributions allowing a much wider use of the method. All methods uses a variety of classification models and model selection algorithms which is a common theme of the thesis.
A Neural Network Model of the Visual Short-Term Memory

In this paper a neural network model of Visual Short-Term Memory (VSTM) is presented. The model links closely with Bundesen’s (1990) well-established mathematical theory of visual attention. We evaluate the model’s ability to fit experimental data from a classical whole and partial report study. Previous statistic models have successfully assessed the spatial distribution of visual attention; our neural network meets this standard and offers a neural interpretation of how objects are consolidated in VSTM at the same time. We hope that in the future, the model will be able to fit temporally dependent phenomena like the attentional blink effect, lag-1 sparing, and attentional dwell-time.

An Exact Relaxation of Clustering

Continuous relaxation of hard assignment clustering problems can lead to better solutions than greedy iterative refinement algorithms. However, the validity of existing relaxations is contingent on problem specific fuzzy parameters that quantify the level of similarity between the original combinatorial problem and the relaxed continuous domain problem. Equivalence of solutions obtained from the relaxation and the hard assignment is guaranteed only in the limit of vanishing ‘fuzzyness’. This paper derives a new exact relaxation without such a fuzzy parameter which is applicable for a wide range of clustering problems such as the K-means objective and pairwise clustering as well as graph partition problems, e.g., for community detection in complex networks. In particular we show that a relaxation to the simplex can be given for which the extreme solutions are stable hard assignment solutions and vice versa. Based on the new relaxation we derive the SR-clustering algorithm that has the same complexity as traditional greedy iterative refinement algorithms but leading to significantly better partitions of the data. A Matlab implementation of the SR-clustering algorithm is available for download.
Automatic Relevance Determination for multi-way models

Estimating the adequate number of components is an important yet difficult problem in multi-way modelling. We demonstrate how a Bayesian framework for model selection based on Automatic Relevance Determination (ARD) can be adapted to the Tucker and CP models. By assigning priors for the model parameters and learning the hyperparameters of these priors the method is able to turn off excess components and simplify the core structure at a computational cost of fitting the conventional Tucker/CP model. To investigate the impact of the choice of priors we based the ARD on both Laplace and Gaussian priors corresponding to regularization by the sparsity promoting L1-norm and the conventional L2-norm, respectively. While the form of the priors had limited effect on the results obtained the ARD approach turned out to form a useful, simple, and efficient tool for selecting the adequate number of components of data within the Tucker and CP structure. For the Tucker and CP model the approach performs better than heuristics such as the Bayesian Information Criterion, Akaike's Information Criterion, DIFFIT and the numerical convex hull (NumConvHull) while operating only at the cost of estimating an ordinary CP/Tucker model. For the CP model the ARD approach performs almost as well as the core
consistency diagnostic. Thus, the ARD framework is a simple yet efficient tool for the estimation of the adequate number of components in multi-way models. A Matlab implementation of the proposed algorithm is available for download at www.erpwavelab.org.
Bayesian non-negative matrix factorization

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Schmidt, M. N. (Intern), Winther, O. (Intern), Hansen, L. K. (Intern)
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Conference: International Conference on Independent Component Analysis and Signal Separation, 01/01/2009
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Bridging the gap between coordinate- and keyword- based search of neuroscientific databases by UMLS-assisted semantic keyword extraction

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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Wilkowski, B. (Intern), Szewczyk, M. M. (Intern), Hansen, L. K. (Intern)
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COORDINATE-BASED META-ANALYTIC SEARCH FOR THE SPM NEUROIMAGING PIPELINE: The BredeQuery plugin for SPM5
Large amounts of neuroimaging studies are collected and have changed our view on human brain function. By integrating multiple studies in meta-analysis a more complete picture is emerging. Brain locations are usually reported as coordinates with reference to a specific brain atlas, thus some of the databases offer so-called coordinate-based searching to the users (e.g. Brede, BrainMap). For such search, the publications, which relate to the brain locations represented by the user coordinates, are retrieved. In this paper we present BredeQuery – a plugin for the widely used SPM5 data analytic pipeline. BredeQuery offers a direct link from SPM5 to the Brede Database coordinate-based search engine. BredeQuery is able to ‘grab’ brain location coordinates from the SPM windows and enter them as a query for the Brede Database. Moreover, results of the query can be displayed in an SPM window and/or exported directly to some popular bibliographic file formats (BibTeX, Reference Manager, etc).

General information
Evaluation of the influence of uncertain forward models on the EEG source reconstruction problem

Introduction Electro-encephalography (EEG) holds great promise for functional brain imaging, due to its high temporal resolution, low cost equipment and the possibility of performing the experiments under much more realistic conditions as compared to functional magnetic resonance imaging and positron emission tomography. Today's EEG brain imaging methods operate with the assumption that the forward model is known when the source estimation is performed. Many sources of uncertainty are involved in the formulation of the forward model like tissue segmentation, tissue conductivities, and electrode locations. In this contribution we investigate how forward model uncertainty influences source localization.

Methods The analysis were based on 3-spheres models, where a high-resolution reference head model denoted as the 'true forward model' were compared with lower resolution forward models with and without erroneous tissue conductivity values. Conductivities brain:skull:scalp=0.33:0.0041:0.33S/m (ratio 1:1/80:1), were used in the true forward model and 1:1/15:1 in an erroneous model. To reveal the influence of the forward fields on the source estimates, we base our analysis on a simple 'stepwise' selection procedure, where a squared error function is used. For simplicity we assume that the true source configuration consists of a single dipole i and we now evaluate the cost estimate of a single dipole solution located at the site j. This allows us to examine how the dipoles are confused in the different areas of the brain when noise is present. Results Due to mismatch between the true and experimental forward model, the reconstruction of the sources is determined by the angles between the i'th forward field associated with the true source and the j'th forward field in the experimental forward model. Figure 1a shows two examples of confusion of the reconstructed sources when the true source is located in left frontal region (Source 1) and left temporal lobe (Source 2). The left side on the vertical lines indicates trusted regions where the cost of selecting one of the sources is smaller than the contribution from noise. As confusion measure we use: The positive prediction value PPV=TP/(TP+FP), where TP is true positives (distance-less-than-or-equals, slant<20mm) and FP is false positives (distance>20mm) both with angular factors smaller than the effective noise level. Figure 1b-1c show the PPV's for the whole brain with the true and erroneous conductivities, respectively. White areas indicate that no TP or FP has been detected. Generally, small signals from sulci and from cortical regions at a large distance from the sensors are more likely to be confused since the differences in angular factors can be small compared to the effective noise level. Increasing 'white' areas are found in figure 1c as a result of the poorer signal-to-noise ratio. Confusion is smaller for sources in the parietal region with the erroneous conductivity model, however, the angular factors also increases indicating a poorer representation of the signal. Conclusions This analysis demonstrated that caution is needed when evaluating the source estimates in different brain regions. Moreover, we demonstrated the importance of reliable forward models, which may be used as a motivation for including the forward model uncertainty into the source reconstruction methods.
Hierarchical Bayesian Model for Simultaneous EEG Source and Forward Model Reconstruction (SOFO MORE)

In this paper we propose an approach to handle forward model uncertainty for EEG source reconstruction. A stochastic forward model is motivated by the many uncertain contributions that form the forward propagation model including the tissue conductivity distribution, the cortical surface, and electrode positions. We first present a hierarchical Bayesian framework for EEG source localization that jointly performs source and forward model reconstruction (SOFO MORE). Secondly, we evaluate the SOFO MORE model by comparison with source reconstruction methods that use fixed forward models. Simulated and real EEG data demonstrate that invoking a stochastic forward model leads to improved source estimates.

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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Stahlhut, C. (Intern), Mørup, M. (Intern), Winther, O. (Intern), Hansen, L. K. (Intern)
Pages: 1-6
Publication date: 2009

Input Space Regularization Stabilizes Pre-images for Kernel PCA De-noising

Solution of the pre-image problem is key to efficient nonlinear de-noising using kernel Principal Component Analysis. Pre-image estimation is inherently ill-posed for typical kernels used in applications and consequently the most widely used estimation schemes lack stability. For de-noising applications we propose input space distance regularization as a stabilizer for pre-image estimation. We perform extensive experiments on the USPS digit modeling problem to evaluate the stability of three widely used pre-image estimators. We show that the previous methods lack stability when the feature mapping is non-linear, however, by applying a simple input space distance regularizer we can reduce variability with very limited sacrifice in terms of de-noising efficiency.

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Authors: Abrahamsen, T. J. (Intern), Hansen, L. K. (Intern)
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**Latent Causal Modelling of Neuroimaging Data**

**General information**
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Technical University of Denmark
Authors: Mørup, M. (Intern), Madsen, K. H. (Extern), Hansen, L. K. (Intern)
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**Learning Latent Structure in Complex Networks**

Latent structure in complex networks, e.g., in the form of community structure, can help understand network dynamics, identify heterogeneities in network properties, and predict ‘missing’ links. While most community detection algorithms are based on optimizing heuristic clustering objectives such as the Modularity, it has recently been shown that latent structure in complex networks is learnable by Bayesian generative link distribution models (Airoldi et al., 2008, Hofman and Wiggins, 2008). In this paper we propose a new generative model that allows representation of latent community structure as in the previous Bayesian approaches and in addition allows learning of node specific link properties similar to that in the modularity objective. We employ a new relaxation method for efficient inference in these generative models that allows us to learn the behavior of very large networks. We compare the link prediction performance of the learning based approaches and other widely used link prediction approaches in 14 networks ranging from medium size to large networks with more than a million nodes. While link prediction is typically well above chance for all networks, we find that the learning based mixed membership stochastic block model of Airoldi et al., performs well and often best in our experiments. The added complexity of the LD model improves link predictions for four of the 14 networks.

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Authors: Mørup, M. (Intern), Hansen, L. K. (Intern)
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Main Research Area: Technical/natural sciences
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Motion Correction of Single-Voxel Spectroscopy by Independent Component Analysis Applied to Spectra From Nonanesthetized Pediatric Subjects

For single-voxel spectroscopy, the acquisition of the spectrum is typically repeated \( n \) times and then combined with a factor in order to improve the signal-to-noise ratio. In practice, the acquisitions are not only affected by random noise but also by physiologic motion and subject movements. Since the influence of physiologic motion such as cardiac and respiratory motion on the data is limited, it can be compensated for without data loss. Individual acquisitions hampered by subject movements, on the other hand, need to be rejected if no correction or compensation is possible. If the individual acquisitions are stored, it is possible to identify and reject the motion-disturbed acquisitions before averaging. Several automatic algorithms were investigated using a dataset of spectra from nonanesthetized infants with a gestational age of 40 weeks. Median filtering removed most subject movement artifacts, but at the cost of increased sensitivity to random noise. Neither independent component analysis nor outlier identification with multiple comparisons has this problem. These two algorithms are novel in this context. The peak height values of the metabolites were increased compared to the mean of all acquisitions for both methods, although primarily for the ICA method. Magn Reson Med, 2009. © 2009 Wiley-Liss, Inc.
Semantic Contours in Tracks Based on Emotional Tags
Outlining a high level cognitive approach to how we select media based on affective user preferences, we model the latent semantics of lyrics as patterns of emotional components. Using a selection of affective last.fm tags as top-down emotional buoys, we apply LSA latent semantic analysis to bottom-up represent the correlation of terms and song lyrics in a vector space that reflects the emotional context. Analyzing the resulting patterns of affective components, by comparing them against last.fm tag clouds describing the corresponding songs, we propose that it might be feasible to automatically generate affective user preferences based on song lyrics.

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DOIs:
10.1007/978-3-642-02518-1_3
Links:
http://www.springerlink.com/content/p464424g4578/
SOFOMORE: Combined EEG source and forward model reconstruction

We propose a new EEG source localization method that simultaneously performs source and forward model reconstruction (SOFOMORE) in a hierarchical Bayesian framework. Reconstruction of the forward model is motivated by the many uncertainties involved in the forward model, including the representation of the cortical surface, conductivity distribution, and electrode positions. We demonstrate in both simulated and real EEG data that reconstruction of the forward model improves localization of the underlying sources.

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Sparse but emotional decomposition of lyrics

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Petersen, M. K. (Intern), Mørup, M. (Intern), Hansen, L. K. (Intern)
Publication date: 2009

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Sparse Coding and Automatic Relevance Determination for Multi-way models

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Authors: Mørup, M. (Intern), Hansen, L. K. (Intern)
Publication date: 2009

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Main Research Area: Technical/natural sciences
Time and Frequency Domain Optimization with Shift, Convolution and Smoothness in Factor Analysis Type Decompositions

We propose the Time Frequency Gradient Method (TFGM) which forms a framework for optimization of models that are constrained in the time domain while having efficient representations in the frequency domain. Since the constraints in the time domain in general are not transparent in a frequency representation we demonstrate how the class of objective functions that are separable in either time or frequency instances allow the gradient in the time or frequency domain to be converted to the opposing domain. We further demonstrate the usefulness of this framework for three different models; Shifted Non-negative Matrix Factorization, Convolutive Sparse Coding as well as Smooth and Sparse Matrix Factorization. Matlab implementation of the proposed algorithms are available for download at www.erpwavelab.org.
Unified ICA-SPM analysis of fMRI experiments: Implementation of an ICA graphical user interface for the SPM pipeline

We present a toolbox for exploratory analysis of functional magnetic resonance imaging (fMRI) data using independent component analysis (ICA) within the widely used SPM analysis pipeline. The toolbox enables dimensional reduction using principal component analysis, ICA using several different ICA algorithms, selection of the number of components using the Bayesian information criterion (BIC), visualization of ICA components, and extraction of components for subsequent analysis using the standard general linear model. We demonstrate how the toolbox is capable of identifying activity and nuisance effects in fMRI data from a visual experiment.

Cognitive Component Analysis

This dissertation concerns the investigation of the consistency of statistical regularities in a signaling ecology and human cognition, while inferring appropriate actions for a speech-based perceptual task. It is based on unsupervised Independent Component Analysis providing a rich spectrum of audio contexts along with pattern recognition methods to map components to known contexts. It also involves looking for the right representations for auditory inputs, i.e. the data analytic processing pipelines invoked by human brains. The main ideas refer to Cognitive Component Analysis, defined as the process of unsupervised grouping of generic data such that the ensuing group structure is well-aligned with that resulting from human cognitive activity. Its hypothesis runs ecologically: features which are essentially independent in a context defined ensemble, can be efficiently coded as sparse independent component representations. The focus has been to construct a preprocessing pipeline for COCA to search for the ‘cognitive structure’, and to measure the alignment of the resulting from unsupervised learning and human cognition. Based on the nature of human auditory system and psychoacoustics, we have constructed the pipeline: feature extraction; feature integration; and principal component analysis. To test whether human uses information theoretically optimal ICA methods in higher cognitive functions, is the main concern in this thesis. It is well-documented that unsupervised learning discovers statistical regularities. However human cognition is too complicated and not yet fully understood. Nevertheless, in our approach we represent human cognitive processes as a classification rule in supervised learning. Thus we have devised a testable protocol to test the consistency of statistical properties and human cognitive activity, i.e. unsupervised learning of perceptual inputs and supervised learning of inputs together with manually obtained labels. The comparison has been carried out at different levels. This protocol has successfully revealed the consistency of two classifications via several speech-based cognitive tasks.
Detection of Weather Radar Clutter

Weather radars provide valuable information on precipitation in the atmosphere but due to the way radars work, not only precipitation is observed by the weather radar. Weather radar clutter, echoes from non-precipitating targets, occur frequently in the data, resulting in lowered data quality. Especially in the application of weather radar data in quantitative precipitation estimation and forecasting a high data quality is important. Clutter detection is one of the key components in achieving this goal. This thesis presents three methods for detection of clutter. The methods use supervised classification and use a range of different techniques and input data. The first method uses external information from multispectral satellite images to detect clutter. The information in the visual, near-infrared, and infrared parts of the spectrum can be used to distinguish between cloud and cloud-free areas and precipitating and non-precipitating clouds. Another method uses the difference in the motion field of clutter and precipitation measured between two radar images. Furthermore, the direction of the wind field extracted from a weather model is used. The third method uses information about the refractive index of the atmosphere as extracted from a numerical weather prediction model to predict the propagation path of the radar’s electromagnetic energy. This facilitates the prediction of areas of clutter caused by anomalous propagation of the radar’s rays. The methods are evaluated using a large independent test set, and to illustrate the performance on individual radar images three typical case examples are also evaluated. The results of the evaluation of the methods show that each method has good skill in detection of clutter with an average classification accuracy of 95%. The methods thus have the potential for increasing the quality of weather radar data in their operational use.

Modelling Brain Tissue using Magnetic Resonance Imaging

Diffusion MRI, or diffusion weighted imaging (DWI), is a technique that measures the restricted diffusion of water molecules within brain tissue. Different reconstruction methods quantify water-diffusion anisotropy in the intra- and extra-cellular spaces of the neural environment. Fibre tracking models then use the directions of greatest diffusion as estimates of white matter fibre orientation. Several fibre tracking algorithms have emerged in the last few years that provide reproducible visualizations of three-dimensional fibre bundles. One class of these algorithms is probabilistic tractography. Although probabilistic tractography currently holds great promise as a powerful non-invasive connectivity-measurement tool, its accuracy and limitations remain to be evaluated. Probabilistic tractography was assessed post mortem in the last year period. No statistical inter- or intra-brain difference in the diffusion coefficient was found in perfusion fixated minipig brains. However, a decreasing tendency in the diffusion coefficient was found at the last
time points about 24 months post mortem and might be explained by an ongoing chemical reaction due to the fixative used. Short-term instabilities within the first 15 hours of DWI scanning were observed and found likely to be caused by the preparation of the postmortem tissue prior to MR scanning. This artefact can be avoided e.g. by simply excluding DW-volumes obtained in the first time period of the scanning session. Probabilistic tractography was validated against two invasive in vivo neuronal tracers that were used to derive a gold standard. A high spatial agreement between tractography and the gold standard was found, and some of the widely known limitations of tractography methods could be confirmed e.g. uncertainty in regions containing crossing fibres, and definition of tract termination. In the thesis we delve behind the published results to describe all the practical issues that had to be considered in order to ensure a reliable outcome, and a successful experiment. This includes the selection of independent anatomical data to be used to derive a gold standard, the selection of a gyrated animal model in place of the human brain, objective selection of the seed region to initiate, and a waypoint region to constrain the tractography results.

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Authors: Dyrby, T. B. (Intern), Hansen, L. K. (Intern)
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Decomposition methods for unsupervised learning
This thesis presents the application and development of decomposition methods for Unsupervised Learning. It covers topics from classical factor analysis based decomposition and its variants such as Independent Component Analysis, Non-negative Matrix Factorization and Sparse Coding to their generalizations to multi-way array, i.e. tensor decomposition, through models such as the CanDecomp/ PARAFAC and the Tucker model. Extensions for these types of decomposition models to incorporate shift, reverberation and general transformations are also described. Finally, a connection between decomposition methods and clustering problems is derived both in terms of classical point clustering but also in terms of community detection in complex networks. A guiding principle throughout this thesis is the principle of parsimony. Hence, the goal of Unsupervised Learning is here posed as striving for simplicity in the decompositions. Thus, it is demonstrated how a wide range of decomposition methods explicitly or implicitly strive to attain this goal. Applications of the derived decompositions are given ranging from multi-media analysis of image and sound data, analysis of biomedical data such as electroencephalography to the analysis of social network data.

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Authors: Mørup, M. (Intern), Hansen, L. K. (Intern), Winther, O. (Intern)
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Algorithms for Sparse Non-negative Tucker Decompositions
There is an increasing interest in analysis of large scale multi-way data. The concept of multi-way data refers to arrays of data with more than two dimensions, i.e., taking the form of tensors. To analyze such data, decomposition techniques are widely used. The two most common decompositions for tensors are the Tucker model and the more restricted PARAFAC model. Both models can be viewed as generalizations of the regular factor analysis to data of more than two modalities.
Non-negative matrix factorization (NMF) in conjunction with sparse coding has lately been given much attention due to its part based and easy interpretable representation. While NMF has been extended to the PARAFAC model no such attempt has been done to extend NMF to the Tucker model. However, if the tensor data analyzed is non-negative it may well be relevant to consider purely additive (i.e., non-negative Tucker decompositions). To reduce ambiguities of this type of decomposition we develop updates that can impose sparseness in any combination of modalities, hence, proposed algorithms for sparse non-negative Tucker decompositions (SN-TUCKER). We demonstrate how the proposed algorithms are superior to existing algorithms for Tucker decompositions when indeed the data and interactions can be considered non-negative. We further illustrate how sparse coding can help identify what model (PARAFAC or Tucker) is the most appropriate for the data as well as to select the number of components by turning off excess components. The algorithms for SN-TUCKER can be downloaded from www.erpwavelab.org.

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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling  
Authors: Mørup, M. (Intern), Hansen, L. K. (Intern)  
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Web of Science (2015): Indexed yes  
BFI (2014): BFI-level 2  
Scopus rating (2014): SJR 0.966 SNIP 1.174 CiteScore 2.52  
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BFI (2013): BFI-level 2  
Scopus rating (2013): SJR 0.827 SNIP 1.041 CiteScore 2.39  
ISI indexed (2013): ISI indexed yes  
BFI (2012): BFI-level 2  
Scopus rating (2012): SJR 0.863 SNIP 1.41 CiteScore 2.48  
ISI indexed (2012): ISI indexed yes  
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Scopus rating (2011): SJR 1.328 SNIP 1.415 CiteScore 2.59  
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Scopus rating (2010): SJR 1.462 SNIP 1.773  
BFI (2009): BFI-level 2  
Scopus rating (2009): SJR 1.329 SNIP 1.708  
BFI (2008): BFI-level 1  
Scopus rating (2008): SJR 1.492 SNIP 1.745  
Web of Science (2008): Indexed yes  
Scopus rating (2007): SJR 1.664 SNIP 2.173  
Web of Science (2007): Indexed yes  
Scopus rating (2006): SJR 1.584 SNIP 2.479  
Web of Science (2006): Indexed yes  
Scopus rating (2005): SJR 1.838 SNIP 2.731
Approximate L0 constrained Non-negative Matrix and Tensor Factorization

Non-negative matrix factorization (NMF), i.e. \( V = WH \) where both \( V, W \) and \( H \) are non-negative has become a widely used blind source separation technique due to its part based representation. The NMF decomposition is not in general unique and a part based representation not guaranteed. However, imposing sparseness both improves the uniqueness of the decomposition and favors part based representation. Sparseness in the form of attaining as many zero elements in the solution as possible is appealing from a conceptional point of view and corresponds to minimizing reconstruction error with an L0 norm constraint. In general, solving for a given L0 norm is an NP hard problem thus convex relaxatin to regularization by the L1 norm is often considered, i.e., minimizing \( \frac{1}{2} ||V-WH_k||^2 + \lambda |H|_1 \). An open problem is to control the degree of sparsity imposed. We here demonstrate that a full regularization path for the L1 norm regularized least squares NMF for fixed \( W \) can be calculated at the cost of an ordinary least squares solution based on a modification of the Least Angle Regression and Selection (LARS) algorithm forming a non-negativity constrained LARS (NLARS). With the full regularization path, the L1 regularization strength \( \lambda \) that best approximates a given L0 can be directly accessed and in effect used to control the sparsity of \( H \). The MATLAB code for the NLARS algorithm is available for download.
Bayesian model comparison in nonlinear BOLD fMRI hemodynamics

Nonlinear hemodynamic models express the BOLD (blood oxygenation level dependent) signal as a nonlinear, parametric functional of the temporal sequence of local neural activity. Several models have been proposed for both the neural activity and the hemodynamics. We compare two such combined models: the original balloon model with a square-pulse neural model (Friston, Mechelli, Turner, & Price, 2000) and an extended balloon model with a more sophisticated neural model (Buxton, Uludag, Dubowitz, & Liu, 2004). We learn the parameters of both models using a Bayesian approach, where the distribution of the parameters conditioned on the data is estimated using Markov chain Monte Carlo techniques. Using a split-half resampling procedure (Strother, Anderson, & Hansen, 2002), we compare the generalization abilities of the models as well as their reproducibility for both synthetic and real data, recorded from two different visual stimulation paradigms. The results show that the simple model is the better one for these data.

General information
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Authors: Jacobsen, D. J. (Intern), Hansen, L. K. (Intern), Madsen, K. H. (Intern)
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ISI indexed (2011): ISI indexed yes
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Scopus rating (2008): SJR 1.492 SNIP 1.745
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.664 SNIP 2.173
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.584 SNIP 2.479
Biclique communities

We present a method for detecting communities in bipartite networks. Based on an extension of the k-clique community detection algorithm, we demonstrate how modular structure in bipartite networks presents itself as overlapping bicliques. If bipartite information is available, the biclique community detection algorithm retains all of the advantages of the k-clique algorithm, but avoids discarding important structural information when performing a one-mode projection of the network. Further, the biclique community detection algorithm provides a level of flexibility by incorporating independent clique thresholds for each of the nonoverlapping node sets in the bipartite network.
Introduction to the Issue on fMRI Analysis for Human Brain Mapping

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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Adali, T. (Ekstern), Wang, Z. (Ekstern), McKeown, M. (Ekstern), Ciuciu, P. (Ekstern), Hansen, L. K. (Intern), Cichocki, A. (Ekstern), Calhoun, V. (Ekstern)
Pages: 813-816
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Main Research Area: Technical/natural sciences
Is Cognitive Activity of Speech Based On Statistical Independence?

This paper explores the generality of COgnitive Component Analysis (COCA), which is defined as the process of unsupervised grouping of data such that the ensuing group structure is well-aligned with that resulting from human cognitive activity. The hypothesis of COCA is ecological: the essentially independent features in a context defined ensemble can be efficiently coded using a sparse independent component representation. Our devised protocol aims at comparing the performance of supervised learning (invoking cognitive activity) and unsupervised learning (statistical regularities) based on similar representations, and the only difference lies in the human inferred labels. Inspired by the previous research on COCA, we introduce a new pair of models, which directly employ the independent hypothesis. Statistical regularities are revealed at multiple time scales on phoneme, gender, age and speaker identity derived from speech signals. We indeed find that the supervised and unsupervised learning provide similar representations measured by the classification similarity at different levels.
Model Order Estimation for Independent Component Analysis of Epoched EEG Signals

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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Rasmussen, P. M. (Intern), Mørup, M. (Intern), Hansen, L. K. (Intern), Amfred, S. M. (Ekstern)
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Publication: Research - peer-review › Article in proceedings – Annual report year: 2008

MuZeeker: a domain specific Wikipedia-based search engine

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Halling, S. C. (Intern), Sigurdsson, M. K. (Intern), Larsen, J. E. (Intern), Knudsen, S. (Intern), Hansen, L. K. (Intern)
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Number: 1
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Conference: The First International Workshop on Mobile Multimedia Processing : December, Tampa, Florida, 01/01/2008
Source: orbit
Source-ID: 223997
Publication: Research - peer-review › Article in proceedings – Annual report year: 2008

On Phonemes As Cognitive Components of Speech
COgnitive Component Analysis (COCA) defined as the process of unsupervised grouping of data such that the ensuing group structure is well-aligned with that resulting from human cognitive activity, has been explored on phoneme data. Statistical regularities have been revealed at multiple time scales. The basic features are 25-dimensional short time (20ms) melfrequency weighted cepstral coefficients. Features are integrated by means of stacking to obtain features at longer time scales. Energy based sparsification is carried out to achieve sparse representations. Our hypothesis is ecological: we assume that features that essentially independent in a context defined ensemble can be efficiently coded using a sparse independent component representation. This means that supervised and unsupervised learning should
result in similar representations. We indeed find that supervised and unsupervised learning seem to identify similar representations, here, measured by the classification similarity.

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Authors: Feng, L. (Intern), Hansen, L. K. (Intern)
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Source: orbit
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**Regularity increases middle latency evoked and late induced beta brain response following proprioceptive stimulation**
Focal attention increases the middle-latency amplitude of somatosensory evoked potentials. Previously this effect has been suggested to be due to increased readiness in somatosensory cortex. Presently, we examine whether regularity of stimulus occurrence increases the proprioceptive evoked response as an indication of increased readiness. This is achieved through detailed analysis of both evoked and induced responses in the time-frequency domain. Electroencephalography in a 64 channels montage was recorded in four-teen healthy subjects. Two paradigms were explored: A Regular alternation between hand of presentation and a Random sequence of hand of presentation. The ERPWAVELAB toolbox was used for decomposition of the wavelet transformed data (7 to 47 Hz, -300 to +1500 ms) yielding the evoked amplitude (AvVvrT) and inter-trial phase coherence as well as the increase of nontime-locked activity (induced). After initial exploration of the AvVVT and induced collapsed files of all subjects using two-way factor analyses (Non-Negative Matrix Factorization), further data decomposition was performed in restricted windows of interest (WOI). Main effects of side of stimulation, onset or offset, regularity and habituation on the evoked and induced activity are described for each WOI. The Regular paradigm evoked more activity than Random in the fast beta range (18-28 Hz) (mean: normalized amplitude 0.38 at 90 ins and 20.9 Hz) including increased phase precision. The findings confirm the possibility of modulation of middle-latency activity by regularity and suggest that this is due to facilitation of activity in secondary somatosensory cortices. Future studies need to examine whether the increased amplitude is associated with increased perceptual acuity.

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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Arnfred, S. M. (Ekstern), Hansen, L. K. (Intern), Parnas, J. (Ekstern), Mørup, M. (Intern)
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Scopus rating (2015): CiteScore 2.74
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 3.013 SNIP 2.52 CiteScore 3.04
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 4.518 SNIP 2.957 CiteScore 3.22
ISI indexed (2013): ISI indexed yes
Segmentation of age-related white matter changes in a clinical multi-center study

Age-related white matter changes (WMC) are thought to be a marker of vascular pathology, and have been associated with motor and cognitive deficits. In the present study, an optimized artificial neural network was used as an automatic segmentation method to produce probabilistic maps of WMC in a clinical multi-center study. The neural network uses information from T1- and T2-weighted and fluid attenuation inversion recovery (FLAIR) magnetic resonance (MR) scans, neighboring voxels and spatial location. Generalizability of the neural network was optimized by including the Optimal Brain Damage (OBD) pruning method in the training stage. Six optimized neural networks were produced to investigate the impact of different input information on WMC segmentation. The automatic segmentation method was applied to MR scans of 362 non-demented elderly subjects from 11 centers in the European multi-center study Leukoaraiosis And Disability (LADIS). Semi-manually delineated WMC were used for validating the segmentation produced by the neural networks. The neural network segmentation demonstrated high consistency between subjects and centers, making it a promising technique for large studies. For WMC volumes less than 10 ml, an increasing discrepancy between semi-manual and neural network segmentation was observed using the similarity index (SI) measure. The use of all three image modalities significantly improved cross-center generalizability compared to neural networks using the FLAIR image only. Expert knowledge not available to the neural networks was a minor source of discrepancy, while variation in MR scan quality constituted the largest source of error.

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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling


Pages: 335-345

Publication date: 2008
Semantic analysis of links in the musical Wikipedia

Wikipedia has significant potential in music information retrieval research. In this work we analyze the link structure in the musical Wikipedia. Wikipedia links differ in certain ways from links on the Web at large. There are an over-abundance of internal links in Wikipedia, links are generated automatically, and they may even maliciously be used to promote certain topics. Wikipedia has been analyzed recently using methods from Web text mining, however, the fact the link structure is different from the Web’s makes this approach questionable. To better understand the link structure and specifically to test the level of consistency of links and page content we perform Probabilistic Latent Semantic Analysis to extract topics from Wikipedia articles. The PLSA model is used to quantify how articles are related. The PLSA-based similarity of documents is then used to evaluate the semantic relevance of the actual links. Our analysis highlights the diversity of Wikipedia links and we conclude that semantic analysis could be a useful tool for Wikipedia.

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Organisations: Department of Informatics and Mathematical Modeling
Authors: Mølgaard, L. L. (Intern), Hansen, L. K. (Intern), Larsen, J. (Intern)
Number of pages: 7
Publication date: 2008

Shift Invariant Multi-linear Decomposition of Neuroimaging Data

We present an algorithm for multilinear decomposition that allows for arbitrary shifts along one modality. The method is applied to neural activity arranged in the three modalities space, time, and trial. Thus, the algorithm models neural activity as a linear superposition of components with a fixed time course that may vary across either trials or space in its overall intensity and latency. Its utility is demonstrated on simulated data as well as actual EEG, and fMRI data. We show how shift-invariant multilinear decompositions of multiway data can successfully cope with variable latencies in data derived from neural activity—a problem that has caused degenerate solutions especially in modeling neuroimaging data with instantaneous multilinear decompositions. Our algorithm is available for download at www.erpwavelab.org.

