A pseudo-Voigt component model for high-resolution recovery of constituent spectra in Raman spectroscopy

Raman spectroscopy is a well-known analytical technique for identifying and analyzing chemical species. Since Raman scattering is a weak effect, surface-enhanced Raman spectroscopy (SERS) is often employed to amplify the signal. SERS signal surface mapping is a common method for detecting trace amounts of target molecules. Since the method produce large amounts of data and, in the case of very low concentrations, low signal-to-noise (SNR) ratio, ability to extract relevant spectral features is crucial. We propose a pseudo-Voigt model as a constrained source separation model, that is able to directly and reliably identify the Raman modes, with overall performance similar to the state of the art non-negative matrix factorization approach. However, the model provides better interpretation and is a step towards enabling the use of SERS in detection of trace amounts of molecules in real-life settings.
Improved detection of chemical substances from colorimetric sensor data using probabilistic machine learning

We present a data-driven machine learning approach to detect drug- and explosives-precursors using colorimetric sensor technology for air-sampling. The sensing technology has been developed in the context of the CRIM-TRACK project. At present a fully- integrated portable prototype for air sampling with disposable sensing chips and automated data acquisition has been developed. The prototype allows for fast, user-friendly sampling, which has made it possible to produce large datasets of colorimetric data for different target analytes in laboratory and simulated real-world application scenarios. To make use of the highly multi-variate data produced from the colorimetric chip a number of machine learning techniques are employed to provide reliable classification of target analytes from confounders found in the air streams. We demonstrate that a data-driven machine learning method using dimensionality reduction in combination with a probabilistic classifier makes it possible to produce informative features and a high detection rate of analytes. Furthermore, the probabilistic machine learning approach provides a means of automatically identifying unreliable measurements that could produce false predictions. The robustness of the colorimetric sensor has been evaluated in a series of experiments focusing on the amphetamine pre-cursor phenylacetone as well as the improvised explosives pre-cursor hydrogen peroxide. The analysis demonstrates that the system is able to detect analytes in clean air and mixed with substances that occur naturally in real-world sampling scenarios. The technology under development in CRIM-TRACK has the potential as an effective tool to control trafficking of illegal drugs, explosive detection, or in other law enforcement applications.

General Information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Cognitive Systems, Copenhagen Center for Health Technology, Department of Micro- and Nanotechnology, Surface Engineering, Cranfield University, Securetec Detektions-Systeme AG, Pro Design Electronic GmbH, Gammedata Instrument AB
Number of pages: 8
Publication date: 2017

Host publication information
Title of host publication: Proceedings of SPIE
Volume: 10183
Publisher: SPIE - International Society for Optical Engineering
Article number: 1018307
ISBN (Print): 9781510608672
Series: Proceedings of SPIE - International Society for Optical Engineering
Volume: 10183
ISSN: 0277-786X
Main Research Area: Technical/natural sciences
Conference: Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) Sensing XVIII, Anaheim, United States, 09/04/2017 - 09/04/2017
Artificial nose, Colorimetric sensor array, Machine learning
Electronic versions:
1018307_1.pdf
DOIs:
10.1117/12.2262468

Bibliographical note
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Source: FindIt
Source-ID: 2371526734
Publication: Research - peer-review › Article in proceedings – Annual report year: 2017

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.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Cognitive Systems
Authors: Troelsgaard, R. (Intern), Hansen, L. K. (Intern), Larsen, J. (Intern)
Number of pages: 97
Publication date: 2017

Publication information
Place of publication: Kgs. Lyngby
Publisher: Technical University of Denmark (DTU)
Original language: English
Series: DTU Compute PHD-2016
Number: 439
ISSN: 0909-3192
Main Research Area: Technical/natural sciences
Electronic versions: phd439_Troelsgaard_R.pdf

Relations
Projects:
Modelling Digital Media Objects
Publication: Research › Ph.D. thesis – Annual report year: 2017

Development and validation of a colorimetric sensor array for fish spoilage monitoring
Given the need for non-destructive methods and sensors for food spoilage monitoring, we have evaluated sixteen chemo-sensitive compounds incorporated in an array for colorimetric detection of typical spoilage compounds (trimethylamine, dimethylamine, cadaverine, putrescine) and characterized their color changes in response to compounds present in fresh products (hexanal, 1-octane-3-ol) used as negative controls. The colorimetric sensor array was used to follow fish spoilage over time at room temperature for up to 24 h as well as at 4 °C for 9 days. Additionally, fish decay was monitored using traditional assays measuring the quantity of thiobarbituric acid, total volatile basic nitrogen, changes in pH, O2 level, as well as following bacterial growth. We found a linear correlation between changes in pH, thiobarbituric acid content and the signal intensity recorded with the colorimetric array over time. During spoilage, the increase in signal intensity of the chemo-sensitive compounds showed a similar trend as the increase in microbial growth. We observed that the sensitivity of the chemo-sensitive compounds depends on the spoilage conditions (room temperature vs. 4 °C), highlighting the importance of the application of an array instead of single chemo-sensitive compounds when following complex changes during food spoilage.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Department of Applied Mathematics and Computer Science, Cognitive Systems, Bioanalytics, Surface Engineering, Benha University, University College Cork
Number of pages: 7
Pages: 346-352
Publication date: 2016
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.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Cognitive Systems, Copenhagen Center for Health Technology
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Number of pages: 184
Publication date: 2016

Publication information
Place of publication: Kgs. Lyngby
Publisher: Technical University of Denmark (DTU)
Original language: English
Series: DTU Compute PHD-2015
Number: 369
ISSN: 0909-3192
Main Research Area: Technical/natural sciences
Electronic versions: phd369_Madsen_J.pdf

Relations
Projects:
Predicting the emotions expressed in music
Publication: Research › Ph.D. thesis – Annual report year: 2016

Surface-enhanced Raman spectroscopic study of DNA and 6-mercapto-1-hexanol interactions using large area mapping
The emergence of 2D SERS substrates with large areas of hot spots has enabled data to be gathered at large scale. This work presents a statistical tool for analysing large amounts of SERS data by utilizing a peak-fitting model in a specific spectral range. By analysing the distributions of Raman intensities and peak positions it is possible to directly inspect the interplay between DNA and 6-mercapto-1-hexanol on gold covered nanopillars. It is demonstrated that optimised
functionalization parameters can be extracted from the Raman spectra directly. Using the peak-fitting approach it is possible to avoid misinterpretation of intensity histograms, where contamination might contribute with an enhanced background and not a peak.
CRIM-TRACK: Sensor System for Detection of Criminal Chemical Substances
Detection of illegal compounds requires a reliable, selective and sensitive detection device. The successful device features automated target acquisition, identification and signal processing. It is portable, fast, user friendly, sensitive, specific, and cost efficient. LEAs are in need of such technology. CRIM-TRACK is developing a sensing device based on these requirements. We engage highly skilled specialists from research institutions, industry, SMEs and LEAs and rely on a team of end users to benefit maximally from our prototypes. Currently we can detect minute quantities of drugs, explosives and precursors thereof in laboratory settings. Using colorimetric technology we have developed prototypes that employ disposable sensing chips. Ease of operation and intuitive sensor response are highly prioritized features that we implement as we gather data to feed into machine learning. With machine learning our ability to detect threat compounds amidst harmless substances improves. Different end users prefer their equipment optimized for their specific field. In an explosives-detecting scenario, the end user may prefer false positives over false negatives, while the opposite may be true in a drug-detecting scenario. Such decisions will be programmed to match user preference. Sensor output can be as detailed as the sensor allows. The user can be informed of the statistics behind the detection, identities of all detected substances, and quantities thereof. The response can also be simplified to “yes” vs. “no”. The technology under development in CRIM-TRACK will provide custom officers, police and other authorities with an effective tool to control trafficking of illegal drugs and drug precursors.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Department of Micro- and Nanotechnology, Surface Engineering, Cognitive Systems, Cranfield University, Pro Design Electronic GmbH, Securetec Detektions-Systeme AG, Gandadata Instrument AB
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Pages: 1-5
Publication date: 2015

Host publication information
Title of host publication: Optics and Photonics for Counterterrorism, Crime Fighting, and Defence XI; and Optical Materials and Biomaterials in Security and Defence Systems Technology XII
Volume: 9652
Publisher: SPIE - International Society for Optical Engineering
Article number: 965208
ISBN (Print): 9781628418620

Series: Proceedings of SPIE, the International Society for Optical Engineering
Volume: 9652
ISSN: 0277-786X
Main Research Area: Technical/natural sciences
Trace vapor sensing, Drugs, Explosives, Precursors, Colorimetry, Optics, Disposable Chip, User friendly

Electronic versions: 965208.pdf
DOIs: 10.1117/12.2194915

Bibliographical note
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Source: PublicationPreSubmission
Source-ID: 116708170
Publication: Research - peer-review › Article in proceedings – Annual report year: 2015

Deep Learning and Music Adversaries
An adversary is an agent designed to make a classification system perform in some particular way, e.g., increase the probability of a false negative. Recent work builds adversaries for deep learning systems applied to image object recognition, exploiting the parameters of the system to find the minimal perturbation of the input image such that the system misclassifies it with high confidence. We adapt this approach to construct and deploy an adversary of deep
learning systems applied to music content analysis. In our case, however, the system inputs are magnitude spectral frames, which require special care in order to produce valid input audio signals from network-derived perturbations. For two different train-test partitionings of two benchmark datasets, and two different architectures, we find that this adversary is very effective. We find that convolutional architectures are more robust compared to systems based on a majority vote over individually classified audio frames. Furthermore, we experiment with a new system that integrates an adversary into the training loop, but do not find that this improves the resilience of the system to new adversaries.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Cognitive Systems, Queen Mary University of London
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Pages: 2059-2071
Publication date: 2015
Main Research Area: Technical/natural sciences