General information
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Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems, University of California at Berkeley, Copenhagen University Hospital
Authors: Mørup, M. (Intern), Hansen, L. K. (Intern), Arnfred, S. M. (Ekstern), Lim, L. (Ekstern), Madsen, K. H. (Intern)
Pages: 1439-1450
Publication date: 2008
Main Research Area: Technical/natural sciences
Structure learning by pruning in independent component analysis

We discuss pruning as a means of structure learning in independent component analysis (ICA). Learning the structure is attractive in both signal processing and in analysis of abstract data, where it can assist model interpretation, generalizability and reduce computation. We derive the relevant saliency expressions and compare with magnitude based pruning and Bayesian sparsification. We show in simulations that pruning is able to identify underlying structures without prior knowledge on the dimensionality of the model. We find, that for ICA, magnitude based pruning is as efficient as saliency based methods and Bayesian methods, for both small and large samples. The Bayesian information criterion...
(BIC) seems to outperform both AIC and test sets as tools for determining the optimal dimensionality.
Synchronization and comparison of Lifelog audio recordings
We investigate concurrent 'Lifelog' audio recordings to locate segments from the same environment. We compare two techniques earlier proposed for pattern recognition in extended audio recordings, namely cross-correlation and a fingerprinting technique. If successful, such alignment can be used as a preprocessing step to select and synchronize recordings before further processing. The two methods perform similarly in classification, but fingerprinting scales better with the number of recordings, while cross-correlation can offer sample resolution synchronization. We propose and investigate the benefits of combining the two. In particular we show that the combination allows sample resolution synchronization and scalability.

Theorems on Positive Data: On the Uniqueness of NMF
We investigate the conditions for which nonnegative matrix factorization (NMF) is unique and introduce several theorems which can determine whether the decomposition is in fact unique or not. The theorems are illustrated by several examples showing the use of the theorems and their limitations. We have shown that corruption of a unique NMF matrix by additive noise leads to a noisy estimation of the noise-free unique solution. Finally, we use a stochastic view of NMF to analyze which characterization of the underlying model will result in an NMF with small estimation errors.
Use and Subtleties of Saddlepoint Approximation for Minimum Mean-Square Error Estimation

An integral representation for the minimum mean-square error (MMSE) estimator for a random variable in an observation model consisting of a linear combination of two random variables is derived. The derivation is based on the moment-generating functions for the random variables in the observation model. The method generalizes so that integral representations for higher-order moments of the posterior of interest can be easily obtained. Two examples are presented that demonstrate how saddle-point approximation can be used to obtain accurate approximations for a MMSE estimator using the derived integral representation. However, the examples also demonstrate that when two saddle points are close or coalesce, then saddle-point approximation based on isolated saddle points is not valid. A saddle-point approximation based on two close or coalesced saddle points is derived and in the examples, the validity and accuracy of the derivation is demonstrated.

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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Beierholm, T. (Intern), Nuttall, A. H. (Ekstern), Hansen, L. K. (Intern)
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764206.pdf
DOIs:
10.1155/2008/764206
moment-generating functions, monkey saddle point, Coalescing saddle points, minimum mean-square error estimation (MMSE), saddle-point approximation

DOIs:
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Source: orbit
Source-ID: 233572
VOCAL SEGMENT CLASSIFICATION IN POPULAR MUSIC
This paper explores the vocal and non-vocal music classification problem within popular songs. A newly built labeled database covering 147 popular songs is announced. It is designed for classifying signals from 1sec time windows. Features are selected for this particular task, in order to capture both the temporal correlations and the dependencies among the feature dimensions. We systematically study the performance of a set of classifiers, including linear regression, generalized linear model, Gaussian mixture model, reduced kernel orthonormalized partial least squares and (K-)means on cross-validated training and test setup. The database is divided in two different ways: with/without artist overlap between training and test sets, so as to study the so called 'artist effect'. The performance and results are analyzed in depth: from error rates to sample-to-sample error correlation. A voting scheme is proposed to enhance the performance under certain conditions.

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Organisations: Department of Informatics and Mathematical Modeling
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Main Research Area: Technical/natural sciences
Pop music database, Music retrieval, vocal segment classification
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Links:
http://www2.imm.dtu.dk/pubdb/p.php?5654
Source: orbit
Source-ID: 233104
Publication: Research - peer-review › Article in proceedings – Annual report year: 2008

Algorithms for Source Separation - with Cocktail Party Applications
In this thesis, a number of possible solutions to source separation are suggested. Although they differ significantly in shape and intent, they share a heavy reliance on prior domain knowledge. Most of the developed algorithms are intended for speech applications, and hence, structural features of speech have been incorporated. Single-channel separation of speech is a particularly challenging signal processing task, where the purpose is to extract a number of speech signals from a single observed mixture. I present a few methods to obtain separation, which rely on the sparsity and structure of speech in a time-frequency representation. My own contributions are based on learning dictionaries for each speaker separately and subsequently applying a concatenation of these dictionaries to separate a mixture. Sparse decompositions required for the decomposition are computed using nonnegative matrix factorization as well as basis pursuit. In my work on the multi-channel problem, I have focused on convolutive mixtures, which is the appropriate model in acoustic setups. We have been successful in incorporating a harmonic speech model into a greater probabilistic formulation. Furthermore, we have presented several learning schemes for the parameters of such models, more specifically, the expectation-maximization (EM) algorithm and stochastic and Newton-type gradient optimization.

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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Olsson, R. K. (Intern), Hansen, L. K. (Intern)
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Original language: English
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Bayesian and non-Bayesian techniques applied to censored survival data with missing values

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Authors: Andersen, M. N. (Intern), Winther, O. (Intern), Hansen, L. K. (Intern)
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Regularized Statistical Analysis of Anatomy

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The Structure of Complex Networks

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phd176_slj.pdf
Links:
Hemodynamic modelling of BOLD fMRI - A machine learning approach
This Ph.D. thesis concerns the application of machine learning methods to hemodynamic models for BOLD fMRI data. Several such models have been proposed by different researchers, and they have in common a basis in physiological knowledge of the hemodynamic processes involved in the generation of the BOLD signal. The BOLD signal is modelled as a non-linear function of underlying, hidden (non-measurable) hemodynamic state variables. The focus of this thesis work has been to develop methods for learning the parameters of such models, both in their traditional formulation, and in a state space formulation. In the latter, noise enters at the level of the hidden states, as well as in the BOLD measurements themselves. A framework has been developed to allow approximate posterior distributions of model parameters to be learned from real fMRI data. This is accomplished with Markov chain Monte Carlo (MCMC) sampling techniques, including ‘parallel tempering’, an improvement of basic MCMC sampling. On top of this, a method has been developed that allows comparisons to be made of the quality of these models. This is based on prediction of test data, and comparisons of learnt parameters for different training data. This gives estimates of the generalization ability of the models, as well as of their reproducibility. The latter is a measure of the robustness of the learnt parameters to variations in training data. Together, these measures allow informed model comparison, or model choice. Using resampling techniques, a measure of the uncertainty about the generalization ability and reproducibility of the models is also obtained. The results show that for some of the data, the standard so-called ‘balloon’ model is sufficient. More complex data have also been designed, however, and for these, the stochastic state space version of the standard balloon model is shown to be superior, although an augmented version of the standard balloon model is not found to be an improvement for either data set.

Castsearch - Context Based Spoken Document Retrieval
The paper describes our work on the development of a system for retrieval of relevant stories from broadcast news. The system utilizes a combination of audio processing and text mining. The audio processing consists of a segmentation step that partitions the audio into speech and music. The speech is further segmented into speaker segments and then transcribed using an automatic speech recognition system, to yield text input for clustering using non-negative matrix factorization (NMF). We find semantic topics that are used to evaluate the performance for topic detection. Based on these topics we show that a novel query expansion can be performed to return more intelligent search results. We also show that the query expansion helps overcome errors of the automatic transcription.
Cognitive components of speech at different time scales

Cognitive component analysis (COCA) is defined as unsupervised grouping of data leading to a group structure well aligned with that resulting from human cognitive activity. We focus here on speech at different time scales looking for possible hidden 'cognitive structure'. Statistical regularities have earlier been revealed at multiple time scales corresponding to: phoneme, gender, height and speaker identity. We here show that the same simple unsupervised learning algorithm can detect these cues. Our basic features are 25-dimensional short time Mel-frequency weighted cepstral coefficients, assumed to model the basic representation of the human auditory system. The basic features are aggregated in time to obtain features at longer time scales. Simple energy based filtering is used to achieve a sparse representation. Our hypothesis is now basically ecological: We hypothesize that features that are essentially independent in a reasonable ensemble can be efficiently coded using a sparse independent component representation. The representations are indeed shown to be very similar between supervised learning (invoking cognitive activity) and unsupervised learning (statistical regularities), hence lending additional support to our cognitive component hypothesis.

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Convolutive ICA for Spatio-Temporal Analysis of EEG

We present a new algorithm for maximum likelihood convolutive ICA (cICA) in which sources are unmixed using stable IIR filters determined implicitly by estimating an FIR filter model of the mixing process. By intro- ducing a FIR model for the sources we show how the order of the filters in the convolutive model can be correctly detected using Bayesian model selection. We demonstrate a framework for deconvolving an EEG ICA subspace. Initial results suggest that in some cases convolutive mixing may be a more realistic model for EEG signals than the instantaneous ICA model.

General information
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Discovering Music Structure via Similarity Fusion

Automatic methods for music navigation and music recommendation exploit the structure in the music to carry out a meaningful exploration of the “song space”. To get a satisfactory performance from such systems, one should incorporate as much information about songs similarity as possible; however, how to do so is not obvious. In this paper, we build on the ideas of the Probabilistic Latent Semantic Analysis (PLSA) that have been successfully used in the document retrieval community. Under this probabilistic framework, any song will be projected into a relatively low dimensional space of “latent semantics”, in such a way that all observed similarities can be satisfactorily explained using the latent semantics. Therefore, one can think of these semantics as the real structure in music, in the sense that they can explain the observed similarities among songs. The suitability of the PLSA model for representing music structure is studied in a simplified scenario consisting of 4412 songs and two similarity measures among them. The results suggest that the PLSA model is a useful framework to combine different sources of information, and provides a reasonable space for song representation.

Effect of Spatial Alignment Transformations in PCA and ICA of Functional Neuroimages

It has been previously observed that spatial independent component analysis (ICA), if applied to data pooled in a particular way, may lessen the need for spatial alignment of scans in a functional neuroimaging study. In this paper we seek to determine analytically the conditions under which this observation is true, not only for spatial ICA, but also for temporal ICA and for principal component analysis (PCA). In each case we find conditions that the spatial alignment operator must satisfy to ensure invariance of the results. We illustrate our findings using functional magnetic-resonance imaging (fMRI) data. Our analysis is applicable to both inter-subject and intra-subject spatial normalization.
ERPWAVERLAB: A toolbox for multi-channel analysis of time-frequency transformed event related potentials

**General information**
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- BFI (2010): BFI-level 1
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- BFI (2009): BFI-level 1
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- BFI (2008): BFI-level 1
- Scopus rating (2008): SJR 1.106 SNIP 0.89
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- Scopus rating (2005): SJR 1.019 SNIP 0.927
- Scopus rating (2004): SJR 1.092 SNIP 0.86
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Learning and clean-up in a large scale music database
We have collected a database of musical features from radio broadcasts (N > 100,000). The database poses a number of hard modeling challenges including: Segmentation problems and missing metadata. We describe our efforts towards cleaning the database using signal processing and machine learning tools.

Model selection for convolutive ICA with an application to spatiotemporal analysis of EEG
We present a new algorithm for maximum likelihood convolutive independent component analysis (ICA) in which components are unmixed using stable autoregressive filters determined implicitly by estimating a convolutive model of the mixing process. By introducing a convolutive mixing model for the components, we show how the order of the filters in the model can be correctly detected using Bayesian model selection. We demonstrate a framework for deconvolving a subspace of independent components in electroencephalography (EEG). Initial results suggest that in some cases, convolutive mixing may be a more realistic model for EEG signals than the instantaneous ICA model.
Multivariate strategies in functional magnetic resonance imaging
We discuss aspects of multivariate fMRI modeling, including the statistical evaluation of multivariate models and means for dimensional reduction. In a case study we analyze linear and non-linear dimensional reduction tools in the context of a 'mind reading' predictive multivariate fMRI model.
multivariate modeling, brain imaging

NMF on positron emission tomography

In positron emission tomography, kinetic modelling of brain tracer uptake, metabolism or binding requires knowledge of the cerebral input function. Traditionally, this is achieved with arterial blood sampling in the arm or as shown in (Liptrot, M, et al., 2004) by non-invasive K-means clustering. We propose another method to estimate time-activity curves (TAC) extracted directly from dynamic positron emission tomography (PET) scans by non-negative matrix factorization (NMF). Since the scaling of the basis curves is lost in the NMF the estimated TAC is scaled by a vector alpha which is calculated from the NMF solution. The method is tested on a [18F]-Altanserin tracer ligand data set consisting of 5 healthy subjects. The results from using K-means clustering and NMF are compared to a sampled arterial TAC. The comparison is done by calculating the correlation with the arterial sampled TAC.

General information
On affine non-negative matrix factorization
We generalize the non-negative matrix factorization (NMF) generative model to incorporate an explicit offset. Multiplicative estimation algorithms are provided for the resulting sparse affine NMF model. We show that the affine model has improved uniqueness properties and leads to more accurate identification of mixing and sources.

On the relevance of spectral features for instrument classification
Automatic knowledge extraction from music signals is a key component for most music organization and music information retrieval systems. In this paper, we consider the problem of instrument modelling and instrument classification from the rough audio data. Existing systems for automatic instrument classification operate normally on a relatively large number of features, from which those related to the spectrum of the audio signal are particularly relevant. In this paper, we confront two different models about the spectral characterization of musical instruments. The first model is related to the Mel frequency cepstrum coefficients (MFCCs), while the second leads to what we will refer to as harmonic representation (HR). Experiments on a large database of real instrument recordings show that the first model offers a more satisfactory characterization, and therefore MFCCs should be preferred to HR for instrument modelling/classification.
Proprioceptive evoked gamma oscillations

General information
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**Shifted Independent Component Analysis**

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**Shifted Non-negative Matrix Factorization**
Non-negative matrix factorization (NMF) has become a widely used blind source separation technique due to its part based representation and ease of interpretability. We currently extend the NMF model to allow for delays between sources and sensors. This is a natural extension for spectrometry data where a shift in onset of frequency profile can be induced by the Doppler effect. However, the model is also relevant for biomedical data analysis where the sources are given by compound intensities over time and the onset of the profiles have different delays to the sensors. A simple algorithm based on multiplicative updates is derived and it is demonstrated how the algorithm correctly identifies the components of a synthetic data set. Matlab implementation of the algorithm and a demonstration data set is available.

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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling  
Authors: Mørup, M. (Intern), Madsen, K. H. (Intern), Hansen, L. K. (Intern)
Temporal feature integration for music genre classification

Temporal feature integration is the process of combining all the feature vectors in a time window into a single feature vector in order to capture the relevant temporal information in the window. The mean and variance along the temporal dimension are often used for temporal feature integration, but they capture neither the temporal dynamics nor dependencies among the individual feature dimensions. Here, a multivariate autoregressive feature model is proposed to solve this problem for music genre classification. This model gives two different feature sets, the diagonal autoregressive (DAR) and multivariate autoregressive (MAR) features which are compared against the baseline mean-variance as well as two other temporal feature integration techniques. Reproducibility in performance ranking of temporal feature integration methods were demonstrated using two data sets with five and eleven music genres, and by using four different classification schemes. The methods were further compared to human performance. The proposed MAR features perform better than the other features at the cost of increased computational complexity.
Unveiling Music Structure Via PLSA Similarity Fusion

Nowadays there is an increasing interest in developing methods for building music recommendation systems. In order to get a satisfactory performance from such a system, one needs to incorporate as much information about songs similarity as possible; however, how to do so is not obvious. In this paper, we build on the ideas of the Probabilistic Latent Semantic Analysis (PLSA) that has been successfully used in the document retrieval community. Under this probabilistic framework, any song will be projected into a relatively low dimensional space of "latent semantics", in such a way that that all observed similarities can be satisfactorily explained using the latent semantics. Additionally, this approach significantly simplifies the song retrieval phase, leading to a more practical system implementation. The suitability of the PLSA model for representing music structure is studied in a simplified scenario consisting of 10,000 songs and two similarity measures among them. The results suggest that the PLSA model is a useful framework to combine different sources of information, and provides a reasonable space for song representation.
Independent Component Analysis in a convoluted world

This thesis is about convolutive ICA with application to EEG. Two methods for convolutive ICA are proposed. One method, the CICAP algorithm, uses a linear predictor in order to formulate the convolutive ICA problem in two steps: linear deconvolution followed by instantaneous ICA. The other method, the CICAAR algorithm, generalizes Infomax ICA to include the case of convolutive mixing. One advantage to the CICAAR algorithm is that Bayesian model selection is made possible, and in particular, it is possible to select the optimal order of the filters in a convolutive mixing model. A protocol for detecting the optimal dimensions is proposed, and verified in a simulated data set. The role of instantaneous ICA in context of EEG is described in physiological terms, and in particular the nature of dipolar ICA components is described. It is showed that instantaneous ICA components of EEG lacks independence when time lags are taken into consideration. The CICAAR algorithm is shown to be able to remove the delayed temporal dependencies in a subset of ICA components, thus making the components "more independent". A general recipe for ICA analysis of EEG is proposed: first decompose the data using instantaneousICA, then select a physiologically interesting subspace, then remove the delayed temporal dependencies among the instantaneous ICA components by using convolutive ICA. By Bayesian model selection, in a real world EEG data set, it is shown that convolutive ICA is a better model for EEG than instantaneous ICA.

Music Genre Classification Systems - A Computational Approach

Automatic music genre classification is the classification of a piece of music into its corresponding genre (such as jazz or rock) by a computer. It is considered to be a cornerstone of the research area Music Information Retrieval (MIR) and closely linked to the other areas in MIR. It is thought that MIR will be a key element in the processing, searching and retrieval of digital music in the near future. This dissertation is concerned with music genre classification systems and in particular systems which use the raw audio signal as input to estimate the corresponding genre. This is in contrast to systems which use e.g. a symbolic representation or textual information about the music. The approach to music genre classification systems has here been system-oriented. In other words, all the different aspects of the systems have been considered and it is emphasized that the systems should be applicable to ordinary real-world music collections. The considered music genre classification systems can basically be seen as a feature representation of the song followed by a classification system which predicts the genre. The feature representation is here split into a Short-time feature extraction part followed by Temporal feature integration which combines the (multivariate) time-series of short-time feature vectors into feature vectors on a larger time scale. Several different short-time features with 10-40 ms frame sizes have been examined and ranked according to their significance in music genre classification. A Consensus sensitivity analysis method was proposed for feature ranking. This method has the advantage of being able to combine the sensitivities over several resamplings into a single ranking. The main efforts have been in temporal feature integration. Two general
frameworks have been proposed; the Dynamic Principal Component Analysis model as well as the Multivariate Autoregressive Model for temporal feature integration. Especially the Multivariate Autoregressive Model was found to be successful and outperformed a selection of state-of-the-art temporal feature integration methods. For instance, an accuracy of 48% was achieved in comparison to 57% for the human performance on an 11-genre problem. A selection of classifiers were examined and compared. We introduced Cooccurrence models for music genre classification. These models include the whole song within a probabilistic framework which is often an advantage compared to many traditional classifiers which only model the individual feature vectors in a song.

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Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Ahrendt, P. (Intern), Hansen, L. K. (Intern)
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**Temporal Feature Integration for Music Organisation**
This Ph.D. thesis focuses on temporal feature integration for music organisation. Temporal feature integration is the process of combining all the feature vectors of a given time-frame into a single new feature vector in order to capture relevant information in the frame. Several existing methods for handling sequences of features are formulated in the temporal feature integration framework. Two datasets for music genre classification have been considered as valid test-beds for music organisation. Human evaluations of these, have been obtained to access the subjectivity on the datasets. Temporal feature integration has been used for ranking various short-time features at different time-scales. This include short-time features such as the Mel frequency cepstral coefficients (MFCC), linear predicting coding coefficients (LPC) and various MPEG-7 short-time features. The ‘consensus sensitivity ranking’ approach is proposed for ranking the short-time features at larger time-scales according to their discriminative power in a music genre classification task. The multivariate AR (MAR) model has been proposed for temporal feature integration. It effectively models local dynamical structure of the short-time features. Different kernel functions such as the convolutive kernel, the product probability kernel and the symmetric Kullback Leibler divergence kernel, which measures similarity between frames of music have been investigated for aiding temporal feature integration in music organisation. A special emphasis is put on the product probability kernel for which the MAR model is derived in closed form. A thorough investigation, using robust machine learning methods, of the MAR model on two different music genre classification datasets, shows a statistical significant improvement using this model in comparison to existing temporal feature integration models. This improvement was more pronounced for the larger and more difficult dataset. Similar findings where observed using the MAR model in a product probability kernel. The MAR model clearly outperformed the other investigated density models: the multivariate Gaussian model and the Gaussian mixture model.

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Approaches to better context modeling and categorization

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Authors: Madsen, R. E. (Intern), Hansen, L. K. (Intern), Larsen, J. (Intern)
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Source-ID: 185929
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Tomographic reconstruction using anatomy and regularization

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Publication: Research › Ph.D. thesis – Annual report year: 2006

Adaptive regularization of noisy linear inverse problems

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A functional meta-analytic atlas with non-negative partial least squares

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A functional meta-analytic atlas with non-negative partial least squares

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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
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Publication: Research - peer-review › Article in proceedings – Annual report year: 2006

A Genre Classification Plug-in for Data Collection
This demonstration illustrates how the methods developed in the MIR community can be used to provide real-time feedback to music users. By creating a genre classifier plug-in for a popular media player we present users with relevant information as they play their songs. The plug-in can furthermore be used as a data collection platform. After informed consent from a selected set of users the plug-in will report on music consumption behavior back to a central server.

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Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Lehn-Schiøler, T. (Intern), Arenas-Garcia, J. (Ekstern), Petersen, K. B. (Ekstern), Hansen, L. K. (Intern)
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Blind separation of more sources than sensors in convolutive mixtures
We demonstrate that blind separation of more sources than sensors can be performed based solely on the second order statistics of the observed mixtures. This a generalization of well-known robust algorithms that are suited for equal number of sources and sensors. It is assumed that the sources are non-stationary and sparsely distributed in the time-frequency plane. The mixture model is convolutive, i.e. acoustic setups such as the cocktail party problem are contained. The limits of identifiability are determined in the framework of the PARAFAC model. In the experimental section, it is demonstrated that real room recordings of 3 speakers by 2 microphones can be separated using the method.

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Data mining a functional neuroimaging database for functional segregation in brain regions

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Authors: Nielsen, F. Å. (Intern), Balslev, D. (Ekstern), Hansen, L. K. (Intern)
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Editor: Olsen, S. I.
Main Research Area: Technical/natural sciences
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Decomposing the time-frequency representation of EEG using non-negative matrix and multi-way factorization

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Publication date: 2006

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Publication: Research - peer-review › Report – Annual report year: 2006

Detecting Weather Radar Clutter by Information Fusion With Satellite Images and Numerical Weather Prediction Model

Output
A method for detecting clutter in weather radar images by information fusion is presented. Radar data, satellite images, and output from a numerical weather prediction model are combined and the radar echoes are classified using supervised classification. The presented method uses indirect information on precipitation in the atmosphere from Meteosat-8 multispectral images and near-surface temperature estimates from the DMI-HIRLAM-S05 numerical weather prediction model. Alternatively, an operational nowcasting product called "Precipitating Clouds" based on Meteosat-8 input is used. A scale-space ensemble method is used for classification and the clutter detection method is illustrated on a case of severe sea clutter contaminated radar data. Detection accuracies above 90 % are achieved and using an ensemble classification method the error rate is reduced by 40 %.

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Detecting weather radar clutter using satellite-based nowcasting products

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Publication date: 2006

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ERPWAVELAB A toolbox for multi-channel analysis of time-frequency transformed event related potentials

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Extraction of time activity curves from positron emission tomography: K-means clustering or non-negative matrix factorization

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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Bodvarsson, B. (Ekstern), Morkebjerg, M. (Ekstern), Hansen, L. K. (Intern), Knudsen, G. (Ekstern), Svarer, C. (Ekstern)
fMRI Neuroinformatics

Functional magnetic resonance imaging (fMRI) generates vast amounts of data. The handling, processing, and analysis of fMRI data would be inconceivable without computer-based methods. fMRI neuroinformatics is concerned with research, development, and operation of these methods. Reconstruction, rudimentary analysis and visualization tools are implemented in software controlling modern MRI scanners. Research in advanced methods for analysis of subtle activation patterns, realistic physiological modeling, or for integration of data from multiple subjects etc., is the basis for a lively research field and has led to the development of a large number of tools.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Nielsen, F. Å. (Intern), Christensen, M. S. (Ekstern), Madsen, K. M. (Ekstern), Lund, T. E. (Ekstern), Hansen, L. K. (Intern)
Pages: 112-119
Publication date: 2006
Main Research Area: Technical/natural sciences

Publication information
Journal: IEEE Engineering in Medicine and Biology Magazine
Volume: 25
Issue number: 2
ISSN (Print): 0739-5175
Ratings:
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.191 SNIP 0.26 CiteScore 0.41
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.295 SNIP 0.52 CiteScore 0.42
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.262 SNIP 0.463 CiteScore 0.47
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.441 SNIP 1.125 CiteScore 0.48
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.317 SNIP 0.892 CiteScore 0.31
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.321 SNIP 1.222 CiteScore 0.21
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.331 SNIP 1.121
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.3 SNIP 1.094
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.265 SNIP 0.831
Scopus rating (2007): SJR 0.364 SNIP 1.083
Scopus rating (2006): SJR 0.28 SNIP 1.266
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.273 SNIP 1.186
Scopus rating (2004): SJR 0.362 SNIP 1.192
Growth-rate regulated genes have profound impact on interpretation of transcriptome profiling in Saccharomyces cerevisiae

General information
State: Published
Organisations: Department of Systems Biology, Cognitive Systems, Department of Informatics and Mathematical Modeling, Center for Biological Sequence Analysis, Center for Microbial Biotechnology
Authors: Regenberg, B. (Intern), Grotkjær, T. (Intern), Winther, O. (Intern), Fausbøll, A. (Intern), Åkesson, M. (Ekstern), Bro, C. (Intern), Hansen, L. K. (Intern), Brunak, S. (Intern), Nielsen, J. (Intern)
Pages: R107
Publication date: 2006
Main Research Area: Technical/natural sciences

Publication information
Journal: Genome Biology (Online Edition)
Volume: 7
ISSN (Print): 1474-760X
Ratings:
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 10.484 SNIP 2.846 CiteScore 11.12
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 8.65 SNIP 2.608 CiteScore 9.08
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 8.188 SNIP 2.224 CiteScore 8.34
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 8.557 SNIP 2.418 CiteScore 8.55
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 7.9 SNIP 2.372 CiteScore 8.14
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 5.989 SNIP 1.973 CiteScore 6.69
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
Identification of non-linear models of neural activity in fMRI

Non-linear hemodynamic models express the BOLD signal as a nonlinear, parametric functional of the temporal sequence of local neural activity. Several models have been proposed for this neural activity. We identify one such parametric model by estimating the distribution of its parameters. These distributions are themselves stochastic, therefore we estimate their variance by epoch based leave-one-out cross validation, using a Metropolis-Hastings algorithm for sampling of the posterior parameter distribution.

General information

State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Jacobsen, D. J. (Intern), Madsen, K. H. (Intern), Hansen, L. K. (Intern)
Pages: 952-955
Publication date: 2006

Host publication information

Title of host publication: 3rd IEEE International Symposium on Biomedical Imaging: Macro to Nano
Publisher: IEEE
ISBN (Print): 0-7803-9576-X
Main Research Area: Technical/natural sciences
model comparison, BOLD fMRI, Bayes, learning, MCMC
Electronic versions:
Jacobsen.pdf
DOIs:
10.1109/ISBI.2006.1625077

Bibliographical note

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Source: orbit
Source-ID: 191546
Publication: Research - peer-review › Article in proceedings – Annual report year: 2006

Linear State-space Models for Blind Source Separation
MIRANDA - Music Information Retrieval And Data Acquisition

In this report we present a music data harvesting system based on a plug-in for a popular music player. When a user is playing a song using the plug-in, information about the song is anonymously submitted to a server. The data gathered using MIRANDA is intended to be released to the MIR community. We argue that even though content-based data is of
interest to the community, also meta data and usage data can be important for research in music similarity.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Lehn-Schiøler, T. (Intern), Petersen, K. B. (Ekstern), Hansen, L. K. (Intern)
Publication date: 2006

Publication information
Original language: English
Main Research Area: Technical/natural sciences
data collection, Sound search
Source: orbit
Source-ID: 191724
Publication: Research - peer-review › Report – Annual report year: 2006

Model structure selection in convolutive mixtures
General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Dyrholm, M. (Intern), Makeig, S. (Ekstern), Hansen, L. K. (Intern)
Publication date: 2006

Host publication information
Title of host publication: 6th International Conference on Independent Component Analysis and Blind Source Separation
Main Research Area: Technical/natural sciences
Electronic versions:
imm3880.pdf
Links:
http://www2.imm.dtu.dk/pubdb/p.php?3880
Source: orbit
Source-ID: 191529
Publication: Research - peer-review › Article in proceedings – Annual report year: 2006

Model structure selection in convolutive mixtures
The CICAAR algorithm (convolutive independent component analysis with an auto-regressive inverse model) allows separation of white (i.i.d) source signals from convolutive mixtures. We introduce a source color model as a simple extension to the CICAAR which allows for a more parsimonious representation in many practical mixtures. The new filter-CICAAR allows Bayesian model selection and can help answer questions like: ‘Are we actually dealing with a convolutive mixture?’. We try to answer this question for EEG data.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Dyrholm, M. (Intern), Makeig, S. (Ekstern), Hansen, L. K. (Intern)
Pages: 74-81
Publication date: 2006
Main Research Area: Technical/natural sciences

Publication information
Journal: Lecture Notes in Computer Science
Volume: 3889
ISSN (Print): 0302-9743
Ratings:
BFI (2017): BFI-level 1
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.315 SNIP 0.552 CiteScore 0.67
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.328 SNIP 0.618 CiteScore 0.37
BFI (2014): BFI-level 1
We discuss the cognitive components of speech at different time scales. We investigate cognitive features of speech including phoneme, gender, height, speaker identity. Integration by feature stacking based on short time MFCCs. Our hypothesis is basically ecological: we assume that features that essentially independent in a reasonable ensemble can be efficiently coded using a sparse independent component representation. This means that supervised and unsupervised learning should result in similar representations. We do indeed find that supervised and unsupervised learning of a model based on identical representations have closely corresponding abilities as classifiers.