Publication information
Journal: IEEE Transactions on Multimedia
Volume: 17
Issue number: 11
ISSN (Print): 1520-9210
Ratings:
BFI (2018): BFI-level 2
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 1.49 SNIP 2.583 CiteScore 5.4
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.216 SNIP 2.592 CiteScore 4.42
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 0.972 SNIP 2.759 CiteScore 3.93
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.009 SNIP 2.826 CiteScore 4.03
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 0.907 SNIP 2.721 CiteScore 3.75
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 0.843 SNIP 2.691 CiteScore 3.43
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 0.935 SNIP 2.425
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 0.98 SNIP 2.539
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.219 SNIP 2.799
Scopus rating (2007): SJR 1.235 SNIP 2.804
Scopus rating (2006): SJR 1.109 SNIP 2.685
Scopus rating (2005): SJR 1.019 SNIP 3.448
Scopus rating (2004): SJR 0.974 SNIP 3.79
Scopus rating (2003): SJR 2.099 SNIP 4.141
Scopus rating (2002): SJR 2.87 SNIP 5.051
Scopus rating (2001): SJR 2.509 SNIP 5.741
Scopus rating (2000): SJR 0.819 SNIP 2.397
Original language: English
AEA-MIR content-based processing and music information retrieval, deep learning
Deep learning, audio adversaries, and music content analysis
We present the concept of adversarial audio in the context of deep neural networks (DNNs) for music content analysis. An adversary is an algorithm that makes minor perturbations to an input that cause major repercussions to the system response. In particular, we design an adversary for a DNN that takes as input short-time spectral magnitudes of recorded music and outputs a high-level music descriptor. We demonstrate how this adversary can make the DNN behave in any way with only extremely minor changes to the music recording signal. We show that the adversary cannot be neutralised by a simple filtering of the input. Finally, we discuss adversaries in the broader context of the evaluation of music content analysis systems.

¿El Caballo Viejo? Latin Genre Recognition with Deep Learning and Spectral Periodicity
The “winning” system in the 2013 MIREX Latin Genre Classification Task was a deep neural network trained with simple features. An explanation for its winning performance has yet to be found. In previous work, we built similar systems using the BALLROOM music dataset, and found their performances to be greatly affected by slightly changing the tempo of the music of a test recording. In the MIREX task, however, systems are trained and tested using the Latin Music Dataset (LMD), which is 4.5 times larger than BALLROOM, and which does not seem to show as strong a relationship between tempo and label as BALLROOM. In this paper, we reproduce the “winning” deep learning system using LMD, and measure the effects of time dilation on its performance. We find that tempo changes of at most ±6 % greatly diminish and improve its performance. Interpreted with the low-level nature of the input features, this supports the conclusion that the system is exploiting some low-level absolute time characteristics to reproduce ground truth in LMD.
Guest Editorial: Machine Learning for Signal Processing

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Cognitive Systems, University of Illinois, Brunel University, University of Surrey
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Pages: 113-116
Publication date: 2015
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Signal Processing Systems
Volume: 79
Issue number: 2
ISSN (Print): 1939-8018
Ratings:
BFI (2018): BFI-level 1
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
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
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.252 SNIP 0.717 CiteScore 0.92
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.288 SNIP 0.829
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.293 SNIP 0.849
BFI (2008): BFI-level 1
Learning Combinations of Multiple Feature Representations for Music Emotion Prediction

Music consists of several structures and patterns evolving through time which greatly influences the human decoding of higher-level cognitive aspects of music like the emotions expressed in music. For tasks, such as genre, tag and emotion recognition, these structures have often been identified and used as individual and non-temporal features and representations. In this work, we address the hypothesis whether using multiple temporal and non-temporal representations of different features is beneficial for modeling music structure with the aim to predict the emotions expressed in music. We test this hypothesis by representing temporal and non-temporal structures using generative models of multiple audio features. The representations are used in a discriminative setting via the Product Probability Kernel and the Gaussian Process model enabling Multiple Kernel Learning, finding optimized combinations of both features and temporal/non-temporal representations. We show the increased predictive performance using the combination of different features and representations along with the great interpretive prospects of this approach.

Perception-Based Personalization of Hearing Aids Using Gaussian Processes and Active Learning

Personalization of multi-parameter hearing aids involves an initial fitting followed by a manual knowledge-based trial-and-error fine-tuning from ambiguous verbal user feedback. The result is an often suboptimal HA setting whereby the full potential of modern hearing aids is not utilized. This article proposes an interactive hearing-aid personalization system that obtains an optimal individual setting of the hearing aids from direct perceptual user feedback. Results obtained with ten hearing-impaired subjects show that ten to twenty pairwise user assessments between different settings—equivalent to 5-10 min—is sufficient for personalization of up to four hearing-aid parameters. A setting obtained by the system was significantly preferred by the subject over the initial fitting, and the obtained setting could be reproduced with reasonable precision. The system may have potential for clinical usage to assist both the hearing-care professional and the user.
**Statistical analysis of large areas of Raman mapped DNA functionalized gold coated silicon nanopillar SERS substrates**

**General information**

State: Published

Organisations: Department of Micro- and Nanotechnology, Surface Engineering, Department of Applied Mathematics and Computer Science, Cognitive Systems, Nanoprobes

Authors: Frøhling, K. B. (Intern), Alstrøm, T. S. (Intern), Bache, M. (Intern), Schmidt, M. S. (Intern), Schmidt, M. N. (Intern), Larsen, J. (Intern), Jakobsen, M. H. (Intern), Boisen, A. (Intern)

Number of pages: 2
Systems for Personalization of Hearing Instruments: A Machine Learning Approach

Today, modern digital devices can be customized significantly to the individual user by adjusting or optimizing multiple parameters affecting the output of the devices. Such personal optimization of devices is referred to as personalization. In the case of hearing aids, personalization is not only a possibility offered to the user, but a requirement that must be performed carefully and precisely in order for the user to utilize the full potential of modern multi-parameter hearing aids. Today though, personalization is still based on a manual time-consuming trial-and-error approach performed by the user himself or, in case of hearing aids, by a hearing-care professional based on typically ambiguous oral feedback from the user. This often results in sub-optimal or even inappropriate settings of multi-parameter devices. This dissertation presents research on a machine-learning based interactive personalization system to improve the personalization of devices and, in particular, of hearing-aid devices. The proposed personalization system iteratively learns a non-parametric probabilistic model of a user’s assumed internal response function over all possible settings of a multi-parameter device based directly on sequential perceptual feedback from the user. A sequential design based on active learning is used to obtain the maximum of the user’s unknown internal response function in as few iterations as possible. Experiments were conducted where the proposed personalization system obtained a significantly preferred setting for individual users within ten to twenty iterations in scenarios with up to four parameters.