**General information**

State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Feng, L. (Intern), Hansen, L. K. (Intern)
Publication date: 2006
Main Research Area: Technical/natural sciences
Unsupervised learning, Mixture of factor analyzers, Supervised learning, Feature stacking
On Low-level Cognitive Components of Speech

In this paper we analyze speech for low-level cognitive features using linear component analysis. We demonstrate generalizable component ‘fingerprints’ stemming from both phonemes and speakers. Phonemes are fingerprints found at the basic analysis window time scale (20 msec), while speaker ‘voiceprints’ are found at time scales around 1000 msec. The analysis is based on homomorphic filtering features and energy based sparsification.
Parallel Factor Analysis as an exploratory tool for wavelet transformed event-related EEG

In the decomposition of multi-channel EEG signals, principal component analysis (PCA) and independent component analysis (ICA) have widely been used. However, as both methods are based on handling two-way data, i.e. two-dimensional matrices, multi-way methods might improve the interpretation of frequency transformed multi-channel EEG of channel x frequency x time data. The multi-way decomposition method Parallel Factor (PARAFAC), also named Canonical Decomposition (CANDECOMP), was recently used to decompose the wavelet transformed ongoing EEG of channel x frequency x time (Miwakeichi, F., Martinez-Montes, E., Valdes-Sosa, P.A., Nishiyama, N., Mizuhara, H., Yamaguchi, Y., 2004. Decomposing EEG data into space-time-frequency components using parallel factor analysis. Neuroimage 22, 1035-1045). In this article, PARAFAC is used for the first time to decompose wavelet transformed event-related EEG given by the inter-trial phase coherence (ITPC) encompassing ANOVA analysis of differences between conditions and 5-way analysis of channel x frequency x time x subject x condition. A flow chart is presented on how to perform data exploration using the PARAFAC decomposition on multi-way arrays. This includes (A) channel x frequency x time 3-way arrays of F test values from a repeated measures analysis of variance (ANOVA) between two stimulus conditions; (B) subject-specific 3-way analyses; and (C) an overall 5-way analysis of channel x frequency x time x subject x condition. The PARAFAC decompositions were able to extract the expected features of a previously reported ERP paradigm: namely, a quantitative difference of coherent occipital gamma activity between conditions of a visual paradigm. Furthermore, the method revealed a qualitative difference which has not previously been reported. The PARAFAC decomposition of the 3-way array of ANOVA F test values clearly showed the difference of regions of interest across modalities, while the 5-way analysis enabled visualization of both quantitative and qualitative differences. Consequently, PARAFAC is a promising data exploratory tool in the analysis of the wavelets transformed event-related EEG.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Mørup, M. (Intern), Hansen, L. K. (Intern), Hermann, C. S. (Ekstern), Parnas, J. (Ekstern), Arnfred, S. M. (Ekstern)
Pages: 938-947
Publication date: 2006
Main Research Area: Technical/natural sciences

Publication information
Journal: NeuroImage
Volume: 29
Issue number: 3
ISSN (Print): 1053-8119
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 3.823 SNIP 1.752 CiteScore 6.31
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 4.48 SNIP 1.84 CiteScore 6.71
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 4.201 SNIP 2.029 CiteScore 6.9
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 4.376 SNIP 2.026 CiteScore 7.06
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 3.922 SNIP 1.937 CiteScore 6.86
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 3.626 SNIP 1.81 CiteScore 6.31
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Phonemes as short time cognitive components

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Feng, L. (Intern), Hansen, L. K. (Intern)
Pages: 869-872
Publication date: 2006

Host publication information
Title of host publication: International Conference on Acoustics, Speech and Signal Processing (ICASSP'06)
Main Research Area: Technical/natural sciences
Electronic versions:
imm4058.pdf
Links:
http://www2.imm.dtu.dk/pubdb/p.php?4058
Source: orbit
Source-ID: 191531
Publication: Research - peer-review › Article in proceedings – Annual report year: 2006

Pitch Based Sound Classification
A sound classification model is presented that can classify signals into music, noise and speech. The model extracts the pitch of the signal using the harmonic product spectrum. Based on the pitch estimate and a pitch error measure, features are created and used in a probabilistic model with soft-max output function. Both linear and quadratic inputs are used. The model is trained on 2 hours of sound and tested on publicly available data. A test classification error below 0.05 with 1 s classification windows is achieved. Further more it is shown that linear input performs as well as a quadratic, and that
even though classification gets marginally better, not much is achieved by increasing the window size beyond 1 s.

Robust multi-scale clustering of large DNA microarray datasets with the consensus algorithm.
Motivation: Hierarchical and relocation clustering (e.g. K-means and self-organizing maps) have been successful tools in the display and analysis of whole genome DNA microarray expression data. However, the results of hierarchical clustering are sensitive to outliers, and most relocation methods give results which are dependent on the initialization of the algorithm. Therefore, it is difficult to assess the significance of the results. We have developed a consensus clustering algorithm, where the final result is averaged over multiple clustering runs, giving a robust and reproducible clustering, capable of capturing small signal variations. The algorithm preserves valuable properties of hierarchical clustering, which is useful for visualization and interpretation of the results. Results: We show for the first time that one can take advantage of multiple clustering runs in DNA microarray analysis by collecting re-occurring clustering patterns in a co-occurrence matrix. The results show that consensus clustering obtained from clustering multiple times with Variational Bayes Mixtures of Gaussians or K-means significantly reduces the classification error rate for a simulated dataset. The method is flexible and it is possible to find consensus clusters from different clustering algorithms. Thus, the algorithm can be used as a framework to test in a quantitative manner the homogeneity of different clustering algorithms. We compare the method with a number of state-of-the-art clustering methods. It is shown that the method is robust and gives low classification error rates for a realistic, simulated dataset. The algorithm is also demonstrated for real datasets. It is shown that more biological meaningful transcriptional patterns can be found without conservative statistical or fold-change exclusion of data. Availability: Matlab source code for the clustering algorithm ClusterLustre, and the simulated dataset for testing are available upon request from T.G. and O.W. Contact: tg@biocentrum.dtu.dk and owi@imm.dtu.dk Supplementary information: http://www.cmb.dtu.dk/
Segmentation of Age-Related White-Matter Changes in a large-scale, multi-centre study

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Dyrby, T. B. (Intern), Rostrup, E. (Ekstern), Straaen, E. C. W. V. (Ekstern), Barkhof, F. (Ekstern), Ropele, S. (Ekstern), Hansen, L. K. (Intern), Waldemar, G. (Ekstern)
Publication date: 2006

Host publication information
Title of host publication: Proceeding International Society for Magnetic Resonance in Medicine : On the behalf on the LADIS
Main Research Area: Technical/natural sciences
Conference: 14th Scientific Meeting and Exhibition of International Society for Magnetic Resonance in Medicine, Seattle, WA, United States, 06/05/2006 - 06/05/2006
Sound Search Engine Concept
Sound search is provided by the major search engines, however, indexing is text based, not sound based. We will establish a dedicated sound search services with based on sound feature indexing. The current demo shows the concept of the sound search engine. The first engine will be released June 2006.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Lehmann, S. (Ekstern), Petersen, K. B. (Ekstern), Lehn-Schiøler, T. (Intern), Hansen, L. K. (Intern), Larsen, J. (Intern), Sigurdsson, S. (Intern), Garcia, J. (Intern)
Publication date: 2006

Publication information
Original language: English
Place of publication: Richard Petersens Plads, Building 321, 2800 Kongens Lyngby, Denmark
Publisher: Informatics and Mathematical Modelling, Technical University of Denmark
Main Research Area: Technical/natural sciences
Sound search concept
Links:
http://www.intelligentsound.org/demos/conceptdemo.swf
Source: orbit
Source-ID: 202505
Publication: Research › Interactive production – Annual report year: 2006

Sparse kernel orthonormalized PLS for feature extraction in large datasets
In this paper we are presenting a novel multivariate analysis method for large scale problems. Our scheme is based on a novel kernel orthonormalized partial least squares (PLS) variant for feature extraction, imposing sparsity constrains in the solution to improve scalability. The algorithm is tested on a benchmark of UCI data sets, and on the analysis of integrated short-time music features for genre prediction. The upshot is that the method has strong expressive power even with rather few features, is clearly outperforming the ordinary kernel PLS, and therefore is an appealing method for feature extraction of labelled data.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Arenas-García, J. (Ekstern), Petersen, K. B. (Ekstern), Hansen, L. K. (Intern)
Publication date: 2006

Host publication information
Title of host publication: NIPS 2006
Main Research Area: Technical/natural sciences
Conference: NIPS 2006, 01/01/2006
Electronic versions: imm4865.pdf
Links:
http://www2.imm.dtu.dk/pubdb/p.php?4865
Source: orbit
Source-ID: 191518
Publication: Research - peer-review › Article in proceedings – Annual report year: 2006

Structure Learning by Pruning In Independent Component Analysis
We discuss pruning as a means of structure learning in independent component analysis. Sparse models are attractive in both signal processing and in analysis of abstract data, they can assist model interpretation, generalizability and reduce computation. We derive the relevant saliency expressions and compare with magnitude based pruning and Bayesian sparsification. We show in simulations that pruning is able to identify underlying sparse structures without prior knowledge on the degree of sparsity. We find that for ICA magnitude based pruning is as efficient as saliency based methods and Bayesian methods, for both small and large samples. The Bayesian information criterion (BIC) seems to outperform both AIC and test sets as tools for determining the optimal degree of sparsity.
Unsupervised Speaker Change Detection for Broadcast News Segmentation

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Jørgensen, K. W. (Intern), Mølgaard, L. L. (Intern), Hansen, L. K. (Intern)
Publication date: 2006

Host publication information
Title of host publication: Eusipco
Main Research Area: Technical/natural sciences
Electronic versions:
imm4416.pdf
Links:
http://www2.imm.dtu.dk/pubdb/p.php?4416
Source: orbit
Source-ID: 191548
Publication: Research - peer-review › Article in proceedings – Annual report year: 2006

A harmonic excitation state-space approach to blind separation of speech

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Olsson, R. K. (Intern), Hansen, L. K. (Intern)
Pages: 993-1000
Publication date: 2005

Host publication information
Title of host publication: Advances in Neural Information Processing Systems
Publisher: MIT Press
Main Research Area: Technical/natural sciences
Electronic versions:
imm3340.pdf
Links:
http://www2.imm.dtu.dk/pubdb/p.php?3340
Source: orbit
Source-ID: 185731
Publication: Research - peer-review › Article in proceedings – Annual report year: 2005

A New Database for Speaker Recognition

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Feng, L. (Intern), Hansen, L. K. (Intern)
Publication date: 2005
Deformable Models for Eye Tracking

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Vester-Christensen, M. (Intern), Leimberg, D. (Ekstern), Ersbøll, B. K. (Intern), Hansen, L. K. (Intern)
Publication date: 2005

Host publication information
Title of host publication: Den 14. Danske Konference i Mønstergenkendelse og Billedanalyse
Main Research Area: Technical/natural sciences
Electronic versions: imm3900.pdf
Source: orbit
Source-ID: 185782
Publication: Research › Article in proceedings – Annual report year: 2005

Heuristics for speeding up gaze estimation

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Leimberg, D. (Ekstern), Vester-Christensen, M. (Intern), Ersbøll, B. K. (Intern), Hansen, L. K. (Intern)
Publication date: 2005

Host publication information
Title of host publication: Proc. Svenska Symposium i Bildanalys, SSBA 2005, Malmø, Sweden
Publisher: SSBA
Main Research Area: Technical/natural sciences
Electronic versions: imm3603.pdf
Source: orbit
Source-ID: 185777
Publication: Research › Article in proceedings – Annual report year: 2005

Making Faces - State-Space Models Applied to Multi-Modal Signal Processing

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Lehn-Schiøler, T. (Intern), Hansen, L. K. (Intern)
Publication date: 2005

Publication information
Original language: English
Mapping from Speech to Images Using Continuous State Space Models

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Lehn-Schiøler, T. (Intern), Hansen, L. K. (Intern), Larsen, J. (Intern)
Publication date: 2005

Host publication information
Title of host publication: Lecture Notes in Computer Science
Publisher: Springer
Main Research Area: Technical/natural sciences
Electronic versions: imm3142.pdf
Links:
http://www2.imm.dtu.dk/pubdb/p.php?3142
Source: orbit
Source-ID: 185711
Publication: Research - peer-review › Article in proceedings – Annual report year: 2005

Minning the posterior cingulate: Segregation between memory and pain components
We present a general method for automatic meta-analyses in neuroscience and apply it on text data from published functional imaging studies to extract main functions associated with a brain area --- the posterior cingulate cortex. Abstracts from PubMed are downloaded, words extracted and converted to a bag-of-words matrix representation. The combined data is analyzed with hierarchical non-negative matrix factorization. We find that the prominent themes in the PCC corpus are episodic memory retrieval and pain. We further characterize the distribution in PCC of the Talairach coordinates available in some of the articles. This shows a tendency to functional segregation between memory and pain components where memory activations are predominantly in the caudal part and pain in the rostral part of PCC.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Nielsen, F. Å. (Intern), Balslev, D. (Ekstern), Hansen, L. K. (Intern)
Pages: 520-532
Publication date: 2005
Main Research Area: Technical/natural sciences

Publication information
Journal: NeuroImage
Volume: 27
Issue number: 3
ISSN (Print): 1053-8119
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 3.823 SNIP 1.752 CiteScore 6.31
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 4.48 SNIP 1.84 CiteScore 6.71
Web of Science (2015): Indexed yes
On Low-level Cognitive Components of Speech

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
On the Slow Convergence of EM and VBEM in Low-Noise Linear Models

We analyze convergence of the expectation maximization (EM) and variational Bayes EM (VBEM) schemes for parameter estimation in noisy linear models. The analysis shows that both schemes are inefficient in the low-noise limit. The linear model with additive noise includes as special cases independent component analysis, probabilistic principal component analysis, factor analysis, and Kalman filtering. Hence, the results are relevant for many practical applications.
Towards Cognitive Component Analysis

Cognitive component analysis (COCA) is here defined as the process of unsupervised grouping of data such that the ensuing group structure is well-aligned with that resulting from human cognitive activity. We have earlier demonstrated that independent components analysis is relevant for representing semantics, not only in text, but also in dynamic text (chat), images, and combinations of text and images. Here we further expand on the relevance of the ICA model for representing context, including two new analyzes of abstract data: social networks and musical features.
Towards emotion modeling based on gaze dynamics in generic interfaces

Datamining on distributed medical databases

This Ph.D. thesis focuses on clustering techniques for Knowledge Discovery in Databases. Various data mining tasks relevant for medical applications are described and discussed. A general framework which combines data projection and data mining and interpretation is presented. An overview of various data projection techniques is offered with the main stress on applied Principal Component Analysis. For clustering purposes, various Generalized Gaussian Mixture models are presented. Further the aggregated Markov model, which provides the cluster structure via the probabilistic decomposition of the Gram matrix, is proposed. Other data mining tasks, described in this thesis are outlier detection and the imputation of the missing data. The thesis presents two outlier detection methods based on the cumulative distribution and a special designated outlier cluster in connection with the Generalized Gaussian Mixture model. Two models for imputation of the missing data, namely the K-nearest neighbor and a Gaussian model are suggested. With the purpose of interpreting a cluster structure two techniques are developed. If cluster labels are available then the cluster understanding via the confusion matrix is available. If data is unlabeled then it is possible to generate keywords (in case of textual data) or key-patterns, as an informative representation of the obtained clusters. The methods are applied on simple artificial data sets, as well as collections of textual and medical data. In Danish: Denne ph.d.-afhandling fokuserer på klyngeanalyseteknikker til ekstraktion af viden fra databaser. Afhandling præsenterer og diskuterer forskellige datamining problemstillinger for medicinske applikationer. Specielt præsenteres en generel struktur der kombinerer data-projektion, datamining og automatisk fortolkning. Indenfor data-projektion gennemgås en række teknikker med speciel vægt på anvendt Principal Komponent Analyse. En række generaliserede Gaussisk miksturmodeller foreslås til klyngeanalyse. Desuden foreslås en aggregatet Markov model, som estimerer klyngestrukturen via dekomposition af en sandsynlighedsbaseret Grammatrix. Herudover beskriver afhandlingen to andre datamining problemstillinger nemlig "outlier" detektor og imputering af manglende data. Afhandlinger præsenterer "outlier" detektionsmetoder. Dels baseret på akumulerede fordelinger, dels baseret på introduktion af en speciel "outlier" klynges i forbindelse med den generaliserede Gaussisk mikstur-model. Med hensyn til imputering af manglende data præsenteres to metoder baseret på en K-nærmeste-nabo eller en Gaussisk model antagelse. Der er udviklet to metoder til automatisk fortolkning af klyngestructuren. Nå klynges annoteringer "labels" er tilgængelige vil konfusionsmatricen danne grundlaget for fortolkningen. Hvis sådanne annoteringer ikke er tilgængelige, er det muligt at generere nøgleord (i tilfælde af tekst data) eller generelt nøgle-mønstre, som således bifører til fortolkning af klyngerne. De foreslåede metoder er testet på simple kunstige dataset såvel som kollektioner af tekst og medicinske data.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Assessing the reproducibility in sets of Talairach coordinates

CICAAR - Convolutive ICA with an Auto-Regressive Inverse Model

Convolutive ICA (c-ICA) captures complex spatio-temporal EEG activity
Defining a local arterial input function for perfusion MRI using independent component analysis

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Calamante, F. (Ekstern), Mørup, M. (Intern), Hansen, L. K. (Intern)
Pages: 789-797
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Main Research Area: Technical/natural sciences

Publication information
Journal: Magnetic Resonance in Medicine
Volume: 52
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Ratings:
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 1.867 SNIP 1.438 CiteScore 3.52
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 2.291 SNIP 1.48 CiteScore 3.54
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.952 SNIP 1.39 CiteScore 3.32
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.959 SNIP 1.44 CiteScore 3.46
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 2.072 SNIP 1.549 CiteScore 3.61
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.056 SNIP 1.476 CiteScore 3.45
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 2.272 SNIP 1.612
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 2.278 SNIP 1.564
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 2.382 SNIP 1.512
Web of Science (2008): Indexed yes
Detection of skin cancer by classification of Raman spectra

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Sigurdsson, S. (Intern), Philipsen, P. A. (Intern), Hansen, L. K. (Intern), Larsen, J. (Intern), Gniadecka, M. (Ekstern), Wulf, H. C. (Ekstern)
Pages: 1784 - 1793
Publication date: 2004
Main Research Area: Technical/natural sciences

Publication information
Journal: I E E E Transactions on Biomedical Engineering
Volume: 51
Issue number: 10
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Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 1.214 SNIP 1.995 CiteScore 4.2
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.132 SNIP 2.083 CiteScore 3.74
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 0.84 SNIP 1.973 CiteScore 3.34
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.081 SNIP 2.073 CiteScore 3.53
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 0.816 SNIP 1.706 CiteScore 3
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Enhanced Context Recognition by Sensitivity Pruned Vocabularies

Language independent `bag-of-words' representations are surprisingly effective for text classification. The generic BOW approach is based on a high-dimensional vocabulary which may reduce the generalization performance of subsequent classifiers, e.g., based on ill-posed principal component transformations. In this communication our aim is to study the effect of sensitivity based pruning of the bag-of-words representation. We consider neural network based sensitivity maps for determination of term relevancy, when pruning the vocabularies. With reduced vocabularies documents are classified using a latent semantic indexing representation and a probabilistic neural network classifier. Pruning the vocabularies to approximately 20% of the original size, we find consistent context recognition enhancement for two mid size data-sets for a range of training set sizes. We also study the applicability of the sensitivity measure for automated keyword generation.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Madsen, R. E. (Intern), Sigurdsson, S. (Intern), Hansen, L. K. (Intern)
Pages: 483-486
Publication date: 2004

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Title of host publication: Proceedings of 17th International Conference on Pattern Recognition (ICPR 2004)
Main Research Area: Technical/natural sciences
Electronic versions: imm2893.pdf
Links:
Source: orbit
Source-ID: 154634
Publication: Research - peer-review › Article in proceedings – Annual report year: 2004
Estimating the number of sources in a noisy convolutive mixture using BIC

The number of source signals in a noisy convolutive mixture is determined based on the exact log-likelihoods of the candidate models. In (Olsson and Hansen, 2004), a novel probabilistic blind source separator was introduced that is based solely on the time-varying second-order statistics of the sources. The algorithm, known as ‘KaBSS’, employs a Gaussian linear model for the mixture, i.e. AR models for the sources, linear mixing filters and a white Gaussian noise model. Using an EM algorithm, which invokes the Kalman smoother in the E-step, all model parameters are estimated and the exact posterior probability of the sources conditioned on the observations is obtained. The log-likelihood of the parameters is computed exactly in the process, which allows for model evidence comparison assisted by the BIC approximation. This is used to determine the activity pattern of two speakers in a convolutive mixture of speech signals.

Finding related functional neuroimaging volumes

We describe a content-based image retrieval technique for finding related functional neuroimaging experiments by voxelization of sets of stereotactic coordinates in Talairach space, comparing the volumes and reporting related volumes in a sorted list. Voxelization is accomplished by convolving each coordinate with a Gaussian kernel. The scheme allows us to compare experiments represented as either lists of coordinates or volumes, and we introduce alternative entrances to databases by image-based indices constructed via novelty measures and singular value decomposition.

General information

State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Olsson, R. K. (Intern), Hansen, L. K. (Intern)
Pages: 618-625
Publication date: 2004
Learning with Uncertainty - Gaussian Processes and Relevance Vector Machines

This thesis is concerned with Gaussian Processes (GPs) and Relevance Vector Machines (RVMs), both of which are particular instances of probabilistic linear models. We look at both models from a Bayesian perspective, and are forced to adopt an approximate Bayesian treatment to learning for two reasons. The first reason is the analytical intractability of the full Bayesian treatment and the fact that we in principle do not want to resort to sampling methods. The second reason, which incidentally justifies our not wanting to sample, is that we are interested in computationally efficient models. Computational efficiency is obtained through sparseness: sparse linear models have a significant number of their weights set to zero. For the RVM, which we treat in Chap. 2, we show that it is precisely the particular choice of Bayesian approximation that enforces sparseness. Probabilistic models have the important property of producing predictive distributions instead of point predictions. We also show that the resulting sparse probabilistic model implies counterintuitive priors over functions, and ultimately inappropriate predictive variances; the model is more certain about its predictions, the further away from the training data. We propose the RVM*, a modified RVM that provides signi cantly better predictive uncertainties. RVMs happen to be a particular case of GPs, the latter having superior performance and being non-sparse non-parametric models. For completeness, in Chap. 3 we study a particular family of approximations to Gaussian Processes, Reduced Rank Gaussian Processes (RRGPs), which take the form of nite extended linear models; we show that GPs are in general equivalent to in nite extended linear models. We also show that RRGPs result in degenerate GPs, which suffer, like RVMs, of inappropriate predictive variances. We solve this problem in by proposing a modi cation of the classic RRGP approach, in the same guise as the RVM*. In the last part of this thesis we move on to the problem of uncertainty in the inputs. Indeed, these were until now considered deterministic, as it is common use. We derive the equations for predicting at an uncertain input with GPs and RVMs, and use this to propagate the uncertainty in recursive multi-step ahead time-series predictions. This allows us to obtain sensible predictive uncertainties when recursively predicting k-steps ahead, while standard approaches that ignore the accumulated uncertainty are way overconfident. Finally we explore a much harder problem: that of training with uncertain inputs. We explore approximating the full Bayesian treatment, which implies an analytically intractable integral. We propose two preliminary approaches. The first one tries to "guess" the unknown "true" inputs, and requires careful optimisation to avoid overfitting. It also requires
prior knowledge of the output noise, which is limiting. The second approach consists in sampling from the inputs posterior, and optimising the hyperparameters. Sampling has the effect of severely incrementing the computational cost, which again is limiting. However, the success in toy experiments is exciting, and should motivate future research.

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Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Candela, J. Q. (Ekstern), Hansen, L. K. (Intern)
Publication date: 2004

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Electronic versions:
imm3237.ps
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Links:
Source: orbit
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Publication: Research › Ph.D. thesis – Annual report year: 2004

Melanoma Diagnosis by Raman Spectroscopy and Neural Networks: Structure Alterations in Proteins and Lipids in Intact Cancer Tissue

General information
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Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Gniadecka, M. (Ekstern), Philipsen, P. A. (Intern), Sigurdsson, S. (Intern), Wessel, S. (Ekstern), Nielsen, O. F. (Ekstern), Christensen, D. H. (Ekstern), Hercogova, J. (Ekstern), Rossen, K. (Ekstern), Thomsen, H. K. (Ekstern), Gniadecki, R. (Ekstern), Hansen, L. K. (Intern), Wulf, H. C. (Ekstern)
Pages: 443-449
Publication date: 2004
Main Research Area: Technical/natural sciences

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Journal: Journal of Investigative Dermatology
Volume: 122
Issue number: 2
Original language: English
Links:
Source: orbit
Source-ID: 154541
Publication: Research - peer-review › Journal article – Annual report year: 2004

Meta-analytic clustering of molecular neuroimaging studies

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Nielsen, F. Å. (Intern), Svarer, C. (Ekstern), Hansen, L. K. (Intern), Knudsen, G. M. (Ekstern)
Publication date: 2004

Host publication information
Title of host publication: Neurodag 2004
Main Research Area: Technical/natural sciences
Electronic versions:
imm3519.pdf
Links:
Source: orbit
Source-ID: 154701
Publication: Research - peer-review › Article in proceedings – Annual report year: 2004
Meta-analytic clustering of molecular neuroimaging studies

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Nielsen, F. Å. (Intern), Svarer, C. (Ekstern), Hansen, L. K. (Intern), Knudsen, G. M. (Ekstern)
Publication date: 2004
Main Research Area: Technical/natural sciences
k-means, meta-analysis, molecular imaging, positron emission tomography, neuroimaging, clustering
Electronic versions:
imm4757.pdf
Source: orbit
Source-ID: 201255
Publication: Research › Poster – Annual report year: 2004

Mining for associations between text and brain activation in a functional neuroimaging database
We describe a method for mining a neuroimaging database for associations between text and brain locations. The objective is to discover association rules between words indicative of cognitive function as described in abstracts of neuroscience papers and sets of reported stereotactic Talairach coordinates. We invoke a simple probabilistic framework in which kernel density estimates are used to model distributions of brain activation foci conditioned on words in a given abstract. The principal associations are found in the joint probability density between words and voxels. We show that the statistically motivated associations are well aligned with general neuroscientific knowledge.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Nielsen, F. Å. (Intern), Hansen, L. K. (Intern), Balslev, D. (Ekstern)
Pages: 369-379
Publication date: 2004
Main Research Area: Technical/natural sciences

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Journal: Neuroinformatics
Volume: 2
Issue number: 4
ISSN (Print): 1539-2791
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BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 1.35 SNIP 1.086 CiteScore 2.72
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.31 SNIP 0.849 CiteScore 2.35
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.156 SNIP 1.022 CiteScore 2.74
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.259 SNIP 1.131 CiteScore 2.73
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.506 SNIP 1.402 CiteScore 2.93
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.221 SNIP 1.111 CiteScore 2.01
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.967 SNIP 0.957
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.948 SNIP 0.987
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.393 SNIP 1.165
Scopus rating (2007): SJR 1.562 SNIP 1.527
Scopus rating (2006): SJR 1.311 SNIP 1.203
Scopus rating (2005): SJR 1.384 SNIP 1.147
Scopus rating (2004): SJR 1.409 SNIP 0.899
Web of Science (2004): Indexed yes
Original language: English
data mining, meta-analysis, information storage and retrieval, databases, brain mapping, magnetic resonance imaging, data interpretation, neuroimaging, positron-emission tomography, statistical
Source: orbit
Source-ID: 196990
Publication: Research - peer-review › Journal article – Annual report year: 2004

Mining Posterior Cingulate

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Nielsen, F. Å. (Intern), Balslev, D. (Ekstern), Hansen, L. K. (Intern)
Publication date: 2004

Host publication information
Main Research Area: Technical/natural sciences
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Source: orbit
Source-ID: 154703
Publication: Research - peer-review › Article in proceedings – Annual report year: 2004

Networking real and virtual brains

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Hansen, L. K. (Intern)
Pages: 166-175
Publication date: 2004

Host publication information
Title of host publication: BRIDGING from technology to society : DTU 1829-2004 - 175 år
Place of publication: Kgs.Lyngby
Publisher: Technical University of Denmark
Editors: Stubkjær, K., Kortenbach, T.
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 154724
Publication: Research - peer-review › Book chapter – Annual report year: 2004

Optimizing the fMRI data-processing pipeline using prediction and reproducibility performance metrics: I. A preliminary group analysis
We argue that published results demonstrate that new insights into human brain function may be obscured by poor and/or limited choices in the data-processing pipeline, and review the work on performance metrics for optimizing pipelines: prediction, reproducibility, and related empirical Receiver Operating Characteristic (ROC) curve metrics. Using the NPAIRS split-half resampling framework for estimating prediction/reproducibility metrics (Strother et al., 2002), we illustrate its use by testing the relative importance of selected pipeline components (interpolation, in-plane spatial smoothing, temporal detrending, and between-subject alignment) in a group analysis of BOLD-fMRI scans from 16 subjects performing a block-design, parametric-static-force task. Large-scale brain networks were detected using a multivariate linear discriminant analysis (canonical variates analysis, CVA) that was tuned to fit the data. We found that
tuning the CVA model and spatial smoothing were the most important processing parameters. Temporal detrending was essential to remove low-frequency, reproducing time trends; the number of cosine basis functions for detrending was optimized by assuming that separate epochs of baseline scans have constant, equal means, and this assumption was assessed with prediction metrics. Higher-order polynomial warps compared to affine alignment had only a minor impact on the performance metrics. We found that both prediction and reproducibility metrics were required for optimizing the pipeline and give somewhat different results. Moreover, the parameter settings of components in the pipeline interact so that the current practice of reporting the optimization of components tested in relative isolation is unlikely to lead to fully optimized processing pipelines.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Strother, S. C. (Ekstern), Conte, S. L. (Ekstern), Hansen, L. K. (Intern)
Pages: S196-S207
Publication date: 2004
Main Research Area: Technical/natural sciences

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Journal: NeuroImage
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Issue number: supplement 1
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BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 3.823 SNIP 1.752 CiteScore 6.31
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 4.48 SNIP 1.84 CiteScore 6.71
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 4.201 SNIP 2.029 CiteScore 6.9
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 4.376 SNIP 2.026 CiteScore 7.06
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 3.922 SNIP 1.937 CiteScore 6.86
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 3.626 SNIP 1.81 CiteScore 6.31
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 3.573 SNIP 1.866
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 3.859 SNIP 1.897
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 4.094 SNIP 1.765
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 3.7 SNIP 1.981
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 3.41 SNIP 1.924
Part-of-Speech Enhanced Context Recognition

Language independent `bag-of-words` representations are surprisingly effective for text classification. In this communication our aim is to elucidate the synergy between language independent features and simple language model features. We consider term tag features estimated by a so-called part-of-speech tagger. The feature sets are combined in an early binding design with an optimized binding coefficient that allows weighting of the relative variance contributions of the participating feature sets. With the combined features documents are classified using a latent semantic indexing representation and a probabilistic neural network classifier. Three medium size data-sets are analyzed and we find consistent synergy between the term and natural language features in all three sets for a range of training set sizes. The most significant enhancement is found for small text databases where high recognition rates are possible.
Probabilistic blind deconvolution of non-stationary sources

We solve a class of blind signal separation problems using a constrained linear Gaussian model. The observed signal is modelled by a convolutive mixture of colored noise signals with additive white noise. We derive a time-domain EM algorithm `KaBSS' which estimates the source signals, the associated second-order statistics, the mixing filters and the observation noise covariance matrix. KaBSS invokes the Kalman smoother in the E-step to infer the posterior probability of the sources, and one-step lower bound optimization of the mixing filters and noise covariance in the M-step. In line with (Parra and Spence, 2000) the source signals are assumed time variant in order to constrain the solution sufficiently. Experimental results are shown for mixtures of speech signals.

Probabilistic Partial Least Squares: How many factors?

Probabilistic Partial Least Squares: How many factors?
Pruning the vocabulary for better context recognition

Language independent 'bag-of-words' representations are surprisingly effective for text classification. The representation is high dimensional though, containing many inconsistent words for text categorization. These inconsistent words result in reduced generalization performance of subsequent classifiers, e.g., from ill-posed principal component transformations. In this communication our aim is to study the effect of reducing the least relevant words from the bag-of-words representation. We consider a new approach, using neural network based sensitivity maps and information gain for determination of term relevancy, when pruning the vocabularies. With reduced vocabularies, documents are classified using a latent semantic indexing representation and a probabilistic neural network classifier. Reducing the bag-of-words vocabularies with 90%-98%, we find consistent classification improvement using two mid size data-sets. We also study the applicability of information gain and sensitivity maps for automated keyword generation.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Madsen, R. E. (Intern), Sigurdsson, S. (Intern), Hansen, L. K. (Intern), Larsen, J. (Intern)
Publication date: 2004

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Publisher: IEEE
ISBN (Print): 0-7695-2128-2
Main Research Area: Technical/natural sciences
Conference: 17th International Conference on Pattern Recognition, 2004., 01/01/2004
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Semi-blind Source Separation Using Head-related Transfer Functions

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling, Department of Acoustic Technology
Authors: Pedersen, M. S. (Intern), Hansen, L. K. (Intern), Kjems, U. (Intern), Rasmussen, K. B. (Intern)
Publication date: 2004
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 201259
Publication: Research › Poster – Annual report year: 2004

Semi-blind Source Separation Using Head-Related Transfer Functions
An online blind source separation algorithm which is a special case of the geometric algorithm by Parra and Fancourt has been implemented for the purpose of separating sounds recorded at microphones placed at each side of the head. By using the assumption that the position of the two sounds are known, the source separation algorithm has been geometrically constrained. Since the separation takes place in a non free-field, a head-related transfer function (HRTF) is used to simulate the response between microphones placed at the two ears. The use of a HRTF instead of assuming free-field improves the separation with approximately 1 dB compared to when free-field is assumed. This indicates that the permutation ambiguity is solved more accurate compared to when free-field is assumed.

General information
State: Published
Testing for difference between two groups of functional neuroimaging experiments

We describe a meta-analytic method that tests for the difference between two groups of functional neuroimaging experiments. We use kernel density estimation in three-dimensional brain space to convert points representing focal brain activations into a voxel-based representation. We find the maximum in the subtraction between two probability densities and compare its value against a resampling distribution obtained by permuting the labels of the two groups. As such it appears as a general method for comparing the local intensity of two non-stationary spatial point processes. The method is applied on data from thermal pain studies where “hot pain” and “cold pain” form the two groups.

Vocabulary Pruning for Improved Context Recognition

Language independent ‘bag-of-words’ representations are surprisingly effective for text classification. The representation is high dimensional though, containing many non-consistent words for text categorization. These non-consistent words result in reduced generalization performance of subsequent classifiers, e.g., from ill-posed principal component transformations. In this communication our aim is to study the effect of reducing the least relevant words from the bag-of-words representation. We consider a new approach, using neural network based sensitivity maps and information gain for determination of term relevancy, when pruning the vocabularies. With reduced vocabularies documents are classified using a latent semantic indexing representation and a probabilistic neural network classifier. Reducing the bag-of-words vocabularies with 90%-98%, we find consistent classification improvement using two mid size data-sets. We also study the applicability of information gain and sensitivity maps for automated keyword generation.
A Probabilistic Framework for Detection of Skin Cancer by Raman Spectra

This Ph.D. thesis focuses on objective methods for diagnosing skin cancer from Raman spectra. A method for suppressing background noise and dimension reduction in Raman spectra is suggested. A robust Bayesian framework for training a neural network is proposed, including an overfit control and outlier framework. Finally, a visualization scheme for extracting important features from the trained neural network classifier based on sensitivity analysis is defined. The performance on two types of skin cancer showed that 97.9% of basal cell carcinoma were identified correctly and 85.5% of malignant melanoma. The neural network classifier visualization showed that frequency bands, previously identified by visual inspection of Raman spectra by medical experts, were considered important for classification. Moreover, frequency band not previously used for skin lesion classification were identified. These identified important features are shown to originate from molecular structure changes in lipids and proteins. While the theme of this dissertation is skin cancer diagnosis from Raman spectra, the dimension reduction and the neural network classifier can be applied in general to other types of pattern recognition problems.

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Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Sigurdsson, S. (Intern), Hansen, L. K. (Intern), Larsen, J. (Intern)
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Main Research Area: Technical/natural sciences
Electronic versions:
imm2454.zip
Links:
Source: orbit
Source-ID: 58689
Publication: Research › Ph.D. thesis – Annual report year: 2003

Multiuser detection and channel estimation: Exact and approximate methods

This dissertation deals with optimal and close to optimal multiuser detection in Code Division Multiple Access. We derive optimal detection strategies in the sense of minimum expected probability of bit error, sequence error, and mean square error. These are implemented efficiently by the use of the Junction Tree Algorithm, which is a generalisation of Pearl's Belief Propagation, the BCJR, sum product, min/max sum, and Viterbi's algorithm. Although efficient algorithms, they have an inherent exponential complexity in the number of users when applied to CDMA multiuser detection. For this reason we propose here to use accurate approximations borrowed from statistical mechanics and machine learning. These give us various algorithms that all can be formulated in a subtractive interference cancellation formalism. The suggested algorithms can e eectively be seen as bias corrections to standard subtractive interference cancellation with hyperbolic tangent tentative decision device, in statistical mechanics and machine learning called the naive mean field approach. The differences between the proposed algorithms lie in how the bias is estimated/approximated. We propose approaches based on a second order Plefka expansion, adaptive TAP, and large system limit self-averaging behaviours, and a method based on Kikuchi and Bethe free energy approximations, which we denote the Generalised Graph Expansion. Since all
these methods are improvements of the naive mean field approach we make a thorough analysis of the convexity and bifurcations of the naive mean field free energy and optima. This proves that we can avoid local minima by tracking a global convex solution into the non-convex region, effectively avoiding error propagation. This method is in statistical physics denoted mean field annealing. We also derive optimal detectors when nuisance parameters such as the channel and noise level are unknown, and show how well the proposed methods fit into this framework via the Generalised Expectation Maximisation algorithm. Our numerical evaluation show that naive mean field annealing and adaptive TAP mean field annealing provides results identical or better than cases found in the literature. While annealing is an important ingredient, the adaptive TAP always has better or identical performance compared to the naive method, but a complexity scaling quadratic per user detected, compared to the naive approach being linear per users detected. We also show how to use the naive mean field approach to derive a low complexity approximative MMSE bit detection from an 8-PSK symbol. The results are nearly indistinguishable from the optimal. The last application is the use of the junction tree algorithm for decoding a subset of channels in a downlink W-CDMA scenario. We show that by such an approach we are able to gain some dB compared to a reference RAKE receiver.

General information
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Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Fabricius, T. (Intern), Hansen, L. K. (Intern), Rasmussen, C. E. (Intern)
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Publication information
Original language: English
Main Research Area: Technical/natural sciences
mean field theory, Communication, channel estimation, multiuser detection
Electronic versions:
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Links:
Source: orbit
Source-ID: 58677
Publication: Research › Ph.D. thesis – Annual report year: 2003

A prediction matrix approach to convolutive ICA

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Hansen, L. K. (Intern), Dyrholm, M. (Intern), Molina et al., C. (ed.) (Ekstern)
Pages: 249-258
Publication date: 2003

Host publication information
Publisher: IEEE Press
Main Research Area: Technical/natural sciences
Electronic versions:
imm2890.pdf
Links:
Source: orbit
Source-ID: 58526
Publication: Research - peer-review › Article in proceedings – Annual report year: 2003

Bayesian multichannel tracking of periodic signals: A new way to determine the running speed of mechanical systems

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Pedersen, T. F. (Intern), Hansen, L. K. (Intern)
Publication date: 2003

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Brain mapping of cold/pain vs. heat/pain: A 3D VRTM analyses on the published PET/fMRI data

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Chen, A. C. N. (Ekstern), Kold, J. (Ekstern), Arendt-Nielsen, L. (Ekstern), Hansen, L. K. (Intern), Nielsen, F. Å. (Intern)
Publication date: 2003

Host publication information
Title of host publication: 9th Annual Meeting of the Organization for Human Brain Mapping, HBM 2003, June 18-22, New York, USA, p. Poster No. 803
Main Research Area: Technical/natural sciences
Links: http://208.164.121.55/hbm2003/abstract/abstract796.htm
Source: orbit
Source-ID: 58581
Publication: Research - peer-review › Article in proceedings – Annual report year: 2003

Color segmentation of skin lesions with the generalizable Gaussian mixture model

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Sigurdsson, S. (Intern), Hansen, L. K. (Intern), Drzewiecki, K. (Ekstern)
Publication date: 2003

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Electronic versions:
imm2875.pdf
Source: orbit
Source-ID: 58722
Publication: Research › Report – Annual report year: 2003

Estimating and suppressing background in Raman spectra with an artificial neural network

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Sigurdsson, S. (Intern), Larsen, J. (Intern), Philipsen, P. A. (Intern), Gniadecka, M. (Ekstern), Wulf, H. C. (Ekstern), Hansen, L. K. (Intern)
Publication date: 2003

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Electronic versions:
imm2839.pdf
Links:
ICA if fMRI based on a convolutive mixture model

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Hansen, L. K. (Intern)
Publication date: 2003

Host publication information
Title of host publication: Ninth Annual Meeting of the Organization for Human Brain Mapping, (HBM), New York, June
Main Research Area: Technical/natural sciences
Conference: Ninth Annual Meeting of the Organization for Human Brain Mapping, (HBM), New York, June, 01/01/2003
Links:
http://208.164.121.55/hbm2003/abstract/abstract840.htm
Source: orbit
Source-ID: 58582
Publication: Research - peer-review › Article in proceedings – Annual report year: 2003

ICA of Functional MRI Data: An Overview

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Calhoun, V. D. (Ekstern), Adali, T. (Ekstern), Hansen, L. K. (Intern), Larsen, J. (Intern), Pekar, J. J. (Ekstern)
Pages: 281-288
Publication date: 2003

Host publication information
Title of host publication: Fourth International Symposium on Independent Component Analysis and Blind Source Separation, Nara, Japan
Main Research Area: Technical/natural sciences
Electronic versions:
imm1669.pdf
Links:
Source: orbit
Source-ID: 58509
Publication: Research - peer-review › Article in proceedings – Annual report year: 2003

Identifying black dots in dermatoscopic images using template matching

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Sigurdsson, S. (Intern), Hansen, L. K. (Intern), Drzewiecki, K. (Ekstern)
Publication date: 2003

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Electronic versions:
imm2874.pdf
Links:
Source: orbit
Source-ID: 58721
Publication: Research - peer-review › Report – Annual report year: 2003
Independent Component Analysis for fMRI: What is Signal and What is Noise?

Many sources of fluctuation contribute to the functional magnetic resonance imaging (fMRI) signal, complicating attempts to infer those changes that are truly related to brain activation. Unlike methods of analysis of fMRI data that test the time course of each voxel against a hypothesized waveform, data-driven methods, such as independent component analysis and clustering, attempt to find common features within the data. This exploratory approach can be revealing when the brain activation is difficult to predict beforehand, such as with complex stimuli and internal shifts of activation that are not time-locked to an easily specified sensory or motor event. These methods can be further improved by incorporating prior knowledge regarding the temporal and spatial extent of brain activation.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: McKeown, M. (Ekstern), Hansen, L. K. (Intern), Sejnowski, T. J. (Ekstern)
Pages: 620-629
Publication date: 2003
Main Research Area: Technical/natural sciences

Publication information
Journal: Current Opinion in Neurobiology
Volume: 13
Issue number: 5
ISSN (Print): 0959-4388
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 5.72 SNIP 1.88 CiteScore 7.39
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 5.271 SNIP 1.776 CiteScore 7.05
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 5.6 SNIP 1.833 CiteScore 6.85
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 6.098 SNIP 1.792 CiteScore 7.37
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 6.115 SNIP 1.755 CiteScore 7.42
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 6.571 SNIP 1.999 CiteScore 7.59
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 7.19 SNIP 1.964
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 7.426 SNIP 2.071
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 8.062 SNIP 2.312
Scopus rating (2007): SJR 7.822 SNIP 2.477
Scopus rating (2006): SJR 7.086 SNIP 2.315
Scopus rating (2005): SJR 6.709 SNIP 2.136
Scopus rating (2004): SJR 7.049 SNIP 2.42
Scopus rating (2003): SJR 7.627 SNIP 2.454
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 7.913 SNIP 2.372
Scopus rating (2001): SJR 6.816 SNIP 2.018
Scopus rating (2000): SJR 7.481 SNIP 2.412
Scopus rating (1999): SJR 7.624 SNIP 2.1
Independent Component Analysis in Multimedia Modeling

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Larsen, J. (Intern), Hansen, L. K. (Intern), Kolenda, T. (Intern), Nielsen, F. Å. (Intern), Amari et al., S. (ed.) (Ekstern)
Pages: 687-696
Publication date: 2003

Host publication information
Title of host publication: Fourth International Symposium on Independent Component Analysis and Blind Source Separation
Main Research Area: Technical/natural sciences
Electronic versions:
imm1668.pdf
Links:
Source: orbit
Source-ID: 58538
Publication: Research - peer-review › Article in proceedings – Annual report year: 2003

Monaural ICA of white noise mixtures is hard
Separation of monaural linear mixtures of ‘white’ source signals is fundamentally ill-posed. In some situations it is not possible to find the mixing coefficients for the full ‘blind’ problem. If the mixing coefficients are known, the structure of the source prior distribution determines the source reconstruction error. If the prior is strongly multi-modal source reconstruction is possible with low error, while source signals from the typical ‘long tailed’ distributions used in many ICA settings can not be reconstructed. We provide a qualitative discussion of the limits of monaural blind separation of white noise signals and give a set of ‘no go’ cases.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Hansen, L. K. (Intern), Petersen, K. B. (Ekstern)
Pages: 815-820
Publication date: 2003

Host publication information
Main Research Area: Technical/natural sciences
Electronic versions:
imm1650.pdf
Source: orbit
Source-ID: 58523
Publication: Research - peer-review › Article in proceedings – Annual report year: 2003

The Evaluation of Preprocessing Choices in Single-Subject BOLD fMRI Using NPAIRS Performance Metrics
This work proposes an alternative to simulation-based receiver operating characteristic (ROC) analysis for assessment of fMRI data analysis methodologies. Specifically, we apply the rapidly developing nonparametric prediction, activation, influence, and reproducibility resampling (NPAIRS) framework to obtain cross-validation-based model performance estimates of prediction accuracy and global reproducibility for various degrees of model complexity. We rely on the concept of an analysis chain meta-model in which all parameters of the preprocessing steps along with the final statistical model are treated as estimated model parameters. Our ROC analog, then, consists of plotting prediction vs. reproducibility...
results as curves of model complexity for competing meta-models. Two theoretical underpinnings are crucial to utilizing this new validation technique. First, we explore the relationship between global signal-to-noise and our reproducibility estimates as derived previously. Second, we submit our model complexity curves in the prediction versus reproducibility space as reflecting classic bias-variance tradeoffs. Among the particular analysis chains considered, we found little impact in performance metrics with alignment, some benefit with temporal detrending, and greatest improvement with spatial smoothing.

**General information**

State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Stephen, L. (Ekstern), Rottenberg, D. (Ekstern), Strother, S. (Ekstern), Anderson, J. (Ekstern), Muley, S. (Ekstern), Ashe, J. (Ekstern), Frutiger, S. (Ekstern), Rehm, K. (Ekstern), Hansen, L. K. (Intern), Yacoub, E. (Ekstern), Hu, X. (Ekstern)
Pages: 10-27
Publication date: 2003
Main Research Area: Technical/natural sciences

**Publication information**

Journal: NeuroImage
Volume: 18
ISSN (Print): 1053-8119
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 3.823 SNIP 1.752 CiteScore 6.31
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 4.48 SNIP 1.84 CiteScore 6.71
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 4.201 SNIP 2.029 CiteScore 6.9
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 4.376 SNIP 2.026 CiteScore 7.06
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 3.922 SNIP 1.937 CiteScore 6.86
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 3.626 SNIP 1.81 CiteScore 6.31
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 3.573 SNIP 1.866
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 3.859 SNIP 1.897
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 4.094 SNIP 1.765
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 3.7 SNIP 1.981
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 3.41 SNIP 1.924
Adaptive tools in virtual environments: Independent component analysis for multimedia

The thesis investigates the role of independent component analysis in the setting of virtual environments, with the purpose of finding properties that reflect human context. A general framework for performing unsupervised classification with ICA is presented in extension to the latent semantic indexing model. Evidence is found that the separation by independence presents a hierarchical structure that relates to context in a human sense. Furthermore, introducing multiple media modalities, a combined structure was found to reflect context description at multiple levels. Different ICA algorithms were compared to investigate computational differences and separation results. The ICA properties were finally implemented in a chat room analysis tool and briefly investigated for visualization of search engines results.

Approximating methods for intractable probabilistic models: Applications in neuroscience

This thesis investigates various methods for carrying out approximate inference in intractable probabilistic models. By capturing the relationships between random variables, the framework of graphical models hints at which sets of random variables pose a problem to the inferential step. The approximating techniques used in this thesis originate from the field of statistical physics which for decades has been facing the same type of intractable computations when analyzing large systems of interacting variables e.g. magnetic spin systems. In general, these approximating techniques are known as mean field methods. The thesis provides a brief introduction to the basic methodology of learning and inference in graphical models as well as a short review of the various types of mean field approximations which recently have been shown to be efficient for carrying out approximate inference in intractable probabilistic models. Starting from the naive mean field approximation we derive for the independent component analysis (ICA) model with instantaneous mixing general expressions for the posterior quantities needed to perform learning by Expectation-Maximization (EM). Furthermore, we explore the feasibility of going beyond the naive mean field approximation for this model. In fact, it turns out that the overcomplete ICA problem can be solved using a simple linear response correction to the mean sufficient
statistics obtained by naive mean field approximation. In addition, we apply to the ICA problem an adaptive version of the Thouless, Anderson and Palmer (TAP) mean field approach which is due to Opper and Winther. To illustrate the methodology on a real world problem, an explorative analysis of a functional magnetic resonance imaging (fMRI) dataset from a visual activation study is carried out using ICA with binary sources. It is shown this approach, which is computationally efficient, infers reasonable brain activation functions. Finally, we outline various ways of carrying out approximate message passing in probabilistic models for which marginalization over some of the clique variables is intractable.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Højen-Sørensen, P. (Intern), Hansen, L. K. (Intern), Rasmussen, C. E. (Intern), Larsen, J. (Intern)
Publication date: Mar 2002

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Electronic versions: imm313.pdf
Links:
Source: orbit
Source-ID: 57999
Publication: Research › Ph.D. thesis – Annual report year: 2002

Analysis of functional neuroimages using ICA with adaptive binary sources

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Højen-Sørensen, P. (Intern), Winther, O. (Intern), Hansen, L. K. (Intern)
Pages: 213-225
Publication date: 2002
Main Research Area: Technical/natural sciences

Publication information
Journal: Neurocomputing
Volume: 49
Issue number: 1-4
ISSN (Print): 0925-2312
Ratings:
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.968 SNIP 1.589 CiteScore 3.61
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.024 SNIP 1.767 CiteScore 3.18
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.942 SNIP 1.793 CiteScore 2.99
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.878 SNIP 2.006 CiteScore 2.95
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.874 SNIP 1.557 CiteScore 2.57
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.966 SNIP 1.84 CiteScore 2.6
ISI indexed (2011): ISI indexed yes
An ica algorithm for analyzing multiple data sets

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Lukic, A. S. (Ekstern), Wernick, M. N. (Ekstern), Hansen, L. K. (Intern), Strother, S. C. (Ekstern)
Pages: 821-824
Publication date: 2002

Host publication information
Title of host publication: IEEE International Conference on Image Processing.
Publisher: IEEE
Main Research Area: Technical/natural sciences
Electronic versions:
imm1509.pdf
Links:
Source: orbit
Source-ID: 56085
Publication: Research - peer-review › Journal article – Annual report year: 2002

A Spatially Robust ICA Algorithm for Multiple fMRI Data Sets

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Lukic, A. S. (Ekstern), Wernick, M. N. (Ekstern), Hansen, L. K. (Intern), Strother, S. C. (Ekstern)
Publication date: 2002

Host publication information
Title of host publication: IEEE International Symposium on Biomedical Imaging
Main Research Area: Technical/natural sciences
Electronic versions:
imm1510.pdf
Automatic anatomical labeling of Talairach coordinates and generation of volumes of interest via the BrainMap database

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Nielsen, F. Å. (Intern), Hansen, L. K. (Intern)
Publication date: 2002

Host publication information
Title of host publication: Presented at the 8th International Conference on Functional Mapping of the Human Brain, June 2–6, 2002, Sendai, Japan
Main Research Area: Technical/natural sciences
Electronic versions:
imm195.pdf
Links:

Cluster analysis of activity-time series in motor learning

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Balslev, D. (Ekstern), Nielsen, F. Å. (Intern), Frutiger, S. A. (Ekstern), Sidtis, J. J. (Ekstern), Christiansen, T. (Intern), Svarer, C. (Ekstern), Strother, S. C. (Ekstern), Rottenberg, D. A. (Ekstern), Hansen, L. K. (Intern), Paulson, O. B. (Ekstern), Law, I. (Ekstern)
Publication date: 2002
Main Research Area: Technical/natural sciences

Publication information
Journal: Human Brain Mapping
Volume: 15
Issue number: 3
ISSN (Print): 1065-9471
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 2.733 SNIP 1.346 CiteScore 5.06
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 3.184 SNIP 1.442 CiteScore 5.57
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 3.018 SNIP 1.612 CiteScore 5.74
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 3.42 SNIP 1.772 CiteScore 6.07
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 3.751 SNIP 1.775 CiteScore 6.79
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Clustering of Sun Exposure Measurements

In a medically motivated Sun-exposure study, questionnaires concerning Sun-habits were collected from a number of subjects together with UV radiation measurements. This paper focuses on identifying clusters in the heterogeneous set of data for the purpose of understanding possible relations between Sun-habits exposure and eventually assessing the risk of skin cancer. A general probabilistic framework originally developed for text and Web mining is demonstrated to be useful for clustering of behavioral data. The framework combines principal component subspace projection with probabilistic clustering based on the generalizable Gaussian mixture model.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Have, A. S. (Intern), Larsen, J. (Intern), Hansen, L. K. (Intern), Philipsen, P. A. (Intern), Thieden, E. (Ekstern), Wulf, H. C. (Ekstern)
Pages: 727-735
Publication date: 2002

Host publication information
Title of host publication: Proceedings of IEEE Workshop on Neural Networks for Signal Processing XII, Matigny, Valais, Switzerland, Sept. 4-6
Publisher: IEEE Press
ISBN (Print): 0-7803-7616-1
Main Research Area: Technical/natural sciences
Electronic versions: imm1193.pdf
DOIs: 10.1109/NNSP.2002.1030090

Bibliographical note
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General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Larsen, J. (Intern), Hansen, L. K. (Intern)
Pages: 141-145
Publication date: 2002
Main Research Area: Technical/natural sciences

Publication information
Journal: Neural Networks
Volume: 15
Issue number: 1
ISSN (Print): 0893-6080
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 1.394 SNIP 2.367 CiteScore 5.15
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.421 SNIP 2.231 CiteScore 3.97
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.108 SNIP 1.856 CiteScore 3.29
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 0.871 SNIP 2.066 CiteScore 3.18
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 0.921 SNIP 1.792 CiteScore 3.11
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 0.876 SNIP 1.829 CiteScore 2.94
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 0.807 SNIP 1.441
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 0.686 SNIP 1.944
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.157 SNIP 1.78
Scopus rating (2007): SJR 1.19 SNIP 2.005
Scopus rating (2006): SJR 0.769 SNIP 1.821
Scopus rating (2005): SJR 0.961 SNIP 2.034
Scopus rating (2004): SJR 0.945 SNIP 2.153
Scopus rating (2003): SJR 1.11 SNIP 2.379
Scopus rating (2002): SJR 0.843 SNIP 1.718
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.977 SNIP 1.829
Scopus rating (2000): SJR 0.495 SNIP 1.354
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 0.734 SNIP 1.361
Original language: English
leave-one-out cross-validation, confidence intervals
Den arbejdende hjerne - hvordan kan den se ud?

General information
State: Published
Organisations: Department of Electrical Engineering, Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Paulson, O. B. (Ekstern), Born, P. (Ekstern), Bundesen, C. (Ekstern), Gade, A. (Intern), Gerlach, C. (Ekstern), Hansen, L. K. (Intern), Holm, S. (Ekstern), Jensen, M. (Ekstern), Kyllingsbæk, S. (Ekstern), Larsen, A. (Ekstern), Law, I. (Ekstern), Rostrup, E. (Ekstern), Svarer, C. (Ekstern)
Pages: 2267-2275
Publication date: 2002
Main Research Area: Technical/natural sciences

Publication information
Journal: Ugeskrift for Laeger
Volume: 164
ISSN (Print): 0041-5782
Ratings:
BFI (2017): BFI-level 1
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.11 SNIP 0.041 CiteScore 0.02
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.124 SNIP 0.077 CiteScore 0.03
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.129 SNIP 0.116 CiteScore 0.05
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.14 SNIP 0.122 CiteScore 0.06
ISI indexed (2013): ISI indexed no
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.146 SNIP 0.15 CiteScore 0.08
ISI indexed (2012): ISI indexed no
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.143 SNIP 0.157 CiteScore 0.1
ISI indexed (2011): ISI indexed no
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.158 SNIP 0.169
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.156 SNIP 0.201
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.155 SNIP 0.17
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.147 SNIP 0.157
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.139 SNIP 0.163
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.142 SNIP 0.173
Scopus rating (2004): SJR 0.172 SNIP 0.209
Scopus rating (2003): SJR 0.145 SNIP 0.183
Scopus rating (2002): SJR 0.142 SNIP 0.141
Scopus rating (2001): SJR 0.145 SNIP 0.187
Scopus rating (2000): SJR 0.139 SNIP 0.194
DTU:Toolbox
The DTU:Toolbox™ is a collection of machine learning algorithms implemented mainly for Matlab™. Currently it holds:
*Independent component analysis (ICA) *Artificial neural networks (ANN) Focus is on developing easy to use algorithms with no or a minimum of parameter tuning. All algorithms come with demonstration scripts that show their use. The toolbox has been developed by the ISP group at institute Informatics and Mathematical Modelling at the Technical University of Denmark. We gratefully acknowledge the support from the Danish Research Council, the European Union MAPAWAMO project, and National Institutes of Health's Human Brain Project. All code can be used freely in research and other non-profit applications. If you publish results obtained with the DTU:Toolbox we kindly ask that our and other relevant sources are properly cited. Description, citation and implementation notes for the individual algorithms, are provided with each algorithm. Questions can directed to the [toolbox supervisor]. See also Mole Research and Development.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Kolenda, T. (Intern), Sigurdsson, S. (Intern), Winther, O. (Intern), Hansen, L. K. (Intern), Larsen, J. (Intern)
Publication date: 2002

Publication information
Original language: English
Publisher: ISP Group, Informatics and Mathematical Modelling, Technical University of Denmark
Main Research Area: Technical/natural sciences
Independent component analysis, ICA, Neural networks, ANN
Links: http://isp.imm.dtu.dk/toolbox/
Source: orbit
Source-ID: 201168
Publication: Research - peer-review › Computer programme – Annual report year: 2002

Exploring fMRI Data for Periodic Signal Components
We use a Bayesian framework to detect periodic components in fMRI data. The resulting detector is sensitive to periodic components with a flexible number of harmonics and with arbitrary amplitude and phases of the harmonics. It is possible to detect the correct number of harmonics in periodic signals even if the fundamental frequency is beyond the Nyquist frequency. We apply the signal detector to locate regions that are highly affected by periodic physiological artifacts, such as cardiac pulsation.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Hansen, L. K. (Intern), Nielsen, F. Å. (Intern), Larsen, J. (Intern)
Pages: 25-44
Publication date: 2002
Main Research Area: Technical/natural sciences

Publication information
Journal: Artificial Intelligence in Medicine
Volume: 25
Issue number: 1
ISSN (Print): 0933-3657
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 0.635 SNIP 1.192 CiteScore 2.65
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 0.791 SNIP 1.833 CiteScore 3.04
Finding related functional neuroimaging volumes

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Nielsen, F. Å. (Intern), Hansen, L. K. (Intern)
Publication date: 2002

Host publication information
Title of host publication: Presented at the 8th International Conference on Functional Mapping of the Human Brain, June 2--6, 2002, Sendai, Japan. Available on CD-ROM
Publisher: Academic Press
Main Research Area: Technical/natural sciences
Links:
Source: orbit
Source-ID: 58197
Publication: Research - peer-review › Article in proceedings – Annual report year: 2002
Hjernen i computeren: Computeren i hjernen

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Lautrup, B. E. (Ekstern), Hansen, L. K. (Intern)
Publication date: 2002

Host publication information
Title of host publication: Homo sapiens 2.0: når teknologien kryber ind under huden
Publisher: Gad
Main Research Area: Technical/natural sciences
Electronic versions: imm2887.pdf
Links:
Source: orbit
Source-ID: 58270
Publication: Research - peer-review › Book chapter – Annual report year: 2002

Improved Deconvolution for Perfusion Quantification

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Andersen, I. K. (Intern), Marstrand, J. R. (Ekstern), Hansen, L. K. (Intern)
Publication date: 2002

Host publication information
Title of host publication: 10'th Ann. Meeting of the Int. Soc. Mag. Res. in Medicine
Main Research Area: Technical/natural sciences
Conference: 10'th Ann. Meeting of the Int. Soc. Mag. Res. in Medicine, 01/01/2002
Links:
Source: orbit
Source-ID: 58256
Publication: Research - peer-review › Article in proceedings – Annual report year: 2002

Independent component analysis for understanding multimedia content
Independent component analysis of combined text and image data from Web pages has potential for search and retrieval applications by providing more meaningful and context dependent content. It is demonstrated that ICA of combined text and image features has a synergistic effect, i.e., the retrieval classification rates increase if based on multimedia components relative to single media analysis. For this purpose a simple probabilistic supervised classifier which works from unsupervised ICA features is invoked. In addition, we demonstrate the suggested framework for automatic annotation of descriptive key words to images.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Kolenda, T. (Intern), Hansen, L. K. (Intern), Larsen, J. (Intern), Winther, O. (Intern), Bourlard et al., H. (ed.) (Ekstern)
Pages: 757-766
Publication date: 2002

Host publication information
Title of host publication: Proceedings of IEEE Workshop on Neural Networks for Signal Processing XII, Martigny, Valais, Switzerland, Sept. 4-6
Publisher: IEEE Press
ISBN (Print): 0-7803-7616-1
Main Research Area: Technical/natural sciences
ICA, webmining, multimedia signal processing
Electronic versions:
We describe a system for meta-analytical modeling of activation foci from functional neuroimaging studies. Our main vehicle is a set of density models in Talairach space capturing the distribution of activation foci in sets of experiments labeled by lobar anatomy. One important use of such density models is identification of novelty, i.e., low probability database events. We rank the novelty of the outliers and investigate the cause for 21 of the most novel, finding several outliers that are entry and transcription errors or infrequent or non-conforming terminology. We briefly discuss the use of atlases for outlier detection. Hum. Brain Mapping 15:146-156, 2002. © 2002 Wiley-Liss, Inc.
Neuroimaging of human pain and virtual reality modelling

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Chen, A. C. N. (Ekstern), Nielsen, F. Å. (Intern), Hansen, L. K. (Intern), Reisin et al., R. C. (ed.) (Ekstern)
Pages: 156-162
Publication date: 2002

Host publication information
Title of host publication: Advances in Clinical Neurophysiology, vol. 54
Publisher: Elsevier Science
Main Research Area: Technical/natural sciences
Links:
Source: orbit
Source-ID: 58162
Publication: Research - peer-review › Article in proceedings – Annual report year: 2002

Outlier estimation and detection: Application to Skin Lesion Classification
We extend MacKay's (1992) Bayesian approach to neural classifiers to include an outlier detector mechanism. We show that the outlier detector can locate misclassified samples

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Sigurdsson, S. (Intern), Larsen, J. (Intern), Hansen, L. K. (Intern), Philipsen, P. A. (Intern), Wulf, H. C. (Ekstern)
Pages: 1049-1052
Publication date: 2002
Perfusion Quantification Using Gaussian Process Deconvolution

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Andersen, I. K. (Intern), Have, A. S. (Intern), Rasmussen, C. E. (Intern), Hansson, L. (Ekstern), Marstrand, J. R. (Ekstern), Larsson, H. B. (Ekstern), Hansen, L. K. (Intern)
Pages: 351-361
Publication date: 2002
Main Research Area: Technical/natural sciences

Publication information
Journal: Magnetic Resonance in Medicine
Volume: 48
Issue number: 2
ISSN (Print): 0740-3194
Ratings:
  BFI (2017): BFI-level 1
  Web of Science (2017): Indexed Yes
  BFI (2016): BFI-level 1
  Scopus rating (2016): SJR 1.867 SNIP 1.438 CiteScore 3.52
  Web of Science (2016): Indexed yes
  BFI (2015): BFI-level 1
  Scopus rating (2015): SJR 2.291 SNIP 1.48 CiteScore 3.54
  Web of Science (2015): Indexed yes
  BFI (2014): BFI-level 1
  Scopus rating (2014): SJR 1.952 SNIP 1.39 CiteScore 3.32
  Web of Science (2014): Indexed yes
  BFI (2013): BFI-level 1
  Scopus rating (2013): SJR 1.959 SNIP 1.44 CiteScore 3.46
  ISI indexed (2013): ISI indexed yes
  Web of Science (2013): Indexed yes
  BFI (2012): BFI-level 1
  Scopus rating (2012): SJR 2.072 SNIP 1.549 CiteScore 3.61
  ISI indexed (2012): ISI indexed yes
  Web of Science (2012): Indexed yes
  BFI (2011): BFI-level 2
  Scopus rating (2011): SJR 2.056 SNIP 1.476 CiteScore 3.45
  ISI indexed (2011): ISI indexed yes
  Web of Science (2011): Indexed yes
  BFI (2010): BFI-level 1
  Scopus rating (2010): SJR 2.272 SNIP 1.612
Probabilistic Hierarchical Clustering with Labeled and Unlabeled Data

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Larsen, J. (Intern), Have, A. S. (Intern), Hansen, L. K. (Intern)
Pages: 56-62
Publication date: 2002
Main Research Area: Technical/natural sciences

Publication information
Journal: International Journal of Knowledge-Based and Intelligent Engineering Systems
Volume: 6
Issue number: 1
ISSN (Print): 1327-2314
Ratings:
BFI (2017): BFI-level 1
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.144 SNIP 0.347 CiteScore 0.42
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.131 SNIP 0.319 CiteScore 0.27
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.222 SNIP 0.502 CiteScore 0.37
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.116 SNIP 0.125 CiteScore 0.16
ISI indexed (2013): ISI indexed no
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.112 SNIP 0.24 CiteScore 0.15
ISI indexed (2012): ISI indexed no
BFI (2011): BFI-level 1
Testing competing hypotheses about single trial fMRI

We use a Bayesian framework to compute probabilities of competing hypotheses about functional activation based on single trial fMRI measurements. Within the framework we obtain a complete probabilistic picture of competing hypotheses, hence control of both type I and type II errors.