Following a short introduction that includes a summary of results and contributions, the first main chapter focuses on the probabilistic modeling framework in which a Gaussian process is used to model the user’s unobserved internal response function. The first main challenge addressed in this context is to account for inconsistent and thus noisy user feedback. The second main challenge addressed is to support feedback which closely reflects the user’s perception while providing maximal information about it without imposing a high cognitive load. In the second main chapter, active learning and sequential design are discussed in relation to the challenge of obtaining the setting that maximizes the user’s unobserved internal response function in as few iterations as possible. For the Gaussian process framework, an active learning criterion is proposed specifically suitable for this type of optimization. The final chapter contains an overall discussion and conclusion of the present work and research based in part on the results from eight scientific paper contributions contained in the appendices.

General information

State: Published
Organisations: Department of Applied Mathematics and Computer Science, Cognitive Systems, Widex A/S
Authors: Nielsen, J. B. (Intern), Larsen, J. (Intern), Nielsen, J. (Ekstern)
Number of pages: 176
Publication date: 2015

Publication information
Place of publication: Kgs. Lyngby
Publisher: DTU Compute
Original language: English
Series: DTU Compute PHD-2014
Number: 325
ISSN: 0909-3192
Main Research Area: Technical/natural sciences
Electronic versions: phd325_Nielsen_JB.pdf
Publication: Research › Ph.D. thesis – Annual report year: 2015

Are deep neural networks really learning relevant features?
In recent years deep neural networks (DNNs) have become a popular choice for audio content analysis. This may be attributed to various factors including advancements in training algorithms, computational power, and the potential for DNNs to implicitly learn a set of feature detectors. We have recently re-examined two works that consider DNNs for the
task of music genre recognition (MGR). These papers conclude that frame-level features learned by DNNs offer an improvement over traditional, hand-crafted features such as Mel-frequency cepstrum coefficients (MFCCs). However, these conclusions were drawn based on training/testing using the GTZAN dataset, which is now known to contain several flaws including replicated observations and artists. We illustrate how considering these flaws dramatically changes the results, which leads one to question the degree to which the learned frame-level features are actually useful for MGR. We make available a reproducible software package allowing other researchers to completely duplicate our figures and results.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Cognitive Systems, Aalborg University
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Publication date: 2014
Main Research Area: Technical/natural sciences
Publication: Research › Paper – Annual report year: 2015
Improving the robustness of Surface Enhanced Raman Spectroscopy based sensors by Bayesian Non-negative Matrix Factorization

Due to applications in areas such as diagnostics and environmental safety, detection of molecules at very low concentrations has attracted recent attention. A powerful tool for this is Surface Enhanced Raman Spectroscopy (SERS) where substrates form localized areas of electromagnetic “hot spots” where the signal-to-noise (SNR) ratio is greatly amplified. However, at low concentrations hot spots with target molecules bound are rare. Furthermore, traditional detection relies on having uncontaminated sensor readings which is unrealistic in a real world detection setting. In this paper, we propose a Bayesian Non-negative Matrix Factorization (NMF) approach to identify locations of target molecules. The proposed method is able to successfully analyze the spectra and extract the target spectrum. A visualization of the loadings of the basis vector is created and the results show a clear SNR enhancement. Compared to traditional data processing, the NMF approach enables a more reproducible and sensitive sensor.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Cognitive Systems, Department of Micro- and Nanotechnology, Surface Engineering, Nanoprobes
Authors: Alstrøm, T. S. (Intern), Frøhling, K. B. (Intern), Larsen, J. (Intern), Schmidt, M. N. (Intern), Bache, M. (Intern), Schmidt, M. S. (Intern), Jakobsen, M. H. (Intern), Boisen, A. (Intern)
Number of pages: 6
Publication date: 2014

Modeling Temporal Structure in Music for Emotion Prediction using Pairwise Comparisons

The temporal structure of music is essential for the cognitive processes related to the emotions expressed in music. However, such temporal information is often disregarded in typical Music Information Retrieval modeling tasks of predicting higher-level cognitive or semantic aspects of music such as emotions, genre, and similarity. This paper addresses the specific hypothesis whether temporal information is essential for predicting expressed emotions in music, as a prototypical example of a cognitive aspect of music. We propose to test this hypothesis using a novel processing pipeline: 1) Extracting audio features for each track resulting in a multivariate “feature time series”. 2) Using generative models to represent these time series (acquiring a complete track representation). Specifically, we explore the Gaussian Mixture model, Vector Quantization, Autoregressive model, Markov and Hidden Markov models. 3) Utilizing the generative models in a discriminative setting by selecting the Probability Product Kernel as the natural kernel for all considered track representations. We evaluate the representations using a kernel based model specifically extended to support the robust two-alternative forced choice self-report paradigm, used for eliciting expressed emotions in music. The methods are evaluated using two data sets and show increased predictive performance using temporal information, thus supporting the overall hypothesis.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Cognitive Systems
Authors: Madsen, J. (Intern), Jensen, B. S. (Intern), Larsen, J. (Intern)
Number of pages: 6
Pages: 319-324
Publication date: 2014
Assessing Miniaturized Sensor Performance using Supervised Learning, with Application to Drug and Explosive Detection