The Quantitative Evaluation of Functional Neuroimaging Experiments: Mutual Information Learning Curves

Learning curves are presented as an unbiased means for evaluating the performance of models for neuroimaging data analysis. The learning curve measures the predictive performance in terms of the generalization or prediction error as a function of the number of independent examples (e.g., subjects) used to determine the parameters in the model. Cross-validation resampling is used to obtain unbiased estimates of a generic multivariate Gaussian classifier, for training set sizes from 2 to 16 subjects. We apply the framework to four different activation experiments, in this case $^{15}$O water data sets, although the framework is equally valid for multisubject fMRI studies. We demonstrate how the prediction error can be expressed as the mutual information between the scan and the scan label, measured in units of bits. The mutual information learning curve can be used to evaluate the impact of different methodological choices, e.g., classification label schemes, preprocessing choices. Another application for the learning curve is to examine the model performance using bias/variance considerations enabling the researcher to determine if the model performance is limited by statistical bias or variance. We furthermore present the sensitivity map as a general method for extracting activation maps from statistical models within the probabilistic framework and illustrate relationships between mutual information and pattern reproducibility as derived in the NPAIRS framework described in a companion paper.
The Quantitative Evaluation of Functional Neuroimaging Experiments: The NPAIRS

We introduce a data-analysis framework and performance metrics for evaluating and optimizing the interaction between activation tasks, experimental designs, and the methodological choices and tools for data acquisition, preprocessing, data analysis, and extraction of statistical parametric maps (SPMs). Our NPAIRS (nonparametric prediction, activation, influence, and reproducibility resampling) framework provides an alternative to simulations and ROC curves by using real PET and fMRI data sets to examine the relationship between prediction accuracy and the signal-to-noise ratios (SNRs) associated with reproducible SPMs. Using cross-validation resampling we plot training-test set predictions of the experimental design variables (e.g., brain-state labels) versus reproducibility SNR metrics for the associated SPMs. We demonstrate the utility of this framework across the wide range of performance metrics obtained from $^{15}$O water PET studies of 12 age- and sex-matched data sets performing different motor tasks (8 subjects/set). For the 12 data sets we apply NPAIRS with both univariate and multivariate data-analysis approaches to: (1) demonstrate that this framework may be used to obtain reproducible SPMs from any data-analysis approach on a common Z-score scale ($r_{SPM(Z)}$); (2) demonstrate that the histogram of a $r_{SPM(Z)}$ image may be modeled as the sum of a data-analysis-dependent noise distribution and a task-dependent, Gaussian signal distribution that scales monotonically with our reproducibility performance metric; (3) explore the relation between prediction and reproducibility performance metrics with an emphasis on bias-variance tradeoffs for flexible, multivariate models; and (4) measure the broad range of reproducibility SNRs and the significant influence of individual subjects. A companion paper describes learning curves for four of these 12 data sets, which describe an alternative mutual-information prediction metric and NPAIRS reproducibility as a function of training-set sizes from 2 to 18 subjects. We propose the NPAIRS framework as a validation tool for testing and optimizing methodological choices and tools in functional neuroimaging.
Time Series Prediction Based on the Relevance Vector Machine with Adaptive Kernels

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Quinonero, J. (Intern), Hansen, L. K. (Intern)
Pages: 985-988
Publication date: 2002

Host publication information
Title of host publication: International Conference on Acoustics, Speech, and Signal Processing
Main Research Area: Technical/natural sciences
A Probabilistic Neural Network Framework for Detection of Malignant Melanoma

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Hintz-Madsen, M. (Intern), Hansen, L. K. (Intern), Larsen, J. (Intern), Drzewiecki, K. (Ekstern)
Pages: 141-183
Publication date: 2001

Host publication information
Title of host publication: Artificial Neural Networks in Cancer Diagnosis, Prognosis and Patient Management
Main Research Area: Technical/natural sciences
skin cancer detection, neural networks
Source: orbit
Source-ID: 57928
Publication: Research - peer-review › Book chapter – Annual report year: 2001

Author cocitation analysis of articles from "NeuroImage"

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Nielsen, F. Å. (Intern), Hansen, L. K. (Intern), Friston et al., K. J. (ed.) (Ekstern)
Publication date: 2001

Host publication information
Title of host publication: 7th Annual Meeting of the Organization for Human Brain Mapping (HBM2001), Brighton, UK, 2001 June 10-14
Publisher: Academic Press
Main Research Area: Technical/natural sciences
Links:
http://www.imm.dtu.dk/~fn/ps/Nielsen2001Author.ps.gz
Source: orbit
Source-ID: 57862
Publication: Research - peer-review › Article in proceedings – Annual report year: 2001

Blind Detection of Independent Dynamic Components

In certain applications of independent component analysis (ICA) it is of interest to test hypotheses concerning the number of components or simply to test whether a given number of components is significant relative to a "white noise" null hypothesis. We estimate probabilities of such competing hypotheses for ICA based on dynamic decorrelation. The probabilities are evaluated in the so-called Bayesian information criterion approximation, however, they are able to detect the content of dynamic components as efficiently as an unbiased test set estimator.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Hansen, L. K. (Intern), Larsen, J. (Intern), Kolenda, T. (Intern)
Pages: 3197-3200
Publication date: 2001

Host publication information
Title of host publication: IEEE International Conference on Acoustics, Speech, and Signal Processing 2001
Volume: 5
Consensus Inference in Neuroimaging

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Hansen, L. K. (Intern), Nielsen, F. Å. (Intern), Strother, S. C. (Ekstern), Lange, N. (Ekstern)
Pages: 1212-1218
Publication date: 2001
Main Research Area: Technical/natural sciences

Publication information
Journal: NeuroImage
Volume: 13
Issue number: 6
ISSN (Print): 1053-8119
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 3.823 SNIP 1.752 CiteScore 6.31
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 4.48 SNIP 1.84 CiteScore 6.71
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 4.201 SNIP 2.029 CiteScore 6.9
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 4.376 SNIP 2.026 CiteScore 7.06
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 3.922 SNIP 1.937 CiteScore 6.86
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 3.626 SNIP 1.81 CiteScore 6.31
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 3.573 SNIP 1.866
Dynamic components of linear stable mixtures from fractional low order moments

The second moment-based independent component analysis scheme of Molgedey and Schuster (1994) is generalized to fractional low-order moments, relevant for linear mixtures of heavy tail stable processes. The Molgedey-Schuster algorithm stands out by allowing explicitly construction of the independent components. Surprisingly, this turns out to be possible also for decorrelation based on fractional low-order moments.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Fabricius, T. (Intern), Kidmose, P. (Intern), Hansen, L. K. (Intern)
Pages: 3957-3960
Publication date: 2001

Host publication information
Title of host publication: Proceedings of International Conference on Acoustics, Speech and Signal Processing, ICASSP2001
Volume: 6
Publisher: IEEE Press
ISBN (Print): 0-7803-7041-4
Main Research Area: Technical/natural sciences
Conference: IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP 2001), Salt Lake City, UT, United States, 07/05/2001 - 07/05/2001
Electronic versions: Kidmose.pdf
DOIs: 10.1109/ICASSP.2001.940710

Bibliographical note
Copyright: 2000 IEEE. Personal use of this material is permitted. However, permission to reprint/republish this material for advertising or promotional purposes or for creating new collective works for resale or redistribution to servers or lists, or to
Ensemble Learning and Linear Response Theory for ICA

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Højen-Sørensen, P. (Intern), Winther, O. (Intern), Hansen, L. K. (Intern), Leen et al., T. (ed.) (Ekstern)
Pages: 542-548
Publication date: 2001

Host publication information
Title of host publication: Advances in Neural Information Processing Systems 13
Publisher: MIT Press
Main Research Area: Technical/natural sciences
Links:

Feature-Space Clustering for fMRI Meta-Analysis

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Goutte, C. (Intern), Hansen, L. K. (Intern), Liptrot, M. G. (Ekstern), Rostrup, E. (Ekstern)
Pages: 165-183
Publication date: 2001
Main Research Area: Technical/natural sciences

Publications information
Journal: Human Brain Mapping
Volume: 13
Issue number: 3
ISSN (Print): 1065-9471
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 2.733 SNIP 1.346 CiteScore 5.06
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 3.184 SNIP 1.442 CiteScore 5.57
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 3.018 SNIP 1.612 CiteScore 5.74
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 3.42 SNIP 1.772 CiteScore 6.07
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 3.751 SNIP 1.775 CiteScore 6.79
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 3.515 SNIP 1.614 CiteScore 6.25
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
Hierarchical Clustering for Datamining

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Have, A. S. (Intern), Larsen, J. (Intern), Hansen, L. K. (Intern), Babs et al., N. (ed.) (Ekstern)
Publication date: 2001

Host publication information
Title of host publication: Proceedings of KES-2001 Fifth International Conference on Knowledge-Based Intelligent Information Engineering Systems & Allied
Main Research Area: Technical/natural sciences
Electronic versions:
imm1244.pdf
Links:
Source: orbit
Source-ID: 57887
Publication: Research - peer-review › Article in proceedings – Annual report year: 2001

Imputating missing values in diary records of sun-exposure study
In a sun-exposure study, questionnaires concerning sun-habits were collected from 195 subjects. This paper focuses on the general problem of missing data values, which occurs when some, or even all of the questions have not been answered in a questionnaire. Here, only missing values of low concentration are investigated. We consider and compare two different models for imputating missing values: the Gaussian model and the non-parametric K-nearest neighbor model.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems, Copenhagen University Hospital
Authors: Have, A. S. (Intern), Philipsen, P. A. (Intern), Larsen, J. (Intern), Hansen, L. K. (Intern), Thieden, E. (Ekstern), Wulf, H. C. (Ekstern)
Pages: 489-498
Publication date: 2001
Mean Field Implementation of Bayesian ICA

Modeling of location in the BrainMap database: Detection of outliers

Modelling the fMRI response using smooth FIR filters
Signal Detection using ICA: Application to Chat Room Topic Spotting

Signal detection and pattern recognition for online grouping huge amounts of data and retrospective analysis is becoming increasingly important as knowledge based standards, such as XML and advanced MPEG, gain popularity. Independent component analysis (ICA) can be used to both cluster and detect signals with weak a priori assumptions in multimedia contexts. ICA of real world data is typically performed without knowledge of the number of non-trivial independent components, hence, it is of interest to test hypotheses concerning the number of components or simply to test whether a given set of components is significant relative to a "white noise" null hypothesis. It was recently proposed to use the so-called Bayesian information criterion (BIC) approximation, for estimation of such probabilities of competing hypotheses. Here, we apply this approach to the understanding of chat. We show that ICA can detect meaningful context structures in a chat room log file.

General Information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Kolenda, T. (Intern), Hansen, L. K. (Intern), Larsen, J. (Intern)
Pages: 540-545
Publication date: 2001

Host publication Information
Title of host publication: Third International Conference on Independent Component Analysis and Blind Source Separation
Main Research Area: Technical/natural sciences
Electronic versions: imm826.pdf
Source: orbit
Source-ID: 57847
Publication: Research - peer-review › Article in proceedings – Annual report year: 2001
Bayesian Averaging is Well-Tempered

Bayesian predictions are stochastic just like predictions of any other inference scheme that generalize from a finite sample. While a simple variational argument shows that Bayes averaging is generalization optimal given that the prior matches the teacher parameter distribution the situation is less clear if the teacher distribution is unknown. I define a class of averaging procedures, the tempered likelihoods, including both Bayes averaging with a uniform prior and maximum likelihood estimation as special cases. I show that Bayes is generalization optimal in this family for any teacher distribution for two learning problems that are analytically tractable learning the mean of a Gaussian and asymptotics of smooth learners.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Hansen, L. K. (Intern), et al, S. S. .. (ed.) (Ekstern)
Pages: 265-271
Publication date: 2000

Bayesian Modelling of fMRI Time Series
We present a Hidden Markov Model (HMM) for inferring the hidden psychological state (or neural activity) during single trial fMRI activation experiments with blocked task paradigms. Inference is based on Bayesian methodology, using a combination of analytical and a variety of Markov Chain Monte Carlo (MCMC) sampling techniques. The advantage of this method is that detection of short time learning effects between repeated trials is possible since inference is based only on single trial experiments.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Højen-Sørensen, P. (Intern), Hansen, L. K. (Intern), Rasmussen, C. E. (Intern)
Pages: 754-760
Publication date: 2000

Comparison of voxel- and volume-of-interest-based analyses in FDG PET scans of HIV positive and healthy individuals

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Liow, J. S. (Ekstern), Rehm, K. (Ekstern), Strother, S. C. (Ekstern), Anderson, R. R. (Ekstern), Mørch, N. J. (Intern), Hansen, L. K. (Intern)
Pages: 612-621
Publication date: 2000
Main Research Area: Technical/natural sciences

Journal: Journal of Nuclear Medicine
Experiences with Matlab and VRML In Functional Neuroimaging Visualizations

We describe some experiences with Matlab and VRML. We are developing a toolbox for neuroinformatics and describe some of the functionalities we have implemented or will implement and how Matlab and VRML support the implementation.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Nielsen, F. Å. (Intern), Hansen, L. K. (Intern)
Modeling text with generalizable Gaussian mixtures

We apply and discuss generalizable Gaussian mixture (GGM) models for text mining. The model automatically adapts model complexity for a given text representation. We show that the generalizability of these models depends on the dimensionality of the representation and the sample size. We discuss the relation between supervised and unsupervised learning in the test data. Finally, we implement a novelty detector based on the density model.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Hansen, L. K. (Intern), Sigurdsson, S. (Intern), Kolenda, T. (Intern), Nielsen, F. Å. (Intern), Kjems, U. (Intern), Larsen, J. (Intern)
Pages: 3494-3497
Publication date: 2000

Modeling the hemodynamic response in fMRI using smooth FIR filters

Modeling the hemodynamic response in functional magnetic resonance (fMRI) experiments is an important aspect of the analysis of functional neuroimages. This has been done in the past using parametric response function, from a limited family. In this contribution, the authors adopt a semi-parametric approach based on finite impulse response (FIR) filters. In order to cope with the increase in the number of degrees of freedom, the authors introduce a Gaussian process prior on the filter parameters. They show how to carry on the analysis by incorporating prior knowledge on the filters, optimizing hyper-parameters using the evidence framework, or sampling using a Markov Chain Monte Carlo (MCMC) approach. The authors present a comparison of their model with standard hemodynamic response kernels on simulated data, and perform a full analysis of data acquired during an experiment involving visual stimulation.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Goutte, C. (Intern), Nielsen, F. Å. (Intern), Hansen, L. K. (Intern)
Modelling the hemodynamic response in fMRI with smooth FIR filters

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Goutte, C. (Intern), Nielsen, F. Å. (Intern), Hansen, L. K. (Intern)
Pages: 1188-
Publication date: 2000
Main Research Area: Technical/natural sciences

Publication information
Journal: IEEE Transactions on Medical Imaging
Volume: 19
Issue number: 12
ISSN (Print): 0278-0062
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 1.522 SNIP 2.369 CiteScore 4.83
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.765 SNIP 2.68 CiteScore 4.9
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.407 SNIP 2.756 CiteScore 4.66
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.916 SNIP 3.2 CiteScore 5.55
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.545 SNIP 2.794 CiteScore 4.94
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.332 SNIP 2.583 CiteScore 4.59
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.343 SNIP 2.619
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.371 SNIP 3.352
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.404 SNIP 2.906
Scopus rating (2007): SJR 1.627 SNIP 3.948
Web of Science (2007): Indexed yes
Neural Networks for Modelling and Control of Dynamic Systems - A Practitioner's Handbook

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Automation, Department of Electrical Engineering, Mathematical Statistics, Cognitive Systems
Authors: Nørgård, P. M. (Intern), Ravn, O. (Intern), Poulsen, N. K. (Intern), Hansen, L. K. (Intern)
Publication date: 2000

Publication information
Publisher: Springer-London
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 200573
Publication: Research - peer-review › Book – Annual report year: 2000

On Comparison of Adaptive Regularization Methods
Modeling with flexible models, such as neural networks, requires careful control of the model complexity and generalization ability of the resulting model which finds expression in the ubiquitous bias-variance dilemma. Regularization is a tool for optimizing the model structure reducing variance at the expense of introducing extra bias. The overall objective of adaptive regularization is to tune the amount of regularization ensuring minimal generalization error. Regularization is a supplement to direct model selection techniques like step-wise selection and one would prefer a hybrid scheme; however, a very flexible regularization may substitute the need for selection procedures. This paper investigates recently suggested adaptive regularization schemes. Some methods focus directly on minimizing an estimate of the generalization error (either algebraic or empirical), whereas others start from different criteria, e.g., the Bayesian evidence. The evidence expresses basically the probability of the model, which is conceptually different from generalization error; however, asymptotically for large training data sets they will converge. First the basic model definition, training and generalization is presented. Next, different adaptive regularization schemes are reviewed and extended. Finally, the experimental section presents a comparative study concerning linear models for regression/time series problems.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Sigurdsson, S. (Intern), Larsen, J. (Intern), Hansen, L. K. (Intern)
Pages: 221-230
Publication date: 2000

Host publication information
Title of host publication: Proceedings of the 2000 IEEE Signal Processing Society Workshop
Volume: 1
Place of publication: Sydney, NSW
Publisher: IEEE
ISBN (Print): 0-7803-6278-0
Main Research Area: Technical/natural sciences
On Independent Component Analysis for Multimedia Signals

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Hansen, L. K. (Intern), Larsen, J. (Intern), Kolenda, T. (Intern)
Pages: 175-199
Publication date: 2000

Host publication information
Title of host publication: Multimedia Image and Video Processing
Main Research Area: Technical/natural sciences
ICA, multimedia signal processing
Links:
http://www2.imm.dtu.dk/pubdb/p.php?627
Source: orbit
Source-ID: 200638
Publication: Research - peer-review › Book chapter – Annual report year: 2000

On the Independent Components of Functional Neuroimages

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Petersen, K. (Ekstern), Hansen, L. K. (Intern), Kolenda, T. (Intern), Rostrup, E. (Ekstern)
Pages: 615-620
Publication date: 2000

Host publication information
Title of host publication: Third International Conference on Independent Component Analysis and Blind Source Separation
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 176517
Publication: Research - peer-review › Article in proceedings – Annual report year: 2000

A probabilistic framework for classification of dermatoscopic images

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Hintz-Madsen, M. (Intern), Hansen, L. K. (Intern), Larsen, J. (Intern)
Number of pages: 156
Publication date: Jul 1999

Publication information
Original language: English
Series: IMM-PHD-1998-57
Main Research Area: Technical/natural sciences
Electronic versions:
Reconstruction and restoration of PET images

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Philipsen, P. A. (Intern), Hansen, L. K. (Intern)
Number of pages: 134
Publication date: May 1999

Publication information
Original language: English
Series: IMM-PHD-1998-55
Main Research Area: Technical/natural sciences
Electronic versions:
Thesis.pdf
Source: orbit
Source-ID: 200844
Publication: Research › Ph.D. thesis – Annual report year: 1999

A Bayesian aproach to estimating activation in fMRI time series

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Danish Research Centre for Magnetic Resonance
Authors: Sørensen, P. H. (Intern), Hansen, L. K. (Intern), Rostrup, E. (Ekstern)
Number of pages: 117
Publication date: 1999

Host publication information
Title of host publication: NeuroImage 9(6)
Publisher: Academic Press
Main Research Area: Technical/natural sciences
Conference: 5th International Conference on Functional Mapping of the Human Brain, Düsseldorf, Germany, 22/06/1999 - 22/06/1999
Source: orbit
Source-ID: 173061
Publication: Research - peer-review › Article in proceedings – Annual report year: 1999

A New Unix Toolbox for Non-linear Warping of MR Brain Images Applied to a 15-0 Water PET Functional Experiment

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Minneapolis VA Medical Center
Authors: Kjems, U. (Intern), Strother, S. (Ekstern), Anderson, J. (Ekstern), Hansen, L. K. (Intern)
Publication date: 1999

Host publication information
Title of host publication: NeuroImage, Vol. 9, No. 6, Part 2/2
Main Research Area: Technical/natural sciences
Conference: 5th International Conference on Functional Mapping of the Human Brain, Düsseldorf, Germany, 22/06/1999 - 22/06/1999
Source: orbit
Source-ID: 172654
Publication: Research › Article in proceedings – Annual report year: 1999

Artificial Neural Network Model for fMRI Timeseries and a Framework for Comparison of Convolution Models
**Discrimination of Cylinders with Different Wall Thicknesses using Neural Networks and Simulated Dolphin Sonar Signals**

This paper describes a method integrating neural networks into a system for recognizing underwater objects. The system is based on a combination of simulated dolphin sonar signals, simulated auditory filters and artificial neural networks. The system is tested on a cylinder wall thickness difference experiment and demonstrates high accuracy for small wall thickness differences. Results from the experiment are compared with results obtained by a false killer whale (pseudorca crassidens).

**Enhancing the Multivariate Signal of 15-0 water PET Studies With a New Non-Linear Neuroanatomical Registration Algorithm**

This paper describes a method integrating neural networks into a system for recognizing underwater objects. The system is based on a combination of simulated dolphin sonar signals, simulated auditory filters and artificial neural networks. The system is tested on a cylinder wall thickness difference experiment and demonstrates high accuracy for small wall thickness differences. Results from the experiment are compared with results obtained by a false killer whale (pseudorca crassidens).
Enhancing the Multivariate Signal of $^{15}$O water PET Studies With a New Non-Linear Neuroanatomical Registration Algorithm

This paper addresses the problem of neuro-anatomical registration across individuals for functional $^{15}$O water PET activation studies. A new algorithm for 3D non-linear structural registration (warping) of MR scans is presented. The method performs a hierarchically scaled search for a displacement field maximizing one of several voxel similarity measures derived from the two dimensional histogram of matched image intensities, subject to a regularizer that ensures...
smoothness of the displacement field. The effect of the non-linear structural registration is studied when it is computed on anatomical MR scans and applied to co-registered [15O] water PET scans from the same subjects; in this experiment a study of visually guided saccadic eye movements. The performance of the non-linear warp is evaluated using multivariate functional signal and noise measures. These measures prove to be useful for comparing different inter-subject registration approaches, e.g. affine versus non-linear. A comparison of 12-parameter affine registration versus non-linear registration demonstrates that the proposed non-linear method increases the number of voxels retained in the cross-subject mask. We demonstrate that improved structural registration may result in an improved multivariate functional signal-to-noise ratio. Furthermore registration of PET scans using the 12-parameter affine transformations that align the co-registered MR images does not improve registration compared to 12-parameter affine alignment of the PET images directly.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Kjems, U. (Intern), Storther, S. C. (Ekstern), Anderson, J. (Ekstern), Law, I. (Ekstern), Hansen, L. K. (Intern)
Pages: 306-319
Publication date: 1999
Main Research Area: Technical/natural sciences

Publication information
Journal: IEEE Transactions on Medical Imaging
Volume: 18
Issue number: 4
ISSN (Print): 0278-0062
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 1.522 SNIP 2.369 CiteScore 4.83
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.765 SNIP 2.68 CiteScore 4.9
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.407 SNIP 2.756 CiteScore 4.66
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.916 SNIP 3.2 CiteScore 5.55
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.545 SNIP 2.794 CiteScore 4.94
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.332 SNIP 2.583 CiteScore 4.59
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.343 SNIP 2.619
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.371 SNIP 3.352
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.404 SNIP 2.906
Scopus rating (2007): SJR 1.627 SNIP 3.948
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.914 SNIP 3.337
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.796 SNIP 3.754
Feature space clustering for fMRI meta-analysis.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Goutte, C. (Intern), Hansen, L. K. (Intern), Liptrot, M. G. (Intern), Rostrup, E. (Ekstern)
Number of pages: 46
Publication date: 1999

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 199670
Publication: Research - peer-review › Journal article – Annual report year: 1999

Generalizable Patterns in Neuroimaging: How Many Principal Components?

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling, Minneapolis VA Medical Center, Danish Research Centre for Magnetic Resonance, Massachusetts General Hospital, Harvard Medical School, National University Hospital
Authors: Hansen, L. K. (Intern), Larsen, J. (Intern), Nielsen, F. Å. (Intern), Strother, S. (Ekstern), Rostrup, E. (Ekstern), Savoy, R. (Ekstern), Lange, N. (Ekstern), Sidtis, J. (Ekstern), Svarer, C. (Ekstern), Paulson, O. (Ekstern)
Pages: 534-544
Publication date: 1999
Main Research Area: Technical/natural sciences

Publication information
Journal: NeuroImage
Volume: 9
Issue number: 5
ISSN (Print): 1053-8119
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 3.823 SNIP 1.752 CiteScore 6.31
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
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<td>2003</td>
<td>SJR 1.974</td>
<td>Indexed yes</td>
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<td>2002</td>
<td>SJR 0.885</td>
<td>Indexed yes</td>
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<td>2001</td>
<td>SJR 0.526</td>
<td>Indexed yes</td>
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**Lyngby - a Modeler´s Matlab Toolbox for Spatio-Temporal Analysis of Functional Neuroimages**

**General information**

State: Published

Organisations: Department of Informatics and Mathematical Modeling, Minneapolis VA Medical Center, Harvard Medical School, University of Minnesota, Copenhagen University Hospital
On clustering fMRI time series

Analysis of fMRI time series is often performed by extracting one or more parameters for the individual voxels. Methods based, e.g., on various statistical tests are then used to yield parameters corresponding to probability of activation or activation strength. However, these methods do not indicate whether sets of voxels are activated in a similar way or in different ways. Typically, delays between two activated signals are not identified. In this article, we use clustering methods to detect similarities in activation between voxels. We employ a novel metric that measures the similarity between the activation stimulus and the fMRI signal. We present two different clustering algorithms and use them to identify regions of similar activations in an fMRI experiment involving a visual stimulus.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems, Danish Research Centre for Magnetic Resonance
Authors: Goutte, C. (Intern), Toft, P. A. (Intern), Rostrup, E. (Ekstern), Nielsen, F. Å. (Intern), Hansen, L. K. (Intern)
Pages: 298-310
Publication date: 1999
Main Research Area: Technical/natural sciences

Publication information
Journal: NeuroImage
Volume: 9
Issue number: 3
ISSN (Print): 1053-8119
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 3.823 SNIP 1.752 CiteScore 6.31
Web of Science (2016): Indexed Yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 4.48 SNIP 1.84 CiteScore 6.71
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 4.201 SNIP 2.029 CiteScore 6.9
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 4.376 SNIP 2.026 CiteScore 7.06
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 3.922 SNIP 1.937 CiteScore 6.86
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 3.626 SNIP 1.81 CiteScore 6.31
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
On Condition Monitoring of Exhaust Values in Marine Diesel Engines

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Fog, T. L. (Intern), Hansen, L. K. (Intern), Larsen, J. (Intern), Hansen, H. (Ekstern), Madsen, L. (Ekstern), Sørensen, P. (Ekstern), Hansen, E. (Ekstern), Pedersen, P. (Ekstern)
Pages: 554-563
Publication date: 1999

Host publication information
Title of host publication: Proceedings of the 1999 IEEE Workshop on Neural Networks for Signal Processing IX
Place of publication: Piscataway
Publisher: IEEE
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 172645
Publication: Research - peer-review › Article in proceedings – Annual report year: 1999

Pturality and Resemblance in fMRI Data Analysis

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling, Massachusetts General Hospital, Harvard Medical School, Minneapolis VA Medical Center
Authors: Lange, N. (Ekstern), Strother, S. (Ekstern), Anderson, J. (Ekstern), Nielsen, F. Å. (Intern), Holmes, A. (Ekstern), Kolenda, T. (Intern), Savoy, R. (Ekstern), Hansen, L. K. (Intern)
Sonar discrimination of cylinders from different angles using neural networks

This paper describes an underwater object discrimination system applied to recognize cylinders of various compositions from different angles. The system is based on a new combination of simulated dolphin clicks, simulated auditory filters and artificial neural networks. The model demonstrates its potential on real data collected from four different cylinders in an environment where the angles were controlled in order to evaluate the models capabilities to recognize cylinders independent of angles.

A Multivariate Approach to Functional Neuro Modeling

This Ph.D. thesis, A Multivariate Approach to Functional Neuro Modeling, deals with the analysis and modeling of data from functional neuro imaging experiments. A multivariate dataset description is provided which facilitates efficient representation of typical datasets and, more importantly, provides the basis for a generalization theoretical framework relating model performance to model complexity and dataset size. Briefly summarized the major topics discussed in the thesis include: - An introduction of the representation of functional datasets by pairs of neuronal activity patterns and overall conditions governing the functional experiment, via associated micro- and macroscopic variables. The description facilitates an efficient microscopic re-representation, as well as a handle on the link between brain and behavior; the latter is achieved by hypothesizing variations in the micro- and macroscopic variables to be manifestations of an underlying system. - A review of two microscopic basis selection procedures, namely principal component analysis and independent component analysis, with respect to their applicability to functional datasets. - Quantitative model performance assessment via a generalization theoretical framework centered around measures of model generalization error. - Only few, if any, examples of the application of generalization theory to functional neuro modeling currently exist in the literature. - Exemplification of the proposed generalization theoretical framework by the application of linear and more flexible, nonlinear microscopic regression models to a real-world dataset. The dependency of model performance, as quantified by generalization error, on model flexibility and training set size is demonstrated, leading to the important realization that no uniformly optimal model exists. - Model visualization and interpretation techniques. The simplicity of this task for linear models contrasts the difficulties involved when dealing with nonlinear models. Finally, a visualization technique for nonlinear models is proposed. A single observation emerges from the thesis as particularly important;
optimal model flexibility is a function of both the complexity and the size of the dataset at hand. This is something that has not received appropriate attention by the functional neuro modeling community so far. The observation implies that optimal model performance rarely is achieved with black-box models; rather, model flexibility must be matched to the specific functional dataset. The potential advantage is a model that more precisely approximates the true nature of the relationship between brain and behavior, thus paving the way for increased insight into the function of the human brain.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Mørch, N. J. (Intern), Hansen, L. K. (Intern)
Publication date: Nov 1998

Publication information
Original language: English
Series: IMM-PHD-1998-47
Main Research Area: Technical/natural sciences
Electronic versions:
morch.thesis.pdf
Source: orbit
Source-ID: 200829
Publication: Research › Ph.D. thesis – Annual report year: 1998

Adaptive Regularization in Neural Network Modeling

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Copenhagen University Hospital
Authors: Larsen, J. (Intern), Svarer, C. (Ekstern), Andersen, L. N. (Intern), Hansen, L. K. (Intern)
Pages: 113-132
Publication date: 1998

Host publication information
Title of host publication: Neural Networks: Tricks of the Trade
Publisher: Springer-Verlag
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 170426
Publication: Research - peer-review › Article in proceedings – Annual report year: 1998

An Empirical Study of Statistical Model Complexity in Neuro-fMRI

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Harvard Medical School, Minneapolis VA Medical Center, MGH-NMR Center, CMRR
Authors: Lange, N. (Ekstern), Hansen, L. K. (Intern), Anderson, J. (Ekstern), Nielsen, F. Å. (Intern), Savoy, R. (Ekstern), KIM, S. (Ekstern), Strother, S. (Ekstern)
Publication date: 1998

Host publication information
Title of host publication: NeuroImage
Publisher: Academic Press
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 170263
Publication: Research › Article in proceedings – Annual report year: 1998

Biomedical Engineering at the Technical University of Denmark
The paper gives a brief overview of the biomedical engineering research and education at the Technical University of Denmark. An account of the research activities since the 1950’s is given, and examples of major efforts within ultrasound, biomagnetism, and neuroimaging are described. The evolution of the teaching activities since the late 1960’s along with an account of the recent initiatives to make a biomedical engineering profile at the university is described.
**Canonical Ridge Analysis with Ridge Parameter Optimization**

**General information**
- State: Published
- Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling, VA Medical Center, PET Imaging Service
- Publication date: 1998
- Main Research Area: Technical/natural sciences
- Functional neuroimaging, orthogonormalized partial least squares, canonical correlation analysis, regularization, canonical ridge

**Electronic versions:**
imm4981.pdf

**Bibliographical note**
More information about the model is available in the Phd-thesis of Finn Årup Nielsen.

**Source:** orbit
**Source-ID:** 200549
**Publication:** Research - peer-review › Conference abstract for conference – Annual report year: 1998

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**Delay analysis of fMRI time series**

**General information**
- State: Published
- Organisations: Department of Informatics and Mathematical Modeling, Massachusetts General Hospital, Minneapolis VA Medical Center
- Authors: Goutte, C. (Intern), Hansen, L. K. (Intern), Savoy, R. (Eksterm), Strother, S. C. (Eksterm)
- Publication date: 1998

**Host publication information**
- Title of host publication: NeuroImage
- Publisher: Academic Press
- Main Research Area: Technical/natural sciences
- Source: orbit
**Source-ID:** 168494
**Publication:** Research › Article in proceedings – Annual report year: 1998
Design of Robust Neural Network Classifiers

This paper addresses a new framework for designing robust neural network classifiers. The network is optimized using the maximum a posteriori technique, i.e., the cost function is the sum of the log-likelihood and a regularization term (prior). In order to perform robust classification, we present a modified likelihood function which incorporates the potential risk of outliers in the data. This leads to the introduction of a new parameter, the outlier probability. Designing the neural classifier involves optimization of network weights as well as outlier probability and regularization parameters. We suggest to adapt the outlier probability and regularisation parameters by minimizing the error on a validation set, and a simple gradient descent scheme is derived. In addition, the framework allows for constructing a simple outlier detector. Experiments with artificial data demonstrate the potential of the suggested framework.

General information

State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Larsen, J. (Intern), Andersen, L. N. (Intern), Hintz-Madsen, M. (Intern), Hansen, L. K. (Intern)
Pages: 1205-1208
Publication date: 1998
Lyngby - A toolbox for functional neuroimaging

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling, Department of Information Technology
Authors: Nielsen, F. Å. (Intern), Toft, P. (Ekstern), Liptrot, M. G. (Intern), Hansen, L. K. (Intern)
Publication date: 1998

Publication information
Original language: English
Publisher: Informatics and Mathematical Modelling, Technical University of Denmark
Main Research Area: Technical/natural sciences
functional neuroimaging, time series, fMRI, multivariate analysis, functional magnetic resonance, FIR filter, MATLAB, clustering
Links:
http://hendrix.imm.dtu.dk/software/lyngby/

Neural Classifier Construction using Regularization, Pruning
In this paper we propose a method for construction of feed-forward neural classifiers based on regularization and adaptive architectures. Using a penalized maximum likelihood scheme, we derive a modified form of the entropic error measure and an algebraic estimate of the test error. In conjunction with optimal brain damage pruning, a test error estimate is used to select the network architecture. The scheme is evaluated on four classification problems.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Pages: 1659-1670
Publication date: 1998
Main Research Area: Technical/natural sciences

Publication information
Journal: Neural Networks
Volume: 11
Issue number: 9
ISSN (Print): 0893-6080
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 1.394 SNIP 2.367 CiteScore 5.15
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.421 SNIP 2.231 CiteScore 3.97
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.108 SNIP 1.856 CiteScore 3.29
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 0.871 SNIP 2.066 CiteScore 3.18
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 0.921 SNIP 1.792 CiteScore 3.11
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Neural Networks in Functional Neuroimaging

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Hansen, L. K. (Intern), Mørch, N. J. (Intern), Nielsen, F. Å. (Intern)
Pages: 1-8
Publication date: 1998

Host publication information
Title of host publication: Proceedings of NORSIG’98, IEEE Nordic Signal Processing Symposium
Place of publication: Aalborg
Publisher: Aalborg University
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 170313
Publication: Research - peer-review » Article in proceedings – Annual report year: 1998

Neuroinformatics based on VRML

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Nielsen, F. Å. (Intern), Hansen, L. K. (Intern)
Publication date: 1998

Host publication information
Title of host publication: Neuro Imaging
Publisher: Academic Press
Main Research Area: Technical/natural sciences
MRI, neuroinformatics, magnetic resonance imaging, PET, positron emission tomography, neuroimaging, fMRI, VRML
Electronic versions:
imm4684.pdf
On Clustering fMRI time series

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Danish Research Centre for Magnetic Resonance
Authors: Goutte, C. (Intern), Toft, P. A. (Intern), Rostrup, E. (Ekstern), Nielsen, F. Å. (Intern), Hansen, L. K. (Intern)
Number of pages: 33
Publication date: 1998

Publication information
Original language: English
Main Research Area: Technical/natural sciences

Bibliographical note
A slightly different version will appear in NeuroImage in 1999.
Source: orbit
Source-ID: 169864
Publication: Research - peer-review › Report – Annual report year: 1998

On small sample experiments in neuroimaging

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Goutte, C. ( Intern), Hansen, L. K. (Intern)
Number of pages: 25
Publication date: 1998

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Links:
Source: orbit
Source-ID: 170401
Publication: Research - peer-review › Report – Annual report year: 1998

Optimized Combination, Regularization, and Pruning in Parallel Consensual Neural Networks

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Reykjavik University
Authors: Benediktsson, J. (Ekstern), Larsen, J. (Intern), Sveinsson, J. (Ekstern), Hansen, L. K. (Intern)
Publication date: 1998

Host publication information
Title of host publication: Proceedings of European Symposium on Remote Sensing, vol. 3500
Main Research Area: Technical/natural sciences
Conference: European Symposium on Remote Sensing, Barcelona, Spain, 01/01/1998
Source: orbit
Source-ID: 169867
Publication: Research - peer-review › Article in proceedings – Annual report year: 1998

Quantitative analysis of ultrasound B-mode images of carotid atherosclerotic plaque: correlation with visual classification and histological examination
This paper presents a quantitative comparison of three types of information available for 52 patients scheduled for carotid endarterectomy: subjective classification of the ultrasound images obtained during scanning before operation, first- and second-order statistical features extracted from regions of the plaque in still ultrasound images from three orthogonal scan planes and finally a histological analysis of the surgically removed plaque. The quantitative comparison was made with the linear model and with separation of the available data into training and test sets. The comparison of subjective
classification with features from still ultrasound images revealed an overall agreement of 60 % for classification of echogenicity and 70 % for classification of structure. Comparison of the histologically determined relative volume of soft materials with features from the still images revealed a correlation coefficient of $r = -0.42$ ($p = 0.002$), for mean echogenicity of the plaque region. The best performing feature was of second order and denoted Contrast ($r = -0.5$). Though significant, the latter correlation is probably not strong enough to be useful for clinical prediction of relative volume of soft materials for individual patients. Reasons for this is discussed in the paper, together with suggestions for improvements.

**General information**

State: Published
Organisations: Department of Information Technology, Cognitive Systems, Department of Informatics and Mathematical Modeling, Copenhagen University Hospital, University of Copenhagen
Authors: Wilhjelm, J. E. (Intern), Grønholdt, M. (Ekstern), Wiebe, B. (Ekstern), Jespersen, S. K. (Intern), Hansen, L. K. (Intern), Sillesen, H. (Ekstern)
Pages: 910-922
Publication date: 1998
Main Research Area: Technical/natural sciences

**Publication information**

Journal: IEEE Transactions on Medical Imaging
Volume: 17
Issue number: 6
ISSN (Print): 0278-0062
Ratings:
- BFI (2017): BFI-level 2
- Web of Science (2017): Indexed Yes
- BFI (2016): BFI-level 2
- Scopus rating (2016): SJR 1.522 SNIP 2.369 CiteScore 4.83
- Web of Science (2016): Indexed yes
- BFI (2015): BFI-level 2
- Scopus rating (2015): SJR 1.765 SNIP 2.68 CiteScore 4.9
- Web of Science (2015): Indexed yes
- BFI (2014): BFI-level 2
- Scopus rating (2014): SJR 1.407 SNIP 2.756 CiteScore 4.66
- Web of Science (2014): Indexed yes
- BFI (2013): BFI-level 2
- Scopus rating (2013): SJR 1.916 SNIP 3.2 CiteScore 5.55
- ISI indexed (2013): ISI indexed yes
- Web of Science (2013): Indexed yes
- BFI (2012): BFI-level 2
- Scopus rating (2012): SJR 1.545 SNIP 2.794 CiteScore 4.94
- ISI indexed (2012): ISI indexed yes
- Web of Science (2012): Indexed yes
- BFI (2011): BFI-level 2
- Scopus rating (2011): SJR 1.332 SNIP 2.583 CiteScore 4.59
- ISI indexed (2011): ISI indexed yes
- BFI (2010): BFI-level 2
- Scopus rating (2010): SJR 1.343 SNIP 2.619
- BFI (2009): BFI-level 2
- Scopus rating (2009): SJR 1.371 SNIP 3.352
- Web of Science (2009): Indexed yes
- BFI (2008): BFI-level 2
- Scopus rating (2008): SJR 1.404 SNIP 2.906
- Scopus rating (2007): SJR 1.627 SNIP 3.948
- Web of Science (2007): Indexed yes
- Scopus rating (2006): SJR 1.914 SNIP 3.337
- Web of Science (2006): Indexed yes
- Scopus rating (2005): SJR 1.796 SNIP 3.754
Source Separation in Short Image Sequences using Delayed Correlation

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Hansen, L. K. (Intern), Larsen, J. (Intern)
Pages: 253-256
Publication date: 1998

Host publication information
Title of host publication: Proceedings of NORSIG’98, IEEE Nordic Signal Processing Symposium Vigsø
Place of publication: Aalborg
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 169858
Publication: Research - peer-review › Article in proceedings – Annual report year: 1998

Space-time analysis of fMRI by feature space clustering

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Danish Research Centre for Magnetic Resonance, Copenhagen University Hospital
Authors: Goutte, C. (Intern), Nielsen, F. Å. (Intern), Svarer, C. (Ekstern), Rostrup, E. (Ekstern), Hansen, L. K. (Intern)
Publication date: 1998

Host publication information
Title of host publication: NeuroImage
Publisher: Academic Press
Main Research Area: Technical/natural sciences
Conference: 4th Int.Conf.on Functional Mapping of the Human Brain, Montreal, Canada, 01/01/1998
Source: orbit
Source-ID: 169859
Publication: Research › Article in proceedings – Annual report year: 1998
Optimization of recurrent neural networks for time series modeling
The present thesis is about optimization of recurrent neural networks applied to time series modeling. In particular, it is considered fully recurrent networks working from only a single external input, one layer of nonlinear hidden units, and a linear output unit applied to prediction of discrete time series. The overall objective is to improve training by application of second-order methods and to improve generalization ability by architecture optimization accomplished by pruning. The major topics covered in the thesis are: 1. The problem of training recurrent networks is analyzed from a numerical point of view. Especially it is analyzed how numerical ill-conditioning of the Hessian matrix might arise. 2. Training is significantly improved by application of the damped Gauss-Newton method, involving the Hessian. This method is found to outperform gradient descent in terms of both quality of solution obtained as well as computation time required. 3. A theoretical definition of the generalization error for recurrent networks is provided. This definition justifies a commonly adopted approach for estimating generalization ability. 4. The viability of pruning recurrent networks by the Optimal Brain Damage (OBD) and Optimal Brain Surgeon (OBS) pruning schemes is investigated. OBS is found to be very effective whereas OBS is severely influenced by numerical problems which leads to pruning of important weights. 5. A novel operational tool for examination of the internal memory of recurrent networks is proposed. The tool allows for assessment of the length of the effective memory of previous inputs built up in the recurrent network during application. Time series modeling is also treated from a more general point of view, namely modeling of the joint probability distribution function of the observed series. Two recurrent models rooted in statistical physics are considered in this respect, namely the "Boltzmann chain" and the "Boltzmann zipper" and a comprehensive tutorial on these models is provided. Boltzmann chains and zippers are found to benefit as well from second-order training and architecture optimization by pruning which is illustrated on artificial problems and a small speech recognition problem.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Pedersen, M. W. (Intern), Hansen, L. K. (Intern), Larsen, J. (Intern)
Number of pages: 322
Publication date: Oct 1997

Publication information
Original language: English
Series: IMM-PHD-1997-37
Main Research Area: Technical/natural sciences
Electronic versions:
thesis.pdf
Source: orbit
Source-ID: 200842
Publication: Research › Ph.D. thesis – Annual report year: 1997

Activations pattern reproducibility: Measuring the effects of group size and data analysis models

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Strother, S. (Ekstern), Lange, N. (Ekstern), Anderson, J. (Ekstern), Schaper, K. (Ekstern), Rehm, K. (Ekstern), Hansen, L. K. (Intern), Rottenberg, D. (Ekstern)
Pages: 312-316
Publication date: 1997
Main Research Area: Technical/natural sciences

Publication information
Journal: Human Brain Mapping
Volume: 5
Issue number: 4
ISSN (Print): 1065-9471
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 2.733 SNIP 1.346 CiteScore 5.06
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 3.184 SNIP 1.442 CiteScore 5.57
Web of Science (2015): Indexed yes
Adaptive Regularization in Neural Network Modelling

**General information**
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Larsen, J. (Intern), Svarer, C. (Ekstern), Andersen, L. N. (Intern), Hansen, L. K. (Intern), Orr, G. (ed.) (Ekstern), Muller, K. (ed.) (Ekstern), Caruana, R. (ed.) (Ekstern)
Publication date: 1997

**Publication information**
Publisher: Springer-Verlag
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 168422
Publication: Research - peer-review › Book – Annual report year: 1997

Adaptive Regularization of Neural Classifiers
We present a regularization scheme which iteratively adapts the regularization parameters by minimizing the validation error. It is suggested to use the adaptive regularization scheme in conjunction with optimal brain damage pruning to optimize the architecture and to avoid overfitting. Furthermore, we propose an improved neural classification architecture eliminating an inherent redundancy in the widely used SoftMax classification network. Numerical results demonstrate the
viability of the method

**General information**
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Pages: 24-33
Publication date: 1997

**Host publication information**
Title of host publication: Proceedings of the IEEE Workshop on Neural Networks for Signal Processing VII
Place of publication: Piscataway, New Jersey
Publisher: IEEE
ISBN (Print): 0-7803-4256-9
Main Research Area: Technical/natural sciences
Electronic versions: Andersen.pdf
DOIs: 10.1109/NNSP.1997.622380

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Source: orbit
Source-ID: 168477
Publication: Research - peer-review › Article in proceedings – Annual report year: 1997

**Comparison of two convolution models for fMRI time series**

**General information**
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Publication date: 1997
Event: Abstract from THIRD INTERNATIONAL CONFERENCE ON FUNCTIONAL MAPPING OF THE HUMAN BRAIN, Copenhagen, .
Main Research Area: Technical/natural sciences
Electronic versions: imm5215.pdf
Source: orbit
Source-ID: 200551
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 1997

**Comparison of two convolution models for fMRI time series**

**General information**
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Harvard University, Minneapolis VA Medical Center, Massachusetts General Hospital, Copenhagen University Hospital
Authors: Nielsen, F. Å. (Intern), Hansen, L. K. (Intern), Toft, P. (Ekstern), Goutte, C. (Intern), Lange, N. (Ekstern), Strother, S. C. (Ekstern), March, N. J. (Intern), Svarer, C. (Ekstern), Savoy, R. (Ekstern), Rosen, B. (Ekstern), Rostrup, E. (Ekstern), Born, P. (Ekstern)
Number of pages: 473
Publication date: 1997

**Host publication information**
Discussion of a Paper by Lange and Zeger

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Hansen, L. K. (Intern)
Pages: 24
Publication date: 1997
Main Research Area: Technical/natural sciences

Publication information
Volume: 46
ISSN (Print): 0035-9254
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 1.407 SNIP 1.692 CiteScore 1.75
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.085 SNIP 1.18 CiteScore 1.5
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.394 SNIP 0.99 CiteScore 1.34
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.32 SNIP 1.149 CiteScore 1.61
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 0.989 SNIP 1.133 CiteScore 1.31
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 0.809 SNIP 0.946 CiteScore 1.07
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 0.663 SNIP 0.901
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 0.849 SNIP 0.865
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.63 SNIP 1.447
Scopus rating (2007): SJR 1.208 SNIP 1.329
Scopus rating (2006): SJR 1.172 SNIP 1.598
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.009 SNIP 1.566
Scopus rating (2004): SJR 1.694 SNIP 1.317
Scopus rating (2003): SJR 1.502 SNIP 1.521
Scopus rating (2002): SJR 1.566 SNIP 1.506
Early Stop Criterion from the Bootstrap Ensemble
This paper addresses the problem of generalization error estimation in neural networks. A new early stop criterion based on a Bootstrap estimate of the generalization error is suggested. The estimate does not require the network to be trained to the minimum of the cost function, as required by other methods based on asymptotic theory. Moreover, in contrast to methods based on cross-validation which require data left out for testing, and thus biasing the estimate, the Bootstrap technique does not have this disadvantage. The potential of the suggested technique is demonstrated on various time-series problems.

Evaluating Statistical Parametric Mapping (SPM) analysis results using Leave-One-Out resampling in a 150-water PET functional activation study.

Evaluating Statistical Parametric Mapping (SPM) analysis results using Leave-One-Out resampling in a 150-water PET functional activation study.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Hansen, L. K. (Intern), Larsen, J. (Intern), Fog, T. L. (Intern)
Pages: 3205-3208
Publication date: 1997

Host publication information
Title of host publication: Proceedings of IEEE ICASSP'97
Place of publication: Munich, Germany
Publisher: IEEE
ISBN (Print): 0-8186-7919-0
Main Research Area: Technical/natural sciences
Conference: IEEE ICASSP'97, Munich, Germany, 01/01/1997
Electronic versions:
Hansen.pdf
DOI:
10.1109/ICASSP.1997.595474

Bibliographical note
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General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Svarer, C. (Ekstern), Strother, S. (Ekstern), Mørch, N. J. (Intern), Law, I. (Ekstern), Hansen, L. K. (Intern), Paulson, O. (Ekstern)
Pages: 374
Publication date: 1997
Main Research Area: Technical/natural sciences

Publication information
Journal: NeuroImage
Volume: 5
ISSN (Print): 1053-8119
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
How many Principal Components?

**General information**

State: Published
Organisations: Department of Informatics and Mathematical Modeling
Pages: 474
Publication date: 1997
Conference: Third International Conference on Functional Mapping of the Human Brain, Copenhagen, Denmark, 01/01/1997
Main Research Area: Technical/natural sciences

**Publication information**

Journal: NeuroImage
Volume: 5
Issue number: 4
ISSN (Print): 1053-8119
Ratings:
- BFI (2017): BFI-level 2
- Web of Science (2017): Indexed Yes
- BFI (2016): BFI-level 2
- Scopus rating (2016): SJR 3.823 SNIP 1.752 CiteScore 6.31
- Web of Science (2016): Indexed yes
- BFI (2015): BFI-level 2
- Scopus rating (2015): SJR 4.48 SNIP 1.84 CiteScore 6.71
- Web of Science (2015): Indexed yes
- BFI (2014): BFI-level 2
- Scopus rating (2014): SJR 4.201 SNIP 2.029 CiteScore 6.9
- Web of Science (2014): Indexed yes
- BFI (2013): BFI-level 2
- Scopus rating (2013): SJR 4.376 SNIP 2.026 CiteScore 7.06
- ISI indexed (2013): ISI indexed yes
- Web of Science (2013): Indexed yes
- BFI (2012): BFI-level 2
- Scopus rating (2012): SJR 3.922 SNIP 1.937 CiteScore 6.86
- ISI indexed (2012): ISI indexed yes
- Web of Science (2012): Indexed yes
- BFI (2011): BFI-level 2
- Scopus rating (2011): SJR 3.626 SNIP 1.81 CiteScore 6.31
- ISI indexed (2011): ISI indexed yes
- Web of Science (2011): Indexed yes
- BFI (2010): BFI-level 2
- Scopus rating (2010): SJR 3.573 SNIP 1.866
- Web of Science (2010): Indexed yes
- BFI (2009): BFI-level 2
- Scopus rating (2009): SJR 3.859 SNIP 1.897
- Web of Science (2009): Indexed yes
- BFI (2008): BFI-level 2
- Scopus rating (2008): SJR 4.094 SNIP 1.765
- Web of Science (2008): Indexed yes
- Scopus rating (2007): SJR 3.7 SNIP 1.981
Nonlinear Versus Linear Models in Functional Neuroimaging: Learning Curves and Generalization Crossover

**General information**
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Mørch, N. J. (Intern), Hansen, L. K. (Intern), Strother, S. (Ekstern), C., S. (Ekstern), Rottenberg, D. (Ekstern), Lautrup, B. (Ekstern), Savoy, R. (Ekstern), Paulson, O. (Ekstern), Duncan, J. (ed.) (Ekstern), Gindi, G. (ed.) (Ekstern)
Pages: 259-270
Publication date: 1997

**Host publication information**
Title of host publication: The 15th International Conference on Information Processing in Medical Imaging
Publisher: Springer Verlag
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 168621
Publication: Research - peer-review › Article in proceedings – Annual report year: 1997

Regularization with a pruning prior
We investigate the use of a regularization prior that we show has pruning properties. Analyses are conducted both using a Bayesian framework and with the generalization method, on a simple toy problem. Results are thoroughly compared with those obtained with a traditional weight decay.

**General information**
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Goutte, C. (Intern), Hansen, L. K. (Intern)
Pages: 1053-1059
Publication date: 1997
Main Research Area: Technical/natural sciences

**Publication information**
Journal: Neural Networks
Volume: 10
Issue number: 6
ISSN (Print): 0893-6080
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
The Error-Reject Trade-Off

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Hansen, L. K. (Intern), Liisberg, C. (Ekstern), Salamon, P. (Ekstern)
Pages: 159-184
Publication date: 1997
Main Research Area: Technical/natural sciences

Publication information
Journal: Open Systems and Information Dynamics
Volume: 4
ISSN (Print): 1230-1612
Ratings:
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.535 SNIP 0.964 CiteScore 1.08
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.533 SNIP 0.586 CiteScore 0.82
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.375 SNIP 0.478 CiteScore 0.62
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.45 SNIP 0.55 CiteScore 0.84
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.494 SNIP 0.718 CiteScore 1.01
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.517 SNIP 0.993 CiteScore 1.1
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.66 SNIP 0.664
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.741 SNIP 0.757
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.765 SNIP 0.721
Scopus rating (2007): SJR 0.562 SNIP 0.524
Scopus rating (2006): SJR 0.47 SNIP 0.7
Scopus rating (2005): SJR 0.293 SNIP 0.493
Scopus rating (2004): SJR 0.222 SNIP 0.408
Scopus rating (2003): SJR 0.164 SNIP 0.38
Scopus rating (2002): SJR 0.203 SNIP 0.5
Scopus rating (2001): SJR 0.32 SNIP 0.501
Scopus rating (2000): SJR 0.364 SNIP 0.525
Scopus rating (1999): SJR 0.179 SNIP 0.311
Original language: English
Source: orbit
Source-ID: 168609
Publication: Research - peer-review › Journal article – Annual report year: 1997

15-0 Water PET: More Noise than signal

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Hansen, L. K. (Intern), Strother, S. C. (Ekstern), Sidtis, J. J. (Ekstern), Anderson, J. R. (Ekstern), Schaper, K. (Ekstern), Rottenberg, D. A. (Ekstern)
A Concordance Correlation Coefficient for Reproducibility of Spatial Activation Patterns

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Hansen, L. K. (Intern), Lange, N. (Ekstern), Pedersen, M. W. (Intern), Savoy, R. L. (Ekstern), Strother, S. C. (Ekstern)
Number of pages: 75
Publication date: 1996

Host publication information
Title of host publication: NeuroImage
Volume: 3
Place of publication: Orlando, FL.
Publisher: Academic Press
Main Research Area: Technical/natural sciences
Conference: Second International Conference on Functional Mapping of the Human Brain, 01/01/1996
Source: orbit
Source-ID: 164794
Publication: Research - peer-review › Article in proceedings – Annual report year: 1996

An artificial Neural Net Approach to Estimation of the Glucose Methabolism Using PET

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Mørch, N. J. (Intern), Svarer, C. (Ekstern), Law, I. (Ekstern), Holm, S. (Ekstern), Hasselbalch, S. (Ekstern), Hansen, L. K. (Intern), Paulson, O. B. (Ekstern)
Publication date: 1996

Host publication information
Title of host publication: Qualification of Brain Function Using PET
Publisher: Academic Press
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 164957
Publication: Research › Article in proceedings – Annual report year: 1996

A Nonlinear 3D Brain Co-registration Method

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Kjems, U. (Intern), Philipsen, P. A. (Intern), Hansen, L. K. (Intern)
Publication date: 1996

Host publication information
Title of host publication: Proceedings of the Interdisciplinary Inversion workshop 4, 1996, IMM, DTU
Main Research Area: Technical/natural sciences
Conference: The Interdisciplinary Inversion workshop 4, IMM, DTU, Lyngby, DK, 01/01/1996
Source: orbit
Source-ID: 166804
Publication: Research › Article in proceedings – Annual report year: 1996
Brain Mapping by Positron Emission Tomography

Cross validation in LULOO
The leave-one-out cross-validation scheme for generalization assessment of neural network models is computationally expensive due to replicated training sessions. Linear unlearning of examples has recently been suggested as an approach to approximative cross-validation. Here we briefly review the linear unlearning scheme, dubbed LULOO, and we illustrate it on a system identification example. Further, we address the possibility of extracting confidence information (error bars) from the LULOO ensemble.

Design and evaluation of neural classifiers
In this paper we propose a method for the design of feedforward neural classifiers based on regularization and adaptive architectures. Using a penalized maximum likelihood scheme we derive a modified form of the entropy error measure and an algebraic estimate of the test error. In conjunction with optimal brain damage pruning the test error estimate is used to optimize the network architecture. The scheme is evaluated on an artificial and a real world problem.
Design and regularization of neural networks: the optimal use of a validation set
We derive novel algorithms for estimation of regularization parameters and for optimization of neural net architectures based on a validation set. Regularisation parameters are estimated using an iterative gradient descent scheme. Architecture optimization is performed by approximative combinatorial search among the relevant subsets of an initial neural network architecture by employing a validation set based optimal brain damage/surgeon (OBD/OBS) or a mean field combinatorial optimization approach. Numerical results with linear models and feed-forward neural networks demonstrate the viability of the methods.

Detection of Malignant Melanoma using Neural Classifiers

Solving Engineering Problems with Neural Networks. Proceedings of the International Conference on Engineering Applications of Neural Networks (EANN'96)

Bibliographical note
Copyright 1996 IEEE. Personal use of this material is permitted. However, permission to reprint/republish this material for advertising or promotional purposes or for creating new collective works for resale or redistribution to servers or lists, or to reuse any copyrighted component of this work in other works must be obtained from the IEEE
Source: orbit
Source-ID: 166763
Publication: Research - peer-review › Article in proceedings – Annual report year: 1996
Digital Image Analysis of Ultrasound B-mode Images of Carotid Atherosclerotic Plaque: Correlation with Histological Examination

This paper reports on a study of how well texture features extracted from B-mode images of atherosclerotic plaque correlates with histological results obtained from the same plaque after carotid endarterectomy. The study reveals that a few second order texture features (diagonal moment, standard deviation and autocorrelation) provide good correlation within the training set (p = 0.04); However, the correlation found so far is not so high, that the method can be used in clinical prediction of plaque constituents.

General information
State: Published
Organisations: Electronics & Signal Processing, Department of Electrical Engineering, Department of Information Technology, Department of Informatics and Mathematical Modeling, Technical University of Denmark, University of Copenhagen
Authors: Wilhjelm, J. E. (Intern), Rosendal, K. (Ekstern), Granholdt, M. M. (Ekstern), Jespersen, S. K. (Intern), Hansen, L. K. (Intern), Sillesen, H. (Ekstern)
Pages: 353-354
Publication date: 1996

Host publication information
Title of host publication: Proceedings of the 10th Nordic-Baltic Conference on Biomedical Engineering
Volume: 34/1
Main Research Area: Technical/natural sciences
Conference: 10th Nordic-Baltic Conference on Biomedical Engineering, Tempere, Finland, 09/06/1996 - 09/06/1996
Source: orbit
Source-ID: 187991
Publication: Research - peer-review › Article in proceedings – Annual report year: 1996

Generalization Performance of Nonlinear vs Linear Models for [150] water PET Functional Activation Studies

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Mørch, N. J. (Intern), Hansen, L. K. (Intern), Strother, S. C. (Ekstern), Law, I. (Ekstern), Svarer, C. (Ekstern), Lautrup, B. (Ekstern), Anderson, J. R. (Ekstern), Lange, N. (Ekstern), Paulson, O. B. (Ekstern)
Pages: 258
Publication date: 1996
Main Research Area: Technical/natural sciences

Publication information
Journal: NeuroImage
Volume: 3
Issue number: 3
ISSN (Print): 1053-8119
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 3.823 SNIP 1.752 CiteScore 6.31
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 4.48 SNIP 1.84 CiteScore 6.71
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 4.201 SNIP 2.029 CiteScore 6.9
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 4.376 SNIP 2.026 CiteScore 7.06
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Intelligent Predictive Control of Nonlinear Processes Using Neural Networks

This paper presents a novel approach to design of generalized predictive controllers (GPC) for nonlinear processes. A neural network is used for modelling the process and a gain-scheduling type of GPC is subsequently designed. The combination of neural network models and predictive control has frequently been discussed in the neural network community. This paper proposes an approximate scheme, the approximate predictive control (APC), which facilitates the implementation and gives a substantial reduction in the required amount of computations. The method is based on a technique for extracting linear models from a nonlinear neural network and using them in designing the control system. The performance of the controller is demonstrated in a simulation study of a pneumatic servo system.
Linear Unlearning for Cross-Validation

The leave-one-out cross-validation scheme for generalization assessment of neural network models is computationally expensive due to replicated training sessions. In this paper we suggest linear unlearning of examples as an approach to approximative cross-validation. Further, we discuss the possibility of exploiting the ensemble of networks offered by leave-one-out for performing ensemble predictions. We show that the generalization performance of the equally weighted ensemble predictor is identical to that of the network trained on the whole training set. Numerical experiments on the sunspot time series prediction benchmark demonstrate the potential of the linear unlearning technique.
Mean Field Reconstruction with Snaky Edge Hints: INVERSE METHODS - Interdisciplinary elements of Methodology, Computation and Application

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Philipsen, P. A. (Intern), Hansen, L. K. (Intern), Toft, P. A. (Intern)
Pages: 312-319
Publication date: 1996

Host publication information
Title of host publication: Lecture Notes on Earth Science
Publisher: Springer-Verlag
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 313221
Publication: Research - Book chapter – Annual report year: 1996

Mean Field Reconstruction with Snaky Edge Hints

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Philipsen, P. A. (Intern), Hansen, L. K. (Intern), Toft, P. A. (Intern)
Pages: 312-319
Publication date: 1996

Host publication information
Title of host publication: Proceedings of the Interdisciplinary Inversion Conference on Methodology, Computation and Integrated Applications IIC’95 1996
Place of publication: Berlin
Publisher: Springer Verlag
Main Research Area: Technical/natural sciences
Conference: The Interdisciplinary Inversion Conference on Methodology, Computation and Integrated Applications, IIC’95 1995, 01/01/1995
Source: orbit
Neural Networks for Sonogram Gap Filling

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Hansen, L. K. (Intern), Klebæk, H. (Ekstern), Jensen, J. A. (Ekstern)
Pages: 1553-1556
Publication date: 1996

Host publication information
Title of host publication: Proceedings of the 1995 IEEE International Ultrasonics Symposium
Main Research Area: Technical/natural sciences
Conference: UFFC'95, Seattle, 01/01/1995
Source-ID: 164795
Publication: Research - peer-review › Article in proceedings – Annual report year: 1996

NNCTRL - a CANCSD toolkit for MATLAB(R)
A set of tools for computer-aided neuro-control system design (CANCSD) has been developed for the MATLAB environment. The tools can be used for construction and simulation of a variety of neural network based control systems. The design methods featured in the toolkit are: direct inverse control, internal model control, feedforward, feedback linearization, optimal control, instantaneous linearization, and nonlinear predictive control. Furthermore, the toolkit has been given a flexible design which allows for incorporation of the user's personal control algorithms

General information
State: Published
Organisations: Department of Automation
Authors: Nørgård, P. M. (Intern), Ravn, O. (Intern), Poulsen, N. K. (Intern), Hansen, L. K. (Intern)
Pages: 368-373
Publication date: 1996

Host publication information
Title of host publication: Proceedings of the 1996 IEEE Symposium on Computer-Aided Control System Design
Publisher: IEEE
ISBN (Print): 07-80-33032-3
Main Research Area: Technical/natural sciences
Electronic versions:
Nørgaard.pdf
DOIs:
10.1109/CACSD.1996.555320

Bibliographical note
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Source-ID: 167350
Publication: Research - peer-review › Article in proceedings – Annual report year: 1996

Pruning with Generalization Based Weight Saliencies: g- OBD, g- OBS

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Pedersen, M. W. (Intern), Hansen, L. K. (Intern), Larsen, J. (Intern)
Pages: 521-528
Publication date: 1996

Host publication information
Regularization of Neural Networks

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Copenhagen University Hospital
Authors: Larsen, J. (Intern), Hansen, L. K. (Intern), Svarer, C. (Ekstern)
Publication date: 1996

Host publication information
Title of host publication: Proceedings of the 4th Interdisciplinary Workshop
Main Research Area: Technical/natural sciences
Conference: The 4th Interdisciplinary Workshop. Tech. Univ. of Denmark, Lyngby, 01/01/1996
Source: orbit
Source-ID: 164959
Publication: Research › Article in proceedings – Annual report year: 1996

Revealing Structural Effects In Functional Imaging with Anatomical Warps

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Number of pages: 137
Publication date: 1996

Host publication information
Title of host publication: NeuroImage, Proceedings of the Second International Conference on Functional Mapping of the Human Brain
Publisher: Academic Press
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 166770
Publication: Research - peer-review › Article in proceedings – Annual report year: 1996

Revisiting Boltzmann learning: parameter estimation in Markov random fields
This article presents a generalization of the Boltzmann machine that allows us to use the learning rule for a much wider class of maximum likelihood and maximum a posteriori problems, including both supervised and unsupervised learning. Furthermore, the approach allows us to discuss regularization and generalization in the context of Boltzmann machines. We provide an illustrative example concerning parameter estimation in an inhomogeneous Markov field. The regularized adaptation produces a parameter set that closely resembles the “teacher” parameters, hence, will produce segmentations that closely reproduce those of the inhomogeneous teacher network

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Hansen, L. K. (Intern), Andersen, L. N. (Intern), Kjems, U. (Intern), Larsen, J. (Intern)
Pages: 3394-3397
Publication date: 1996

Host publication information
Title of host publication: Proceedings of the IEEE International Conference on Acoustics, Speech and Signal Processing
Volume: Volume 6
Publisher: IEEE
ISBN (Print): 07-80-33192-3
The NNSYSID Toolbox - A MATLAB Toolbox for System Identification with Neural Networks

To assist the identification of nonlinear dynamic systems, a set of tools has been developed for the MATLAB(R) environment. The tools include a number of different model structures, highly effective training algorithms, functions for validating trained networks, and pruning algorithms for determination of optimal network architectures. The toolbox should be regarded as a nonlinear extension to the system identification toolbox provided by The MathWorks, Inc. This paper gives a brief overview of the entire collection of toolbox functions.