This Ph.D. thesis titled “Assessing Miniaturized Sensor Performance using Supervised Learning, with Application to Drug and Explosive Detection” is a part of the strategic research project “Miniaturized sensors for explosives detection in air” funded by the Danish Agency for Science and Technology’s, Program Commission on Nanoscience Biotechnology and IT (NABIIT), case number: 2106-07-0031. The project, baptized “Xsense” was led by professor Anja Boisen, DTU Nanotech. DTU Informatics participate in the project as data analysis partner.

This thesis presents advances in the area of detection of vapor emanated by explosives and drugs, similar to an electronic nose. To evaluate sensor responses a data processing and evaluation pipeline is required. The work presented herein focuses on the feature extraction, feature representation and sensor accuracy. Thus the primary aim of this thesis is twofold; firstly, present methods suitable for assessing sensor accuracy, and secondly improve sensor performance by enhancing the preprocessing and feature extraction.

Five different miniaturized sensors are presented. Naturally, each sensor require its own special preprocessing and feature extraction techniques before the sensor responses can be applied to supervised learning algorithms. The technologies used for sensing consist of Calorimetry, Cantilevers, Chemoselective compounds, Quartz Crystal Microbalance and Surface Enhanced Raman Scattering. Each of the sensors have their own strength and weaknesses. The reasoning for using multiple sensors was the desire to investigate the feasibility for an integrated multisensor solution. A unique setup of multiple independent detectors is able to vastly enhance accuracy compared to what a single sensor can deliver. As we are detecting hazardous compounds this enables the need for sensors to deliver not only decisions but also certainty about decisions. This requirement is handled by introducing classifiers that offer posterior probabilities and not only decisions. The three probabilistic classification models utilized are Artificial Neural Networks, Logistic Regression and Gaussian Processes. Often, there is no tradition for using these methods in the communities of the prescribed sensors. Here, a method of too much complexity is often undesired so it is a balance when to utilize more sophisticated methods. For this reason, an array of methods that only discriminate between samples are used as baseline. The methods used vary from sensor to sensor, as these methods serve as baseline performance when introducing new methods. The most widely used baseline method in this thesis is the k-nearest-neighbor algorithm. This method is of particular interest in the application of sensors, as the sensors are designed to provide robust and reliable measurements. That means, the sensors are designed to have repeated measurement clusters. Sensor fusion is presented for the sensor based on chemoselective compounds.

An array of color changing compounds are handled and in unity they make up an colorimetric sensor array. In this setting it is valuable to qualify which compounds in the colorimetric sensor array are important. That knowledge enables the ability to either reduce the size of the sensor or replace less sensitive and unimportant compounds with more selective and responsive compounds. A framework based on forward selection Gaussian Process classification is demonstrated to successfully identify a set of important compounds.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Cognitive Systems
Authors: Alstrøm, T. S. (Intern), Larsen, J. (Intern)
Number of pages: 262
Publication date: 2013

Publication information
Place of publication: Kgs. Lyngby
Publisher: Technical University of Denmark (DTU)
Original language: English
Series: IMM-PHD-2012
Number: 292
Bounded Gaussian process regression

We extend the Gaussian process (GP) framework for bounded regression by introducing two bounded likelihood functions that model the noise on the dependent variable explicitly. This is fundamentally different from the implicit noise assumption in the previously suggested warped GP framework. We approximate the intractable posterior distributions by the Laplace approximation and expectation propagation and show the properties of the models on an artificial example. We finally consider two real-world data sets originating from perceptual rating experiments which indicate a significant gain obtained with the proposed explicit noise-model extension.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Cognitive Systems
Authors: Jensen, B. S. (Intern), Nielsen, J. B. (Intern), Larsen, J. (Intern)
Number of pages: 6
Publication date: 2013

Host publication information
Title of host publication: 2013 IEEE International Workshop on Machine Learning for Signal Processing (MLSP)
Publisher: IEEE

Series: Machine Learning for Signal Processing
ISSN: 1551-2541
Main Research Area: Technical/natural sciences
DoIs:
10.1109/MLSP.2013.6661916
Source: dtu
Source-ID: n::oai:DTIC-ART:iel/425732497::34103
Publication: Research - peer-review › Article in proceedings – Annual report year: 2013

Hearing Aid Personalization

Modern digital hearing aids require and offer a great level of personalization. Today, this personalization is not performed based directly on what the user actually perceives, but on a hearing-care professional’s interpretation of what the user explains about what is perceived. In this paper, an interactive personalization system based on Gaussian process regression and active learning is proposed, which personalize the hearing aids based directly on what the user perceives. Preliminary results demonstrate a significant difference between a truly personalized setting obtained with the proposed system and a setting obtained by the current practice.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Cognitive Systems, Widex A/S
Authors: Nielsen, J. B. (Intern), Nielsen, J. (Ekstern), Jensen, B. S. (Intern), Larsen, J. (Intern)
Number of pages: 4
Publication date: 2013