Unsupervised Learning and Generalization

The concept of generalization is defined for a general class of unsupervised learning machines. The generalization error is a straightforward extension of the corresponding concept for supervised learning, and may be estimated empirically using a test set or by statistical means-in close analogy with supervised learning. The empirical and analytical estimates are compared for principal component analysis and for K-means clustering based density estimation.
Design and evaluation of neural classifiers application to skin lesion classification

Addresses design and evaluation of neural classifiers for the problem of skin lesion classification. By using Gauss Newton optimization for the entropic cost function in conjunction with pruning by Optimal Brain Damage and a new test error estimate, the authors show that this scheme is capable of optimizing the architecture of neural classifiers. Furthermore, error-reject tradeoff theory indicates, that the resulting neural classifiers for the skin lesion classification problem are near-optimal.

Empirical generalization assessment of neural network models

This paper addresses the assessment of generalization performance of neural network models by use of empirical techniques. We suggest to use the cross-validation scheme combined with a resampling technique to obtain an estimate of the generalization performance distribution of a specific model. This enables the formulation of a bulk of new generalization performance measures. Numerical results demonstrate the viability of the approach compared to the standard technique of using algebraic estimates like the FPE. Moreover, we consider the problem of comparing the generalization performance of different competing models. Since all models are trained on the same data, a key issue is to take this dependency into account. The optimal split of the data set of size N into a cross-validation set of size Ny and a training set of size N(1-γ) is discussed. Asymptotically (large data sees), γopt→1 such that a relatively larger amount is left for validation.
Neural network for sonogram gap filling

In duplex imaging both an anatomical B-mode image and a sonogram are acquired, and the time for data acquisition is divided between the two images. This gives problems when rapid B-mode image display is needed, since there is not time for measuring the velocity data. Gaps then appear in the sonogram and in the audio signal, rendering the audio signal useless, thus making diagnosis difficult. The current goal for ultrasound scanners is to maintain a high refresh rate for the B-mode image and at the same time attain a high maximum velocity in the sonogram display. This precludes the intermixing of the B-mode and sonogram pulses, and time must be shared between the two. Gaps will appear frequently in the sonogram since, e.g., half the time is spent on B-mode acquisition. The information in the gaps can be filled from the available information through interpolation. One possibility is to use a neural network for predicting mean frequency of the velocity signal and its variance. The neural network then predicts the evolution of the mean and variance in the gaps, and the sonogram and audio signal are reconstructed from these. The technique is applied on in-vivo data from the carotid artery. The neural network is trained on part of the data and the network is pruned by the optimal brain damage procedure in order to reduce the number of parameters in the network, and thereby reduce the risk of overfitting. The neural predictor is compared to using a linear filter for the mean and variance time series, and is shown to yield better results, i.e., the variances of the predictions are lower. The ability of the neural predictor to reconstruct both the sonogram and the audio signal, when only 50% of the time is used for velocity data acquisition, is demonstrated for the in-vivo data.
Training and evaluation of neural networks for multivariate time series processing

We study the training and generalization for multivariate time series processing. It is suggested to use a quasi-maximum likelihood approach rather than the standard sum of squared errors, thus taking dependencies among the errors of the individual time series into account. This may lead to improved generalization performance. Further, we extend the optimal brain damage pruning technique to the multivariate case. A key ingredient is an algebraic expression for the generalization ability of a multivariate model. The variability of the suggested techniques is successfully demonstrated in a multivariate scenario involving the prediction of the cylinder pressure in a marine engine.

Visualization of neural networks using saliency maps

The saliency map is proposed as a new method for understanding and visualizing the nonlinearities embedded in feedforward neural networks, with emphasis on the ill-posed case, where the dimensionality of the input-field by far exceeds the number of examples. Several levels of approximations are discussed. The saliency maps are applied to medical imaging (PET-scans) for identification of paradigm-relevant regions in the human brain.
Adaptive regularization

Regularization, e.g., in the form of weight decay, is important for training and optimization of neural network architectures. In this work the authors provide a tool based on asymptotic sampling theory, for iterative estimation of weight decay parameters. The basic idea is to do a gradient descent in the estimated generalization error with respect to the regularization parameters. The scheme is implemented in the authors' Designer Net framework for network training and pruning, i.e., is based on the diagonal Hessian approximation. The scheme does not require essential computational overhead in addition to what is needed for training and pruning. The viability of the approach is demonstrated in an experiment concerning prediction of the chaotic Mackey-Glass series. The authors find that the optimized weight decays are relatively large for densely connected networks in the initial pruning phase, while they decrease as pruning proceeds.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems, Technical University of Denmark
Authors: Hansen, L. K. (Intern), Rasmussen, C. E. (Intern), Svarer, C. (Ekstern), Larsen, J. (Intern)
Pages: 78-87
Publication date: 1994

Host publication information
Title of host publication: Proceedings of the 4th IEEE Workshop Neural Networks for Signal Processing
Publisher: IEEE
ISBN (Print): 0-780-32026-3
Main Research Area: Technical/natural sciences
Electronic versions:
Carl.pdf
DOIs:
10.1109/NNSP.1994.366061

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Source: orbit
Source-ID: 264879
Publication: Research - peer-review › Article in proceedings – Annual report year: 1994

Generalization performance of regularized neural network models

Architecture optimization is a fundamental problem of neural network modeling. The optimal architecture is defined as the one which minimizes the generalization error. This paper addresses estimation of the generalization performance of regularized, complete neural network models. Regularization normally improves the generalization performance by restricting the model complexity. A formula for the optimal weight decay regularizer is derived. A regularized model may be characterized by an effective number of weights (parameters); however, it is demonstrated that no simple definition is possible. A novel estimator of the average generalization error (called FPER) is suggested and compared to the final prediction error (FPE) and generalized prediction error (GPE) estimators. In addition, comparative numerical studies demonstrate the qualities of the suggested estimator.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Larsen, J. (Intern), Hansen, L. K. (Intern)
Pages: 42-51
Publication date: 1994
Neural estimation of kinetic rate constants from dynamic PET-scans

A feedforward neural net is trained to invert a simple three compartment model describing the tracer kinetics involved in the metabolism of [18F]fluorodeoxyglucose in the human brain. The network can estimate rate constants from positron emission tomography sequences and is about 50 times faster than direct fitting of rate constants using the parametrized transients of the compartment model.

Towards semen quality assessment using neural networks

The paper presents the methodology and results from a neural net based classification of human sperm head morphology. The methodology uses a preprocessing scheme in which invariant Fourier descriptors are lumped into “energy” bands. The resulting networks are pruned using optimal brain damage. Performance comparable to the error rate for human technicians is obtained.
Designer networks for time series processing

The conventional tapped-delay neural network may be analyzed using statistical methods and the results of such analysis can be applied to model optimization. The authors review and extend efforts to demonstrate the power of this strategy within time series processing. They attempt to design compact networks using the so-called optima brain damage (OBD) method. The benefits from compact architectures are three-fold. Their generalization ability is at least comparable, they involve less computational burden, and they are faster to adapt if the environment changes. It is shown that the generalization error of the network may be estimated, without extensive cross-validation, using a modification of Akaike's final prediction error (FPE) estimate (1969).

On design and evaluation of tapped-delay neural network architectures

Pruning and evaluation of tapped-delay neural networks for the sunspot benchmark series are addressed. It is shown that the generalization ability of the networks can be improved by pruning using the optimal brain damage method of Le Cun, Denker and Solla. A stop criterion for the pruning algorithm is formulated using a modified version of Akaike's final prediction error estimate. With the proposed stop criterion, the pruning scheme is shown to produce successful architectures with a high yield.
Boltzmann learning of parameters in cellular neural networks

The use of Bayesian methods to design cellular neural networks for signal processing tasks and the Boltzmann machine learning rule for parameter estimation is discussed. The learning rule can be used for models with hidden units, or for completely unsupervised learning. The latter is exemplified by unsupervised adaptation of an image segmentation cellular network. The learning rule is applied to adaptive segmentation of satellite imagery.

Ensemble methods for handwritten digit recognition

Neural network ensembles are applied to handwritten digit recognition. The individual networks of the ensemble are combinations of sparse look-up tables (LUTs) with random receptive fields. It is shown that the consensus of a group of
networks outperforms the best individual of the ensemble. It is further shown that it is possible to estimate the ensemble performance as well as the learning curve on a medium-size database. In addition the authors present preliminary analysis of experiments on a large database and show that state-of-the-art performance can be obtained using the ensemble approach by optimizing the receptive fields. It is concluded that it is possible to improve performance significantly by introducing moderate-size ensembles; in particular, a 20-25% improvement has been found. The ensemble random LUTs, when trained on a medium-size database, reach a performance (without rejects) of 94% correct classification on digits written by an independent group of people.

**General information**
State: Published
Organisations: Risø National Laboratory for Sustainable Energy
Authors: Hansen, L. K. (Intern), Liisberg, C. (Intern), Salamon, P. (Ekstern)
Publication date: 1992

**Host publication information**
Title of host publication: Proceedings of the IEEE-SP Workshop Neural Networks for Signal Processing
Publisher: IEEE
ISBN (Print): 0-7803-0557-4
Main Research Area: Technical/natural sciences
Electronic versions:
Liisberg.pdf
DOIs:
10.1109/NNSP.1992.253679

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Source: orbit
Source-ID: 264712
Publication: Research - peer-review › Article in proceedings – Annual report year: 1992

**Neural Network Ensembles**
We propose several means for improving the performance an training of neural networks for classification. We use crossvalidation as a tool for optimizing network parameters and architecture. We show further that the remaining generalization error can be reduced by invoking ensembles of similar networks.

**General information**
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Hansen, L. K. (Intern), Salamon, P. (Ekstern)
Pages: 993-1001
Publication date: 1990
Main Research Area: Technical/natural sciences

**Publication information**
Journal: IEEE Transactions on Pattern Analysis and Machine Intelligence
Volume: 12
ISSN (Print): 0162-8828
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 6.298 SNIP 6.317 CiteScore 13.59
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 5.357 SNIP 7.658 CiteScore 12.66
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 4.024 SNIP 7.97 CiteScore 11.05
On the Peierls Transition in a Periodic Potential

The properties of a one-dimensional conductor in the presence of an external periodic potential VQ have been investigated. The low temperature gap is enhanced, the temperature dependence of the gap $\Delta(T)$ is smeared at TPF, the Peierls transition temperature in the absence of VQ, and hence there is no longer a real phase transition. We also relate the phase pinning frequency $\omega_\theta$ to the size of VQ.

**General information**

State: Published  
Organisations: Department of Informatics and Mathematical Modeling, Department of Mechanical Engineering  
Authors: Hansen, L. K. (Intern), da Costa Carneiro, K. (Intern)  
Pages: 531-535  
Publication date: 1984  
Main Research Area: Technical/natural sciences

**Publication information**

Journal: Solid State Communications  
Volume: 49  
Issue number: 6  
ISSN (Print): 0038-1098  
Ratings:  
BFI (2017): BFI-level 1  
Web of Science (2017): Indexed Yes  
BFI (2016): BFI-level 1
Projects:

Causal fingerprints of brain connectivity

Department of Applied Mathematics and Computer Science
Period: 01/07/2017 → 30/06/2020
Number of participants: 4
PhD Student:
Krohne, Lærke Karen (Intern)
Supervisor:
Hansen, Lars Kai (Intern)
Main Supervisor:
Madsen, Kristoffer Hougaard (Intern)
Siebner, Hartwig R. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Improving customer experience and retention with Big Data analytics
Department of Applied Mathematics and Computer Science
Period: 01/04/2017 → 31/03/2020
Number of participants: 5
Phd Student:
Kowalczyk, Damian (Intern)
Supervisor:
Derungs, Jörg (Ekstern)
Hansen, Lars Kai (Intern)
Kjall, Uffe (Ekstern)
Main Supervisor:
Larsen, Jan (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Industrial PhD
Project: PhD

Big Data Analytics with special emphasis on Food Supply Chain Data
Department of Applied Mathematics and Computer Science
Period: 15/03/2017 → 14/03/2020
Number of participants: 3
Phd Student:
Vermue, Laurent (Intern)
Supervisor:
Hansen, Lars Kai (Intern)
Main Supervisor:
Ersbøll, Bjarne Kjær (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansierede - Virksomhed
Project: PhD

Big Data Analytics with special emphasis on Food Supply Chain Data(2/2)
Department of Applied Mathematics and Computer Science
Period: 01/01/2017 → 31/12/2019
Number of participants: 3
Phd Student:
Jørgensen, Philip Johan Havemann (Intern)
Supervisor:
Hansen, Lars Kai (Intern)
Main Supervisor:
Ersbøll, Bjarne Kjær (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD
Big Data Analytics with special emphasis on Food Supply Chain data

Department of Applied Mathematics and Computer Science
Period: 01/12/2016 → 30/11/2019
Number of participants: 3
Phd Student:
Ipsen, Niels Bruun (Intern)
Supervisor:
Hansen, Lars Kai (Intern)
Main Supervisor:
Ersbøll, Bjarne Kjær (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Learning to Read and Think

Department of Applied Mathematics and Computer Science
Period: 01/10/2016 → 30/09/2019
Number of participants: 3
Phd Student:
Nørregaard, Jeppe (Intern)
Supervisor:
Larsen, Jan (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Ultra-long term subcutaneous EEG monitoring of brain function and disease

Department of Applied Mathematics and Computer Science
Period: 01/09/2016 → 31/08/2019
Number of participants: 4
Phd Student:
Gangstad, Sirin Wilhelmsen (Intern)
Supervisor:
Duun-Henriksen, Jonas (Intern)
Kjær, Troels Wesenberg (Ekstern)
Main Supervisor:
Hansen, Lars Kai (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Industrial PhD
Project: PhD

Machine Learning as a Service

Department of Applied Mathematics and Computer Science
Period: 01/07/2016 → 30/06/2019
Number of participants: 3
Phd Student:
Zdyb, Franciszek Olaf (Intern)
Supervisor:
Ersbøll, Bjarne Kjær (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Geometrical aspects of manifold learning
Department of Applied Mathematics and Computer Science
Period: 01/12/2015 → 30/11/2018
Number of participants: 3
Phd Student:
Arvanitidis, Georgios (Intern)
Supervisor:
Hauberg, Søren (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Decreasing the spatial uncertainty in non-invasive brain stimulation, EEG and MEG based on advanced head modelling
Department of Applied Mathematics and Computer Science
Period: 15/10/2015 → 14/10/2018
Number of participants: 4
Phd Student:
Nielsen, Jesper Duemose (Intern)
Supervisor:
Madsen, Kristoffer Hougaard (Intern)
Thielscher, Axel (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Monitoring and modelling of behavioural changes using smartphone and wearable sensing
Department of Applied Mathematics and Computer Science
Period: 01/03/2015 → 05/08/2018
Number of participants: 3
Phd Student:
Kamronn, Simon Due (Intern)
Supervisor:
Hansen, Lars Kai (Intern)
Main Supervisor:
Larsen, Jakob Eg (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansierede - Virksomhed
Project: PhD
A multi-modal modelling approach to schizophrenia
Supervised and Unsupervised machine learning methods for subtyping and prediction

Department of Applied Mathematics and Computer Science
Period: 15/12/2014 → 14/12/2017
Number of participants: 3
Phd Student:
Axelsen, Martin Christian (Intern)
Supervisor:
Bak, Nikolaj (Ekstern)
Main Supervisor:
Hansen, Lars Kai (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Machine learning for portable EEG devices: Long term monitoring of brain states

Department of Applied Mathematics and Computer Science
Period: 15/12/2014 → 27/02/2018
Number of participants: 3
Phd Student:
Poulsen, Andreas Trier (Intern)
Supervisor:
Kouider, Sid (Ekstern)
Main Supervisor:
Hansen, Lars Kai (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Active Bayesian Sensing

Department of Applied Mathematics and Computer Science
Period: 01/03/2014 → 31/03/2017
Number of participants: 6
Phd Student:
Andersen, Michael Riis (Intern)
Supervisor:
Winther, Ole (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Schmidt, Mikkel Nørgaard (Intern)
Heskes, Tom (Ekstern)
Theodoridis, Sergios (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Offentlig finansiering

Relations
Publications:
Probabilistic models for structured sparsity
Project: PhD

Bayesian Modelling of Functional Whole Brain Connectivity
Bayesian Modelling of Functional Whole Brain Connectivity

Data analysis and participant privacy protection in a large-scale computational social science experiment

Modeling Structural Brain Connectivity
Mørup, Morten (Intern)
Examiner:
Hansen, Lars Kai (Intern)
Jbabdi, Saad (Ekstern)
Thiran, Jean-Philippe (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: 1/3 FUU, 1/3 inst 1/3 Andet

Relations
Publications:
Modeling Structural Brain Connectivity
Project: PhD

Præcis og hurtig neurofeedback med billeddannelse EEG
Department of Applied Mathematics and Computer Science
Period: 15/03/2013 → 29/07/2016
Number of participants: 6
Phd Student:
Hansen, Sofie Therese (Intern)
Supervisor:
Stahhut, Carsten (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Andersen, Tobias (Intern)
Heskes, Tom (Ekstern)
Kjær, Troels Wesenberg (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)

Relations
Publications:
EEG Based Inference of Spatio-Temporal Brain Dynamics
Project: PhD

Machine learning tools for navigation of audio data
Department of Applied Mathematics and Computer Science
Period: 15/12/2012 → 18/01/2017
Number of participants: 6
Phd Student:
Troelsgaard, Rasmus (Intern)
Supervisor:
Larsen, Jan (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Mørup, Morten (Intern)
Jensen, Søren Holdt (Intern)
Theodoridis, Sergios (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)

Relations
Publications:
Modelling Digital Media Objects
Project: PhD

**Temoral Dynamics of High Resolution Networks**
Department of Applied Mathematics and Computer Science
Period: 01/04/2012 → 13/08/2015
Number of participants: 6
Phd Student:
Sekara, Vedran (Intern)
Supervisor:
Jensen, Mogens Hegh (Ekstern)
Main Supervisor:
Jørgensen, Sune Lehmann (Intern)
Examiner:
Hansen, Lars Kai (Intern)
Bagrow, James (Ekstern)
Holme, Johan Petter (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Eksternt finansieret virksomhed
Project: PhD

**Inferring intentions from brain data in real-time**
Department of Applied Mathematics and Computer Science
Number of participants: 7
Phd Student:
Stanek, Konrad (Intern)
Supervisor:
Hansen, Lars Kai (Intern)
Siebner, Hartwig R. (Ekstern)
Main Supervisor:
Winther, Ole (Intern)
Examiner:
Andersen, Tobias (Intern)
Brass, Marcel (Ekstern)
Maris, Eric (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU) Samf.

**Relations**
Publications:
Inferring human intentions from the brain data
Project: PhD

**Personalized Music Organization Systems**
Department of Applied Mathematics and Computer Science
Period: 15/12/2011 → 23/10/2015
Number of participants: 6
Phd Student:
Madsen, Jens (Intern)
Supervisor:
Hansen, Lars Kai (Intern)
Main Supervisor:
Larsen, Jan (Intern)
Examiner:
Schmidt, Mikkel Nørgaard (Intern)
Pearce, Marcus Thomas (Ekstern)
Theodoridis, Sergios (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: 1/3 FUU, 1/3 inst 1/3 Andet

Relations
Publications:
Predicting the emotions expressed in music
Project: PhD

Statistical learning for predictive targeting in online advertising
Department of Applied Mathematics and Computer Science
Period: 01/12/2011 → 04/03/2015
Number of participants: 6
Phd Student:
Fruergaard, Bjarne Ørum (Intern)
Supervisor:
Urban, Jesper (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Winther, Ole (Intern)
Candela, Joaquin (Ekstern)
Igel, Christian (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: ErhvervsPhD-ordningen VTU
Project: PhD

Multi-modal analysis of EEG data
Department of Applied Mathematics and Computer Science
Period: 01/10/2011 → 25/05/2016
Number of participants: 6
Phd Student:
Frølich, Laura (Intern)
Supervisor:
Marup, Morten (Intern)
Main Supervisor:
Andersen, Tobias (Intern)
Examiner:
Hansen, Lars Kai (Intern)
Debener, Stefan (Ekstern)
Dyrholm, Mads (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Modelling the structure of complex networks
Department of Applied Mathematics and Computer Science
Mapping the functional integration in the human basal ganglia by means of multi-modal magnetic resonance imaging

Department of Applied Mathematics and Computer Science
Period: 01/12/2010 → 26/05/2014
Number of participants: 8
PhD Student:
Andersen, Kasper Winther (Intern)
Supervisor:
Dyrby, Tim Bjørn (Intern)
Madsen, Kristoffer Hougaard (Intern)
Siebner, Hartwig R. (Ekstern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Winther, Ole (Intern)
Heskes, Tom (Ekstern)
Thirion, Bertrand (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Large Scale Machine Learning in High-dimensional Data

Department of Informatics and Mathematical Modeling
Period: 01/04/2010 → 30/08/2013
Number of participants: 5
PhD Student:
Hansen, Toke Jansen (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Winther, Ole (Intern)
Kjær, Troels Wesenberg (Ekstern)
Müller, Klaus-Robert (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD
Knowledge Discovery in the Blogosphere
Department of Informatics and Mathematical Modeling
Period: 01/09/2009 → 31/10/2011
Number of participants: 2
Phd Student:
Szewczyk, Marcin Marek (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Kernel Methods for Machine Learning with life-sciences applications
Department of Informatics and Mathematical Modeling
Period: 01/08/2009 → 30/08/2013
Number of participants: 6
Phd Student:
Abrahamsen, Trine Julie (Intern)
Supervisor:
Winther, Ole (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Larsen, Jan (Ekstern)
Jensen, Søren Holdt (Intern)
Kaski, Samuel (Ekstern)
Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Systems neuroimaging: Modeling non-linear information processing networks
Department of Informatics and Mathematical Modeling
Period: 01/08/2009 → 01/11/2015
Number of participants: 2
Phd Student:
Klinkby, Kristian Tjalsfe (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Active learning in cognitive information processing systems
Department of Informatics and Mathematical Modeling
Period: 01/04/2009 → 19/04/2013
Number of participants: 6
Phd Student:
Jensen, Bjørn Sand (Intern)
Supervisor:
Hansen, Lars Kai (Intern)
Electrophysiological correlates of spatiotemporal attention in humans

Department of Informatics and Mathematical Modeling
Period: 01/04/2009 → 21/09/2012
Number of participants: 6
Phd Student:
Nielsen, Simon (Intern)
Supervisor:
Hansen, Lars Kai (Intern)
Main Supervisor:
Andersen, Tobias (Intern)
Examiner:
Marup, Morten (Intern)
Kyllingsbæk, Søren (Intern)
Nieuwenstein, Mark R. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Integrative multimodal brain imaging

Department of Informatics and Mathematical Modeling
Period: 15/12/2008 → 30/04/2012
Number of participants: 6
Phd Student:
Rasmussen, Peter Mondrup (Intern)
Supervisor:
Lund, Torben E. (Ekstern)
Madsen, Kristoffer Hougaard (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Larsen, Jan (Ekstern)
Siebner, Hartwig R. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Machine Learning and Signal Processing in Miniaturized Sensor for Explosive Detection

Department of Informatics and Mathematical Modeling
Period: 01/10/2008 → 17/06/2013
Number of participants: 5
Phd Student:
Alstrøm, Tommy Sonne (Intern)
Knowledge Discovery in Neuroinformatics

Department of Informatics and Mathematical Modeling
Period: 01/05/2008 → 30/11/2011
Number of participants: 5
PhD Student:
Wilkowski, Bartlomiej (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Larsen, Jan (Ekstern)
Kidmose, Preben (Intern)
Mandic, Danilo P. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Machine Learning for Integrating Biological Data Across Experimental Technologies

Department of Informatics and Mathematical Modeling
Period: 15/02/2008 → 01/06/2011
Number of participants: 5
PhD Student:
Henao, Ricardo (Intern)
Main Supervisor:
Winther, Ole (Intern)
Examiner:
Hansen, Lars Kai (Intern)
Girolami, Mark (Ekstern)
Vehtari, Aki (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU) Samf.
Project: PhD

Probabilistic Methods for Biomedical Signals

Department of Informatics and Mathematical Modeling
Period: 15/02/2008 → 31/08/2011
Number of participants: 6
PhD Student:
Stahlhut, Carsten (Intern)
Supervisor:
Winther, Ole (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Larsen, Jan (Ekstern)
Müller, Klaus-Robert (Ekstern)
Sörnmo, Leif (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Image Analysis of Food Quality
Department of Informatics and Mathematical Modeling
Period: 01/01/2008 → 28/09/2011
Number of participants: 7
Phd Student:
Arngren, Morten (Intern)
Supervisor:
Hansen, Per W. (Ekstern)
Larsen, Rasmus (Intern)
Main Supervisor:
Larsen, Jan (Intern)
Examiner:
Hansen, Lars Kai (Intern)
vanden Berg, Frans W.J. (Intern)
Dias, Jose M. Bioucas (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: ErhvervsPhD-ordningen VTU
Project: PhD

Cognitive components for contextual search of music
Department of Informatics and Mathematical Modeling
Period: 01/07/2007 → 29/09/2010
Number of participants: 5
Phd Student:
Petersen, Michael Kai (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Larsen, Jan (Ekstern)
Honkela, Timo (Ekstern)
Sikström, Sverker (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Cognitive Components in Sound Streams
Department of Informatics and Mathematical Modeling
Period: 01/09/2006 → 21/04/2010
Number of participants: 7
Phd Student:
Petersen, Anders (Intern)
Supervisor:
Hansen, Lars Kai (Intern)
Kyllingsbæk, Søren (Intern)
Main Supervisor:
Andersen, Tobias (Intern)
Examiner:
Larsen, Jan (Ekstern)
Bundesen, Claus (Ekstern)
Logan, Gordon D. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Eksternt finansieret virksomhed
Project: PhD

Search in Spoken Documents
Department of Informatics and Mathematical Modeling
Period: 01/04/2006 → 16/12/2009
Number of participants: 6
Phd Student:
Mølgaard, Lasse Lohilahti (Intern)
Supervisor:
Hansen, Lars Kai (Intern)
Main Supervisor:
Larsen, Jan (Intern)
Examiner:
Winther, Ole (Intern)
Andreasen, Troels (Ekstern)
Girolami, Mark (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Molecular Brain Imaging - New Data-analytic Strategies
Department of Informatics and Mathematical Modeling
Period: 15/03/2006 → 31/10/2007
Number of participants: 2
Phd Student:
Böðvarsson, Bjarni (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Eksternt finansieret virksomhed
Project: PhD

Godkendelse og sporing af tømmerstokke ved 3D-billedbehandling
Department of Informatics and Mathematical Modeling
Period: 15/10/2005 → 27/05/2009
Number of participants: 7
Phd Student:
Dahl, Anders Bjorholm (Intern)
Supervisor:
Aanæs, Henrik (Intern)
Tarp-Johansen, Mads Jeppe (Ekstern)
Main Supervisor:
Ersbøll, Bjarne Kjær (Intern)
Examiner:
Hansen, Lars Kai (Intern)
Demirci, M. Fatih (Ekstern)
Sauter, Udo Hans (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: ErhvervsPhD-ordningen VTU
Project: PhD

**Signalbehandling for proactive pervasive computing**

Department of Informatics and Mathematical Modeling
Period: 01/10/2005 → 05/05/2009
Number of participants: 5
Phd Student:
Nielsen, Andreas Brinch (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Larsen, Jan (Ekstern)
Jensen, Søren Holdt (Intern)
Oja, Erkki (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

**Læring og Interaktionsdesign af tekst input på mobile enheder**

Department of Informatics and Mathematical Modeling
Period: 01/08/2005 → 01/07/2009
Number of participants: 6
Phd Student:
Proschowsky, Morten Smidt (Intern)
Supervisor:
Schultz, Nette (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Larsen, Jan (Ekstern)
Dunlop, Mark (Ekstern)
Sikström, Sverker (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

**Probabilistic Methods in Multiple Target Tracking**

Department of Informatics and Mathematical Modeling
Period: 01/08/2005 → 18/08/2010
Number of participants: 4
Phd Student:
Brink, Frederik Ettrup (Intern)
Supervisor:
Dall, Jørgen (Intern)
Tuxen, Fredrik (Ekstern)
Integration and Modeling of Medical Signals

Department of Informatics and Mathematical Modeling
Period: 01/03/2005 → 29/09/2008
Number of participants: 7
PhD Student: Mørup, Morten (Intern)
Supervisor: Amfred, Sidsæ Marie (Ekstern)
Winther, Ole (Intern)
Main Supervisor: Hansen, Lars Kai (Intern)
Examiner: Larsen, Jan (Ekstern)
Bro, Rasmus (Intern)
Müller, Klaus-Robert (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: ErhvervsPhD-ordningen VTU
Project: PhD

Development of Clinical Spectroscopy with High Field MR-scanners

Department of Informatics and Mathematical Modeling
Period: 01/02/2005 → 31/03/2010
Number of participants: 6
PhD Student: de Nijs, Robin (Intern)
Supervisor: Hanson, Lars G. (Intern)
Main Supervisor: Hansen, Lars Kai (Intern)
Examiner: Larsen, Jan (Ekstern)
Björkman-Burtscher, Isabella M. (Ekstern)
Lonsdale, Markus Nowak (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Kvantitativ tractografi: Statistisk modellering af hjernens neurale forbindelser med diffusion tensor imaging

Department of Informatics and Mathematical Modeling
Period: 01/02/2005 → 28/11/2008
Number of participants: 7
PhD Student: Dyrby, Tim Bjørn (Intern)
Supervisor: Baaré, William F. C. (Ekstern)
Waldemar, Gunhild (Ekstern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Winther, Ole (Intern)
Poline, Jean-Baptiste (Ekstern)
Stødkilde-Jørgensen, Hans (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Ansat eksternt
Project: PhD

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**Signal separation using independent component analysis with explicit source modelling**

Department of Informatics and Mathematical Modeling
Period: 01/02/2005 → 28/01/2009
Number of participants: 4
Phd Student:
Schmidt, Mikkel Nørgaard (Intern)
Main Supervisor:
Larsen, Jan (Intern)
Examiner:
Hansen, Lars Kai (Intern)
Jutten, Christian (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

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**Understanding Multi-Agent Sound Environments**

Department of Informatics and Mathematical Modeling
Period: 01/02/2005 → 28/11/2008
Number of participants: 5
Phd Student:
Feng, Ling (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Larsen, Jan (Ekstern)
Honkela, Timo (Ekstern)
Kyllingsbæk, Søren (Intern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

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**Detektering af falske ekkoer i data fra vejrradar**

Department of Informatics and Mathematical Modeling
Period: 01/10/2004 → 05/11/2008
Number of participants: 8
Phd Student:
Bøvith, Thomas (Ekstern)
Supervisor:
Gill, Rashpal S. (Ekstern)
Hansen, Lars Kai (Intern)
Overgaard, Søren (Ekstern)
Main Supervisor:
Nielsen, Allan Aabjerg (Intern)
Examiner:
Larsen, Rasmus Werner (Intern)
Michelson, Daniel B. (Ekstern)
Rasmussen, Michael Robdrup (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: 1/3 DTU-stip, 2/3 FUR/andet
Project: PhD