Host publication information
Title of host publication: Proceedings of the 3rd NIPS Workshop on Machine Learning and Interpretation in Neuroimaging 2013
BFI conference series: Neural Information Processing Systems (5000199)
Main Research Area: Technical/natural sciences
Source: dtu
Source-ID: u::10033
Publication: Research - peer-review › Article in proceedings – Annual report year: 2013
Personalized Audio Systems - a Bayesian Approach

Modern audio systems are typically equipped with several user-adjustable parameters unfamiliar to most users listening to the system. To obtain the best possible setting, the user is forced into multi-parameter optimization with respect to the user's own objective and preference. To address this, the present paper presents a general inter-active framework for personalization of such audio systems. The framework builds on Bayesian Gaussian process regression in which a model of the user's objective function is updated sequentially. The parameter setting to be evaluated in a given trial is selected by model-based sequential experimental design. A Gaussian process model is proposed which incorporates correlation among particular parameters providing better modeling capabilities compared to a standard model. A ve-band equalizer is considered for demonstration purposes, in which the parameters are optimized using the proposed framework. Twelve test subjects obtain a personalized setting with the framework, and these settings are significantly preferred to those obtained with random experimentation.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Cognitive Systems
Authors: Nielsen, J. B. (Intern), Jensen, B. S. (Intern), Hansen, T. J. (Intern), Larsen, J. (Intern)
Number of pages: 10
Publication date: 2013

Host publication information
Title of host publication: Audio Engineering Society : Convention Paper
Publisher: Audio Engineering Society
Article number: 9000
BFI conference series: AES convention (5010926)
Main Research Area: Technical/natural sciences
Conference: 135th AES Convention, New York, United States, 17/10/2013 - 17/10/2013
Source: dtu
Source-ID: u::10032
Publication: Research - peer-review › Article in proceedings – Annual report year: 2013

Predictive Modeling of Expressed Emotions in Music Using Pairwise Comparisons

We introduce a two-alternative forced-choice (2AFC) experimental paradigm to quantify expressed emotions in music using the arousal and valence (AV) dimensions. A wide range of well-known audio features are investigated for predicting the expressed emotions in music using learning curves and essential baselines. We furthermore investigate the scalability issues of using 2AFC in quantifying emotions expressed in music on large-scale music databases. The possibility of dividing the annotation task between multiple individuals, while pooling individuals' comparisons is investigated by looking at the subjective differences of ranking emotion in the AV space. We find this to be problematic due to the large variation in subjects' rankings of excerpts. Finally, solving scalability issues by reducing the number of pairwise comparisons is analyzed. We compare two active learning schemes to selecting comparisons at random by using learning curves. We show that a suitable predictive model of expressed valence in music can be achieved from only 15% of the total number of comparisons when using the Expected Value of Information (EVOI) active learning scheme. For the arousal dimension we require 9% of the total number of comparisons.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Cognitive Systems
Authors: Madsen, J. (Intern), Jensen, B. S. (Intern), Larsen, J. (Intern)
Pages: 253-277
Publication date: 2013
Conference: 9th International Symposium on Computer Music Modelling and Retrieval (CMMR 2012), London, United Kingdom, 19/06/2012 - 19/06/2012
Main Research Area: Technical/natural sciences

Publication information
Journal: Lecture Notes in Computer Science
Volume: 7900
ISSN (Print): 0302-9743
Ratings:
BFI (2018): BFI-level 1
BFI (2017): BFI-level 1
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 0.67 SJR 0.315 SNIP 0.552
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.

General information
State: Published
Publication information
ISSN (Print): 1520-6149
Ratings:
BFI (2018): BFI-level 1
BFI (2017): BFI-level 1
BFI (2016): BFI-level 1
BFI (2015): BFI-level 1
BFI (2014): BFI-level 1
BFI (2013): BFI-level 1
ISI indexed (2013): ISI indexed no
BFI (2012): BFI-level 1
ISI indexed (2012): ISI indexed no
BFI (2011): BFI-level 1
ISI indexed (2011): ISI indexed no
BFI (2010): BFI-level 1
BFI (2009): BFI-level 1
BFI (2008): BFI-level 1
Original language: English
Signal Processing and Analysis
DOIs:
10.1109/ICASSP.2013.6638242

Bibliographical note
This work was supported in part by the Danish Council for Strategic Research of the Danish Agency for Science Technology and Innovation under the CoSound project, case number 11-115328
Source: dtu
Source-ID: n::oai:DTIC-ART:iel/409795279::33202
Publication: Research - peer-review › Conference article – Annual report year: 2013


General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems, Universidad de Cantabria, Universidad Carlos III de Madrid, Universitat de Valencia
Publication date: 2012

Publication information
Publisher: IEEE
ISBN (Print): 978-1-4673-1024-6
Original language: English
Series: Machine Learning for Signal Processing
ISSN: 1551-2541
Main Research Area: Technical/natural sciences
DOIs:
10.1109/MLSP.2012.6349704
Source: dtu
Source-ID: n::oai:DTIC-ART:inspec/374937550::24430
An Electronic Patch for Wearable Health Monitoring by Reflectance Pulse Oximetry