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**Funktionelle hjørnebilleder - Modellering og data-analyse**
Department of Informatics and Mathematical Modeling
Period: 01/09/2004 → 17/06/2009
Number of participants: 8
Phd Student:
Madsen, Kristoffer Hougaard (Intern)
Supervisor:
Larsen, Axel (Ekstern)
Lund, Torben E. (Ekstern)
Sidaros, Karam (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Larsen, Jan (Ekstern)
Adali, Tulay (Ekstern)
Kjær, Troels Wesenberg (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

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**State Space Models of Sound Environments - Analysis by Synthesis**
Department of Informatics and Mathematical Modeling
Period: 01/05/2004 → 05/11/2007
Number of participants: 5
Phd Student:
Olsson, Rasmus Kongsgaard (Ekstern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Larsen, Jan (Ekstern)
Anemüller, Jörn (Ekstern)
Jensen, Søren Holdt (Intern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Eksternt finansieret virksomhed
Project: PhD

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**Matematisk modellering af multimedie netværk**
Department of Informatics and Mathematical Modeling
Period: 01/02/2004 → 03/09/2007
Number of participants: 5
Phd Student: 
Jørgensen, Sune Lehmann (Intern) 
Main Supervisor: 
Hansen, Lars Kai (Intern) 
Examiner: 
Larsen, Jan (Ekstern) 
Cox, Ingemar (Intern) 
Johansen, Peter (Ekstern) 

Financing sources 
Source: Internal funding (public) 
Name of research programme: DTU-lønnet stipendie 
Project: PhD

Automated Characterization and Recognition of 2D and 3D Brain Structure in MRI for Diagnostic Support 
Department of Informatics and Mathematical Modeling 
Number of participants: 5 
Phd Student: 
Sjöstrand, Karl (Intern) 
Main Supervisor: 
Larsen, Rasmus (Intern) 
Examiner: 
Hansen, Lars Kai (Intern) 
Hastie, Trevor J. (Ekstern) 
Åström, Karl (Ekstern)

Financing sources 
Source: Internal funding (public) 
Name of research programme: DTU-lønnet stipendie 
Project: PhD

Functional Data Analysis in Medical Signal Processing 
Department of Informatics and Mathematical Modeling 
Period: 15/09/2003 → 31/05/2007 
Number of participants: 5 
Phd Student: 
Jacobsen, Danjal Jakup (Intern) 
Main Supervisor: 
Hansen, Lars Kai (Intern) 
Examiner: 
Winther, Ole (Intern) 
Nørgård, Peter Magnus (Intern) 
Poline, Jean-Baptiste (Ekstern) 

Financing sources 
Source: Internal funding (public) 
Name of research programme: DTU-lønnet stipendie 
Project: PhD

Probabilistic Networks: Diagnostic Decision Support Systems 
Department of Informatics and Mathematical Modeling 
Period: 15/05/2003 → 05/11/2007 
Number of participants: 6 
Phd Student: 
Andersen, Morten Nonboe (Intern) 
Supervisor: 
Hansen, Lars Kai (Intern)
Main Supervisor:
Winther, Ole (Intern)

Examiner:
Nielsen, Bo Friis (Intern)
Gerds, Thomas Alexander (Ekstern)
Heskes, Tom (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Webmining: Finding Meaning in Distributed Signals on the Internet
Department of Informatics and Mathematical Modeling
Period: 01/04/2003 → 30/06/2006
Number of participants: 7
Phd Student:
Meng, Anders (Intern)
Supervisor:
Hansen, Lars Kai (Intern)
Rose, Michael (Intern)
Main Supervisor:
Larsen, Jan (Intern)
Examiner:
Winther, Ole (Intern)
Casey, Michael A. (Ekstern)
Riis, Søren Kamaric (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU, Samfinansiering
Project: PhD

Spatio-Temporal Analysis of Electro-Encephalography Data
Department of Informatics and Mathematical Modeling
Period: 01/02/2003 → 07/09/2006
Number of participants: 5
Phd Student:
Dyrholm, Mads (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Larsen, Jan (Ekstern)
Anemüller, Jörn (Ekstern)
Jensen, Søren Holdt (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Web-mining: Finding meaning in distributed signals on the internet
Department of Informatics and Mathematical Modeling
Period: 01/09/2002 → 13/03/2006
Number of participants: 6
Phd Student:
Madsen, Rasmus Elsborg (Intern)
Supervisor:
Larsen, Jan (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Winther, Ole (Intern)
Kaski, Samuel (Ekstern)
Svendsen, Michael Ø. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Condition Monitoring and Management from Acoustic Emissions
Department of Informatics and Mathematical Modeling
Period: 01/06/2002 → 18/11/2005
Number of participants: 6
Phd Student:
Pontoppidan, Niels Henrik Bohl (Intern)
Supervisor:
Fog, Torben L. (Intern)
Main Supervisor:
Larsen, Jan (Intern)
Examiner:
Hansen, Lars Kai (Intern)
Gustafsson, Fredrik (Ekstern)
Steel, John Alexander (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Anden EU-finansiering
Project: PhD

Tomographic Reconstruction using Anatomical Regularisation
Department of Informatics and Mathematical Modeling
Period: 01/06/2002 → 13/03/2006
Number of participants: 7
Phd Student:
Høgh-Rasmussen, Esben (Intern)
Supervisor:
Hansen, Per Christian (Intern)
Svarer, Claus (Ekstern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Larsen, Jan (Ekstern)
Andersen, Jens Damgaard (Ekstern)
Berry, Michael W. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Ansat eksternt
Project: PhD

New approximation Methods for Non-linear Signal Processing Systems
Department of Informatics and Mathematical Modeling
Period: 01/05/2002 → 02/01/2006
Number of participants: 5
Phd Student:
Petersen, Kaare Brandt (Ekstern)
Supervisor:
Hansen, Lars Kai (Intern)
Main Supervisor:
Winther, Ole (Intern)
Examiner:
Söderberg, Bo (Ekstern)
Valpola, Harri (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Eksternt finansieret virksomhed
Project: PhD

Tools for Multi-Media Signal Processing the "binding" Problem
Department of Informatics and Mathematical Modeling
Period: 01/04/2002 → 20/10/2005
Number of participants: 6
Phd Student:
Lehn-Schiøler, Tue (Intern)
Supervisor:
Larsen, Jan (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Winther, Ole (Intern)
Müller, Klaus-Robert (Ekstern)
Viberg, Mats (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Bayesian Modelling for Multi-Agent control
Department of Informatics and Mathematical Modeling
Period: 01/04/2001 → 01/10/2004
Number of participants: 6
Phd Student:
Quinonero, Joaquin (Intern)
Supervisor:
Rasmussen, Carl Edward (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Nielsen, Bo Friis (Intern)
Andersen, Jens Damgaard (Ekstern)
Williams, Christopher K. I. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Eksternt EU-finansieret
Project: PhD
Statistical Image Segmentation in 3D and 4D
Department of Informatics and Mathematical Modeling
Period: 01/01/2001 → 04/06/2004
Number of participants: 6
Phd Student:
Stegmann, Mikkel Bille (Intern)
Supervisor:
Larsen, Rasmus (Intern)
Larsson, Henrik B.W. (Ekstern)
Main Supervisor:
Ersbøll, Bjarne Kjær (Intern)
Examiner:
Hansen, Lars Kai (Intern)
Sonka, Milan (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Signal Processing in Humanitarian Demining
The aim is to investigate the possibilities for multisensor based system for detection and classification of buried landmines. The main focus is on signal and image processing techniques for improvement of Ground Penetrating Radar detection system

Department of Informatics and Mathematical Modeling
Biomedical Engineering
Department of Electrical Engineering
NDRF
Period: 01/11/2000 → 30/10/2003
Number of participants: 5
Project participant:
Jakobsen, Kaj Bjarne (Intern)
Karlsen, Brian (Intern)
Nymann, Ole (Ekstern)
Project Manager, organisational:
Hansen, Lars Kai (Intern)
Sørensen, Helge Bjarup Dissing (Intern)

Mapping Visual Cortical Regions in Awake, Behaving Monkey using Functional MRI (MAPAWAMO)
Most of our understanding of the human visual system comes from comparison with experimental data, especially single-cell data, obtained in monkeys. The problem has been that one has to compare results obtained not only in different species but also with different techniques. A considerable advance could be made if one could compare the functional imaging results in human to those obtained with the same technique in monkeys and then in a second step compare within the same species functional imaging data with single-cell or other experimental data. To that end one needs functional magnetic resonance imaging (fMRI) in the awake, behaving monkey. The overall aim is to perfect the monkey fMRI technique already in place in order to compare different types of fMRI analysis with an existing metabolic mapping standard in the monkey and to compare directly cortical networks in human and non human primates. We will use fMRI to map visual cortical regions responsive to different types of visual stimuli and active in visual discrimination tasks in monkeys and in humans. We will within the same monkey subject compare activation maps measured with fMRI and those obtained by metabolic labeling (double label 2deoxyglucose - 2DG). This latter data will serve as “ground truth” with which to compare the results of the different analysis techniques for the fMRI signals. We will also use ICA to develop new tools to estimate functional connectivity and compare this to the extensive anatomical knowledge available in the monkey.

Department of Informatics and Mathematical Modeling
Medical School
R.U. Neurophysiology
French National Institute for Computer Science and Applied Mathematics
Period: 01/09/2000 → 31/08/2003
Number of participants: 3
Project participant:
Nielsen, Finn Årup (Intern)
Dyrholm, Mads (Intern)
Project Manager, organisational:
Hansen, Lars Kai (Intern)

Datamining in distributed medial databases
Department of Informatics and Mathematical Modeling
Period: 01/07/2000 → 16/02/2004
Number of participants: 6
Phd Student:
Have, Anna Szynkowiak (Intern)
Supervisor:
Hansen, Lars Kai (Intern)
Main Supervisor:
Larsen, Jan (Intern)
Examiner:
Winther, Ole (Intern)
Hulle, Marc Van (Ekstern)
Svarer, Claus (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Ansat eksternt CAMP
Project: PhD

Natural networks for data editing and imputation
Department of Informatics and Mathematical Modeling
Period: 01/03/2000 → 05/12/2001
Number of participants: 2
Phd Student:
Larsen, Bjørn Steen (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Offentlig finansiering
Project: PhD

Bayesiansk signalbehandling og detektion
Department of Informatics and Mathematical Modeling
Period: 01/01/2000 → 25/09/2003
Number of participants: 7
Phd Student:
Fabricius, Thomas (Intern)
Supervisor:
Nørklit, Ole (Ekstern)
Rasmussen, Carl Edward (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Larsen, Jan (Ekstern)
Fleury, Bernard H. (Ekstern)
Rasmussen, Lars Kildehøj (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: DTU-lønnnet stipendie
Project: PhD

**Signal processing for diagnosis support systems**
Department of Informatics and Mathematical Modeling
Period: 01/12/1999 → 06/10/2003
Number of participants: 6
Phd Student:
Sigurdsson, Sigurdur (Intern)
Supervisor:
Larsen, Jan (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Winther, Ole (Intern)
Andersen, Jens Damgaard (Ekstern)
Benediktsson, Jón Atli (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

**Multichannel adaptive analysis of rotating systems**
Department of Informatics and Mathematical Modeling
Period: 01/09/1999 → …
Number of participants: 8
Phd Student:
Pedersen, Thorkild Find (Intern)
Supervisor:
Gram-Hansen, Klaus (Ekstern)
Hansen, Per Christian (Intern)
Herlufsen, Henrik (Ekstern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Sørensen, Helge Bjarup Dissing (Intern)
Pedersen, Jacob Mørch (Ekstern)
Randall, R. B. (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Erhvervsforskerordningen
Project: PhD

**Det medicotekniske grundlag for MR-perfusionsmåling med kontraststof**
Department of Informatics and Mathematical Modeling
Period: 01/08/1999 → 28/03/2003
Number of participants: 6
Phd Student:
Andersen, Irene Klærke (Intern)
Supervisor:
Signal and Image Processing for Telemedicine (SITE).

Project No. 3135. The rapid development in sensor technology, signal processing methods and parallel computing technology has enabled the physical realization of complex mathematical models in a diversity of scientific and industrial areas. This beginning interdisciplinary convergence of methodologies in science and technology has already had an impact on several industries and is emerging in medical imaging and more generally in telemedicine. It seems very likely that bringing together specialists from the mentioned areas could further boost the development of medical information processing in Denmark. Such considerations also head to incorporating the disciplines signal processing, scientific computing, and image analysis in the Department of Mathematical Modelling (IMM) together with applied mathematical physics, numerical analysis, operations research, and statistics. Furthermore, there has been established a close co-operation between scientist from DTU and several departments from different hospitals and university clinics.

Department of Informatics and Mathematical Modeling
Period: 01/07/1999 → 30/06/2003
Number of participants: 9
Project participant:
Madsen, Kaj (Intern)
Hansen, Per Christian (Intern)
Hansen, Lars Kai (Intern)
Ersbøll, Bjarne Kjær (Intern)
Carstensen, Jens Michael (Intern)
Larsen, Jan (Intern)
Sørensen, John Aasted (Intern)
Sigurdsson, Sigurdur (Intern)
Project Manager, organisational:
Conradsen, Knut (Intern)
Project

Modelling og digital signalbehandling for MR-baseret måling af blodgennemstrømning

Department of Informatics and Mathematical Modeling
Period: 01/02/1999 → 27/09/2002
Number of participants: 6
Phd Student:
Sidaros, Karam (Intern)
Supervisor:
Larsson, Henrik B. W. (Ekstern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Larsen, Jan (Ekstern)
Calamante, Fernando (Ekstern)
Schaumburg, Kjeld (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD
Source Localisation from EEG
Patients with severe epilepsy may sometimes be cured by removing tissue containing "epileptogenic" centre from the brain, through a surgical procedure. Multielectrode EEG recordings can help to pinpoint the location of the epileptogenic centre through inverse modelling, using eg dipole models, and spheric or anatomically based head models. The project aims to identify capabilities of existing software and algorithms and their further potential for use in clinical work.

Department of Informatics and Mathematical Modeling
Period: 01/01/1999 → 31/03/1999
Number of participants: 4
Project participant:
Rasmussen, Carl Edward (Intern)
Madsen, Flemming-Find (Ekstern)
Hoegenhaven, Hans (Ekstern)
Project Manager, organisational:
Hansen, Lars Kai (Intern)

Financing sources
Source: Unknown
Name of research programme: Ukendt
Amount: 75,000.00 Danish Kroner
Project

Adaptive tools for shared virtual environments

Department of Informatics and Mathematical Modeling
Period: 01/10/1998 → 26/09/2002
Number of participants: 7
Phd Student:
Kolenda, Thomas (Intern)
Supervisor:
Christensen, Niels Jørgen (Intern)
Larsen, Jan (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Sørensen, Helge Bjarup Dissing (Intern)
Andreasen, Troels (Ekstern)
Jensen, Søren Holdt (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsstipendium
Project: PhD

Data Mining in Hydraulics

Department of Informatics and Mathematical Modeling
Period: 01/10/1998 → 14/06/2002
Number of participants: 6
Phd Student:
Keijzer, Maarten (Intern)
Supervisor:
Babovic, Vladan (Ekstern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Larsen, Jan (Ekstern)
Banzhaf, Wolfgang (Ekstern)
Mayoh, Brian (Ekstern)
Identification of mental states from EEG
Analysis of multichannel EEG from subjects engaged in meditation is carried out for the purpose of characterising this mental state.

Department of Informatics and Mathematical Modeling
Period: 01/10/1998 → 31/12/1998
Number of participants: 3
Project participant:
Rasmussen, Carl Edward (Intern)
Kjaer, Troels W. (Ekstern)
Project Manager, organisational:
Hansen, Lars Kai (Intern)

Multikanal systemer til kombineret adaptiv støjreduction og signalseperation
Department of Informatics and Mathematical Modeling
Period: 01/09/1998 → 14/06/2002
Number of participants: 8
PhD Student:
Kidmose, Preben (Intern)
Supervisor:
Hansen, Steffen Duus (Intern)
Hansen, Per Christian (Intern)
Sørensen, John Aasted (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Larsen, Jan (Ekstern)
Hanssen, Alfred (Ekstern)
Nolan, John (Ekstern)

Modellerings, visualisering og metaanalyse af hjernebilleder
Department of Informatics and Mathematical Modeling
Period: 01/05/1998 → 11/09/2002
Number of participants: 6
PhD Student:
Nielsen, Finn Årup (Intern)
Supervisor:
Larsen, Jan (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Thyregod, Poul (Intern)
Andersen, Jens Damgaard (Ekstern)
Ph. D. Project: Finn Årup Nielsen: Analysis, Visualization and Metaanalysis of Neuroimages

Department of Informatics and Mathematical Modeling
Period: 01/04/1998 → 31/03/2001
Number of participants: 3
Project participant:
Larsen, Jan (Intern)
Nielsen, Finn Årup (Intern)

Project Manager, organisational:
Hansen, Lars Kai (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsstipendium
Project: PhD

THOR Center for Neuroinformatics

Neuroinformatics is a research field rooted in classical disciplines like signal processing, biology, physics, computer science and engineering. Neuroinformatics combines learning from the brain and learning about the brain. By studying information processing in the brain neuroinformatics invents new computing paradigms (e.g., artificial neural networks) with the objective of understanding the dynamics of the conscious mind. Neuroinformatics is a key component of a US research program, the Human Brain Project which is supported by all the major American governmental funding agencies and hosted by the National Institute of Health. The geographically and scientifically distributed nature of the collaborating research groups involved in this interdisciplinary neuroscience effort calls for new visual and interactive means of communication. A point strongly emphasized in this program is the need for using the World Wide Web for communication and dissemination of results. With partners in the Copenhagen area we have established the "Copenhagen Brain Research Center".

Department of Informatics and Mathematical Modeling
Period: 01/04/1998 → ...
Number of participants: 3
Project participant:
Larsen, Jan (Intern)
Nielsen, Finn Årup (Intern)

Project Manager, organisational:
Hansen, Lars Kai (Intern)

Financing sources
Source: Unknown
Name of research programme: Ukendt
Amount: 1,616,400.00 Danish Kroner
Source: Unknown
Name of research programme: Ukendt
Amount: 3,610,000.00 Danish Kroner

Ph.D. Project: Pedro Hoejen Soerensen: Statistical Analysis of Dynamical Brain Scans

This project concerns basic research in spatio-temporal modelling of functional magnetic resonance images. Methods for identification of significant change in image sequences will be developed and applied to neuroimaging.

Department of Informatics and Mathematical Modeling
Period: 01/02/1998 → 31/01/2001
Number of participants: 3
Project participant:
Hoejen-Sørensen, Pedro (Intern)
Larsen, Jan (Intern)

Project Manager, organisational:
Hansen, Lars Kai (Intern)
ADAPTIVE TOOLS FOR SHARED VIRTUAL ENVIRONMENTS under

Fully immersive virtual environments, while proven useful in many specialized contexts still suffer from relatively high costs and complexity. In this task we will use and expand the already existing VR installations for experiments on immersive multi-user virtual environments. VRML - Virtual Reality Modeling Language - a Web standard which allows interactive access to low-end, but platform independent, hyperlinked virtual environments is a promising candidate for standard workplace VR. We hypothesise that a multi-user interactive virtual environment will be a productive platform for communication of complex data, models, products and organizations. Such environments can be realised on high-end graphics platforms, providing immersion at high speeds in realistic scenery, or alternatively on generic platforms based on Web standards, with emphasis on interaction between geographically remote users in spatial hypertexts. Further we hypothesize that life in complex multiuser environments will meet a number of basic challenges relating to navigation, communication and physical comfort, challenges that are best overcome with the assistance of adaptive software agents.

Cognitive Systems

Department of Informatics and Mathematical Modeling
Aarhus University
Period: 01/01/1998 → 31/12/2001
Number of participants: 6
Project participant:
Larsen, Jan (Intern)
Kolenda, Thomas (Intern)
Christiansen, Torben (Intern)
Christensen, Niels Jørgen (Intern)
Project Manager, organisational:
Hansen, Lars Kai (Intern)
Høøck, Jens (Ekstern)
Heøck, Jens (Ekstern)
Project
Thyregod, Poul (Intern)
Main Supervisor:
Madsen, Henrik (Intern)
Examiner:
Hansen, Lars Kai (Intern)
Olsen, Eli Vibeke (Ekstern)
Sundberg, Rolf (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Erhvervsforskerordningen
Project: PhD

Signalbehandling i Delfinens Sonarsystem
Department of Informatics and Mathematical Modeling
Period: 01/09/1996 → 15/05/2000
Number of participants: 5
Phd Student:
Andersen, Lars Nonboe (Intern)
Supervisor:
Hansen, Jan (Intern)
Main Supervisor:
Larsen, Jan (Intern)
Examiner:
Dalsgaard, Paul (Ekstern)
Sørensen, Helge Bjarup Dissing (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-Su Stipendium, Eksperiment
Project: PhD

Statistical learning theory and neural networks
Study some statistical aspects of learning with linear and non-linear models. Use generalization theory. Study aspects of different learning procedures to analyze their relationship.

Department of Informatics and Mathematical Modeling
Period: 01/09/1996 → 15/09/1997
Number of participants: 2
Project participant:
Hansen, Lars Kai (Intern)
Project Manager, organisational:
Goutte, Cyril (Intern)

Adaptiv signalbehandling og detektion af modermærkekraft
Department of Informatics and Mathematical Modeling
Period: 01/03/1995 → …
Number of participants: 5
Phd Student:
Hintz-Madsen, Mads (Intern)
Supervisor:
Larsen, Jan (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Lautrup, Benny (Ekstern)
Wulf, Hans Christian (Ekstern)
Rekonstruktion og segmentering af PET-scan data

Department of Informatics and Mathematical Modeling
Period: 01/03/1995 → 16/06/1999
Number of participants: 5
PhD Student:
Philipsen, Peter Alshede (Intern)
Supervisor:
Svarer, Claus (Eksperiment)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Holm, Søren (Intern)
Sørensen, Helge Bjarup Dissing (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-Su Stipendium, Eksperiment
Project: PhD

Bayesiansk signalbehandling og forteolkning af pet-scan

Department of Informatics and Mathematical Modeling
Period: 01/02/1995 → …
Number of participants: 4
PhD Student:
Kjems, Ulrik (Intern)
Supervisor:
Larsen, Jan (Intern)
Svarer, Claus (Eksperiment)
Main Supervisor:
Hansen, Lars Kai (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-Su Stipendium, Eksperiment
Project: PhD

Ph.D. Project: Bayesian Signal Processing and Interpretation of Brain Scans
This Ph.D.-project is about digital image processing of three-dimensional functional and anatomical image volumes of the human brain. Several approaches are investigating for improvement of the functional analysis. A problem in activation studies involving multiple subjects is the individual anatomical variation. This variation can be minimized by performing normalizing “wars” of the anatomy. Another approach investigated is noise reduction in PET activation images using Prior models for random fields. Parameter estimation in these random fields is of particular interest.

Department of Informatics and Mathematical Modeling
Period: 01/02/1995 → 01/03/1998
Number of participants: 3
Project participant:
Larsen, Jan (Intern)
Kjems, Ulrik (Intern)
Project Manager, organisational:
Hansen, Lars Kai (Intern)
Project
Ph.D. Project: Prediction of the Cylinder Condition in Marine Engines Using Neural Networks

Marine engine monitoring is an active research area with a long history. Successful monitoring is vital for marine traffic safety and significant economic factors can be involved e.g., in the form of transport delay costs and additional use of spare parts. At present, only quite simple electronic methods exist for monitoring the cylinder condition in marine engines. Certain mechanical systems have been constructed, although robust, they do not provide adequate information about the specific fault conditions. Development of new and better methods for signal analysis in fault diagnosing is therefore of great interest. The goal of the project is to develop a detailed and reliable system for monitoring the cylinder condition in marine engines. The cylinder condition will be monitored by use of sensors which either directly or indirectly can measure important parameters of the cylinder condition (temperature, cylinder pressure and sound/vibrations). This demands integration of information from sources with different signal characteristics and signal-to-noise ratios in a comprehensive evaluation of the cylinder condition (signal/sensor fusion). Also, design of performance criteria by use of for instance Bayesian analysis and integration of specific expert knowledge (prior information) will be considered. One specific form of prior information is the so-called wavelet representation for sound/vibration signals. In this case the network input could be represented as sound/vibration "images" describing time dependent development of the signal's frequency spectrum. Such representation can be useful for detection of anomalies and non-stationarity. The diagnosing tool will be a neural network and therefore a detailed study of neural network architectures and performance optimization methods will be necessary. Especially methods for analyzing multivariate time series (simultaneous prediction of several parameters) will be in focus.

Department of Informatics and Mathematical Modeling

MAN B&W Diesel A/S

University of Copenhagen
Period: 01/12/1994 → 31/05/1998
Number of participants: 5
Project participant:
Ph.D. Project: Signal Processing with Feedback Networks

The aim of this project is the analysis of feed-back neural networks, including the learning process, optimization of model structure and statistical validation. A essential property of an adaptive system is adequate training performance. However, it is generally accepted that training feedback networks is a difficult task. The project concerns the analysis of mechanisms complicating training and suggests second order training methods. The use of feedback networks calls for an analysis of stability and robustness. By considering the network as a dynamical system, the project objective is clarify stability issues. Finally, the project is devoted to the study of model structure optimization. In particular, the study focuses on whether existing methods for feed-forward networks can be applied to feed-back networks as well. Further, methods for validation of model structures is under development. The feed-back networks are primarily analyzed in connection with time-series modeling/prediction problems.

Department of Informatics and Mathematical Modeling
Period: 01/09/1994 → 31/10/1997
Number of participants: 3
Project participant:
Larsen, Jan (Intern)
Pedersen, Morten With (Intern)
Project Manager, organisational:
Hansen, Lars Kai (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Program Stipendium-SU, Eksp
Amount: 1,200,000.00 Danish Kroner
Project: PhD

Adaptive Neural Signal Processing Systems
Starting from nonlinear adaptive systems based on neural networks, the objective is to study methods for: * model evaluation and interpretation * adaptive learning in non-stationary environments * optimization of model structures * design
of experimental conditions including database design. Model evaluation (including generalization ability) and interpretation are fundamental issues when designing signal processing systems for practical applications, and several problems regarding definition and reliable estimation are still to be solved. The fact that most practical problems involves adaptation to changing environmental conditions calls for investigation of methods for model design, including optimization of model structure. In particular, recurrent neural networks and heterogeneous network ensembles will be studied. Finally, the project covers methods for experimental design, especially active learning and combined supervised/unsupervised learning schemes. The theoretical research is carried out in close synergy with application projects covering: * Analysis and interpretation of brain scan data * Medical decision support systems, * Humanitarian mine detection * Monitoring and inspection systems.

Department of Informatics and Mathematical Modeling  
Period: 01/03/1994 → …  
Number of participants: 2  
Project participant:  
Hansen, Lars Kai (Intern)  
Project Manager, organisational:  
Larsen, Jan (Intern)

Financing sources  
Source: Unknown  
Name of research programme: Ukendt  
Amount: 500,000.00 Danish Kroner

Human Brain Project  
Neuroscience is expanding nationally and internationally. The 90's were proclaimed "Decade of the Brain" by the US Congress, and a large funding program the so-called "Human Brain Project" was established. Nationally the Danish Research Councils created a substantial funding program for Interdisciplinary Neuroscience. New technology is key to the growth of neuroscience and engineering and informatics competences are of vital importance for large neuroscience projects. The DTU Human Brain Project group collaborates with an international consortium of researchers from leading neuroscience labs in the USA and Japan on new data analytic strategies for functional neuroimaging. In the 1996 the group was funded by the US Human Brain Project and by the Danish Research Councils. Functional neuroimaging by Positron Emission Tomography (PET) and functional Magnetic Resonance Imaging (fMRI) is opening a new window to the working human brain. These brain scan techniques provide highly complex data sets. The scans are indirect measures of brain activity while subjects perform well defined mental tasks. The work of the DTU group concerns basic signal processing, pattern recognition and visualization. A fast volume "warp" algorithm was developed for co-registration of PET brain scans using anatomical MRI applied to co-registration of PET group studies at Rigshospitalet, University of Copenhagen. Markov Field methods were developed for edge preserving smoothing of PET scans. Artificial neural network models were designed, evaluated, and visualized for detection of brain activation in PET scans under saccadic eye movements. Noise levels in PET scans were analyzed. A number of data analytic strategies for fMRI were compared on data sets from Massachusetts General Hospital. Artificial neural networks were used to estimate Glucose Metabolism from dynamic PET scans.

Department of Informatics and Mathematical Modeling  
University of Copenhagen  
Minneapolis VA Medical Center  
University of Minnesota  
Research Institute of Brain & Blood Vessels  
University of Chicago  
Massachusetts General Hospital  
Harvard Medical School  
Period: 01/01/1994 → …  
Number of participants: 21  
Project participant:  
OHLsson, Børje Ola Mattias (Intern)  
Toft, Peter Aundal (Intern)  
Nielsen, Finn Årup (Intern)  
Mørch, Niels J.S. (Intern)  
Kjems, Ulrik (Intern)
Philipsen, Peter Alsheide (Intern)
Rasmussen, Carl Edward (Intern)
Larsen, Jan (Intern)
Pauison, Olaf B. (Ekstern)
Svarer, Claus (Ekstern)
Law, Ian (Ekstern)
Gade, Anders (Ekstern)
Lautrup, Benny (Ekstern)
Rottenberg, David (Ekstern)
Strother, Stephen (Ekstern)
Kim, Seong-Gi (Ekstern)
Kanno, Iwao (Ekstern)
Chen, Chin-Tu (Ekstern)
Savoy, Robert (Ekstern)
Lange, Nicholas (Ekstern)
Project Manager, organisational:
Hansen, Lars Kai (Intern)

Financing sources
Name of research programme: Unknown
Amount: 845,377.00 Danish Kroner

Avancerede metoder i adaptiv regulering
Department of Electrical Engineering
Period: 01/02/1993 → 20/09/1996
Number of participants: 6
Phd Student:
Nørgård, Peter Magnus (Intern)
Supervisor:
Hansen, Lars Kai (Intern)
Poulsen, Niels Kjølstad (Intern)
Main Supervisor:
Ravn, Ole (Intern)
Examiner:
Jantzen, Jan (Intern)
Wagner, Christian Hedager (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-Su Stipendium, Eksperiment

CONNECT, Computational Neural Network Center
The Computational Neural Network Center was established March 1, 1991. The center's main research objective is actively to promote and support the collaboration between Danish researchers in theory, implementation and application of neural computation. An additional objective is to establish a graduate level training in the subject of artificial neural networks. In 1993 a plan funded by the Danish Research councils extended CONNECT for the period 1994-1996. The research plan is now centered around two projects: a theory project at the Niels Bohr Institute and the neural signal processing project at the Technical University of Denmark. Neural networks form an attractive framework for development of non-linear signal processing systems. They allow for system specification by "example" and thereby avoid explicit modeling. Arbitrary transfer functions may be modeled and neural net programs are "born" parallel facilitating implementation on massively parallel hardware. Theoretical tools for studying learning dynamics and generalization have matured considerably. Generalization, i.e., the ability to perform well on data not seen during adaptation, is the key concept for network design and evaluation. The research in 1996 concerned design, evaluation and visualization of non-linear adaptive models. A novel criterion for network pruning based on the generalization theory was formulated. A method for fast approximate crossvalidation of adaptive models was developed, and applied to system identification. The first scheme for generalization based evaluation of unsupervised learning algorithms was published and applied to optimization of Principal Component Analysis and k-Means Clustering. The Boltzmann Machine Learning Rule was
generalized and applied to parameter estimation in inhomogeneous Markov Fields. The generalized form of the Boltzmann Machine network becomes susceptible to the generic tools for design and evaluation previously developed.

Department of Informatics and Mathematical Modeling

University of Copenhagen
Period: 01/03/1991 → …
Number of participants: 14
Project participant:
Larsen, Jan (Intern)
Goutte, Cyril (Intern)
Ohlsson, Børje Ola Mattias (Intern)
Toft, Peter Aundal (Intern)
Fog, Torben L. (Intern)
March, Niels J.S. (Intern)
Pedersen, Morten With (Intern)
Hintz-Madsen, Mads (Intern)
Kjems, Ulrik (Intern)
Nielsen, Johannes Kristoffer (Intern)
Lautrup, Benny (Ekstern)
Solla, Sara (Ekstern)
Winter, Ole (Ekstern)
Project Manager, organisational:
Hansen, Lars Kai (Intern)

Financing sources
Source: Unknown
Name of research programme: Ukendt
Amount: 5,000,000.00 Danish Kroner
Project

Neurale Netværk

Department of Physics
Period: 01/02/1990 → …
Number of participants: 4
PhD Student:
Eller, Jacob Rudolph (Intern)
Supervisor:
Larsen, Flemming (Intern)
Main Supervisor:
Cotterill, Rodney M J (Intern)
Examiner:
Hansen, Lars Kai (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: ATV- Gammel ordning
Project: PhD