We report the development of an Electronic Patch for wearable health monitoring. The Electronic Patch is a new health monitoring system incorporating biomedical sensors, microelectronics, radio frequency (RF) communication, and a battery embedded in a 3-dimensional hydrocolloid polymer. In this paper the Electronic Patch is demonstrated with a new optical biomedical sensor for reflectance pulse oximetry so that the Electronic Patch in this case can measure the pulse and the oxygen saturation. The reflectance pulse oximetry solution is based on a recently developed annular backside silicon photodiode to enable low power consumption by the light emitting components. The Electronic Patch has a disposable part of soft adhesive hydrocolloid polymer and a reusable part of hard polyolaurinlactam. The disposable part contains the battery. The reusable part contains the reflectance pulse oximetry sensor and microelectronics. The reusable part is 'clicked' into the disposable part when the patch is prepared for use. The patch has a size of 88 mm by 60 mm and a thickness of 5 mm.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Cognitive Systems, Department of Informatics and Mathematical Modeling, MEMS-AppliedSensors Group, MicroElectroMechanical Systems Section, Copenhagen University Hospital
Authors: Haahr, R. G. (Intern), Duun, S. B. (Intern), Toft, M. H. (Ekstern), Belhage, B. (Ekstern), Larsen, J. (Intern), Birkelund, K. (Intern), Thomsen, E. V. (Intern)
Pages: 45-53
Publication date: 2012
Main Research Area: Technical/natural sciences

Publication information
Journal: IEEE Transactions on Biomedical Circuits and Systems
Volume: 6
ISSN (Print): 1932-4545
Ratings:
BFI (2018): BFI-level 1
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.985 SNIP 1.857 CiteScore 3.21
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.061 SNIP 1.587 CiteScore 3.28
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.27 SNIP 1.96 CiteScore 3.97
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.707 SNIP 2.54 CiteScore 4.83
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.192 SNIP 2.22 CiteScore 3.98
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.93 SNIP 1.903 CiteScore 3.34
ISI indexed (2011): ISI indexed no
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.546 SNIP 1.445
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.907 SNIP 1.728
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.642 SNIP 1.097
Original language: English
Wearable health monitoring, Photoplethysmography (PPG), Electronic Patch, Blood oxygen saturation, Reflectance pulse oximetry
A predictive model of music preference using pairwise comparisons

Music recommendation is an important aspect of many streaming services and multi-media systems, however, it is typically based on so-called collaborative filtering methods. In this paper we consider the recommendation task from a personal viewpoint and examine to which degree music preference can be elicited and predicted using simple and robust queries such as pairwise comparisons. We propose to model - and in turn predict - the pairwise music preference using a very flexible model based on Gaussian Process priors for which we describe the required inference. We further propose a specific covariance function and evaluate the predictive performance on a novel dataset. In a recommendation style setting we obtain a leave-one-out accuracy of 74% compared to 50% with random predictions, showing potential for further refinement and evaluation.

Combining Semantic and Acoustic Features for Valence and Arousal Recognition in Speech

The recognition of affect in speech has attracted a lot of interest recently; especially in the area of cognitive and computer sciences. Most of the previous studies focused on the recognition of basic emotions (such as happiness, sadness and anger) using categorical approach. Recently, the focus has been shifting towards dimensional affect recognition based on the idea that emotional states are not independent from one another but related in a systematic manner. In this paper, we design a continuous dimensional speech affect recognition model that combines acoustic and semantic features. We design our own corpus that consists of 59 short movie clips with audio and text in subtitle format, rated by human subjects in arousal and valence (A-V) dimensions. For the acoustic part, we combine many features and use correlation based feature selection and apply support vector regression. For the semantic part, we use the affective norms for English words (ANEW), that are rated also in A-V dimensions, as keywords and apply latent semantics analysis (LSA) on those words and words in the clips to estimate A-V values in the clips. Finally, the results of acoustic and semantic parts are combined. We show that combining semantic and acoustic information for dimensional speech recognition improves the results. Moreover, we show that valence is better estimated using semantic features while arousal is better estimated using acoustic features.
Feature extraction using distribution representation for colorimetric sensor arrays used as explosives detectors

We present a colorimetric sensor array which is able to detect explosives such as DNT, TNT, HMX, RDX and TATP and identifying volatile organic compounds in the presence of water vapor in air. To analyze colorimetric sensors with statistical methods, a suitable representation of sensory readings is required. We present a new approach of extracting features from a colorimetric sensor array based on a color distribution representation. For each sensor in the array, we construct a K-nearest neighbor classifier based on the Hellinger distances between color distribution of a test compound and the color distribution of all the training compounds. The performance of this set of classifiers are benchmarked against a set of K-nearest neighbor classifiers that is based on traditional feature representation (e.g., mean or global mode). The suggested approach of using the entire distribution outperforms the traditional approaches which use a single feature.

Haussdorff and hellinger for colorimetric sensor array classification

Development of sensors and systems for detection of chemical compounds is an important challenge with applications in areas such as anti-terrorism, demining, and environmental monitoring. A newly developed colorimetric sensor array is able to detect explosives and volatile organic compounds; however, each sensor reading consists of hundreds of pixel values, and methods for combining these readings from multiple sensors must be developed to make a classification system. In this work we examine two distance based classification methods, K-Nearest Neighbor (KNN) and Gaussian process (GP) classification, which both rely on a suitable distance metric. We evaluate a range of different distance measures and propose a method for sensor fusion in the GP classifier. Our results indicate that the best choice of distance measure depends on the sensor and the chemical of interest.
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 first 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 field 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.
Interactive 3D audio: Enhancing awareness of details in immersive soundscapes?
Spatial audio and the possibility of interacting with the audio environment is thought to increase listeners’ attention to details in a soundscape. This work examines if interactive 3D audio enhances listeners’ ability to recall details in a soundscape. Nine different soundscapes were constructed and presented in either mono, stereo, 3D, or interactive 3D, and performance was evaluated by asking factual questions about details in the audio. Results show that spatial cues can increase attention to background sounds while reducing attention to narrated text, indicating that spatial audio can be constructed to guide listeners’ attention.

Modeling Expressed Emotions in Music using Pairwise Comparisons
We introduce a two-alternative forced-choice experimental paradigm to quantify expressed emotions in music using the two wellknown arousal and valence (AV) dimensions. In order to produce AV scores from the pairwise comparisons and to visualize the locations of excerpts in the AV space, we introduce a flexible Gaussian process (GP) framework which learns from the pairwise comparisons directly. A novel dataset is used to evaluate the proposed framework and learning curves show that the proposed framework needs relative few comparisons in order to achieve satisfactory performance. This is further supported by visualizing the learned locations of excerpts in the AV space. Finally, by examining the predictive performance of the user-specific models we show the importance of modeling subjects individually due to significant subjective differences.

Multi-colorimetric sensor array for detection of illegal materials
The detection of low pressure illegal compounds is an important analytical problem which requires reliable, selective and sensitive detection methods which provide the highest level of confidence in the result. Therefore, to contribute in the successful development of the recognition technology and signal processing enhancements to sensing methods,
recognition ability, data acquisition time and data processing algorithms are necessary. In this research we work towards the development of a rapid, easy in use, highly sensitive, specific (minimal false positives) sensor based on a colorimetric sensing technology.

**General information**

State: Published
Organisations: Department of Micro- and Nanotechnology, Nanointegration, Nanoprobes, Surface Engineering, Department of Applied Mathematics and Computer Science, Cognitive Systems
Authors: Kostesha, N. (Intern), Boisen, A. (Intern), Jakobsen, M. H. (Intern), Alstrøm, T. S. (Intern), Larsen, J. (Intern)
Number of pages: 4
Publication date: 2012

**Host publication information**

Title of host publication: 2012 IEEE Sensors
Publisher: IEEE
ISBN (Print): 978-1-4577-1766-6

ISSN: 1930-0395
Main Research Area: Technical/natural sciences
Conference: 2012 IEEE Sensors, Taipei, Taiwan, Province of China, 28/10/2012 - 28/10/2012
DOI: 10.1109/ICSENS.2012.6411474
Source: dtu
Source-ID: n::oai:DTIC-ART:iel/377909958::25510
Publication: Research - peer-review › Article in proceedings – Annual report year: 2013

**Pseudo inputs for pairwise learning with Gaussian processes**

We consider learning and prediction of pairwise comparisons between instances. The problem is motivated from a perceptual view point, where pairwise comparisons serve as an effective and extensively used paradigm. A state-of-the-art method for modeling pairwise data in high dimensional domains is based on a classical pairwise probit likelihood imposed with a Gaussian process prior. While extremely flexible, this non-parametric method struggles with an inconvenient $O(n^3)$ scaling in terms of the $n$ input instances which limits the method only to smaller problems. To overcome this, we derive a specific sparse extension of the classical pairwise likelihood using the pseudo-input formulation. The behavior of the proposed extension is demonstrated on a toy example and on two real-world data sets which outlines the potential gain and pitfalls of the approach. Finally, we discuss the relation to other similar approximations that have been applied in standard Gaussian process regression and classification problems such as FI(T)C and PI(T)C.

**General information**

State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Nielsen, J. B. (Intern), Jensen, B. S. (Intern), Larsen, J. (Intern)
Number of pages: 6
Publication date: 2012

**Host publication information**

Title of host publication: 2012 IEEE International Workshop on Machine Learning for Signal Processing (MLSP)
Publisher: IEEE
ISBN (Print): 978-1-4673-1024-6

Series: Machine Learning for Signal Processing
ISSN: 1551-2541
Main Research Area: Technical/natural sciences
DOI: 10.1109/MLSP.2012.6349812
Source: dtu
Source-ID: n::oai:DTIC-ART:iel/373905296::22666
Publication: Research - peer-review › Article in proceedings – Annual report year: 2012
Towards Cognizant Hearing Aids: Modeling of Content, Affect and Attention

Hearing aids improved significantly after the integration of advanced digital signal processing applications. This improvement will continue and evolve through obtaining intelligent, individualized hearing aids integrating top-down (knowledge-based) and bottom-up (signal-based) approaches by making use of research done within cognitive science that is the interdisciplinary study of mind and intelligence bringing together various disciplines including Artificial Intelligence, Cognitive Psychology, and Neuroscience.

This thesis focuses on three subjects within cognitive science related to hearing. Initially, a novel method for automatic speech recognition using binary features from binary masks, is discussed. The performance of binary features in terms of robustness to noise is compared with the ASR state of the art features, mel frequency cepstral coefficients. Secondly, human top-down auditory attention is studied. A computational top-down attention model is presented and behavioral experiments are carried out to investigate the role of top-down task driven attention in the cocktail party problem. Finally, automatic emotion recognition from speech is studied using a dimensional approach and with a focus of integrating semantic and acoustic features. An emotional speech corpus that consists of short movie clips with audio and text parts, rated by human subjects in two affective dimensions (arousal and valence), is prepared to evaluate the method proposed.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Karadogan, S. (Intern), Larsen, J. (Intern)
Number of pages: 142
Publication date: 2012

Publication information
Publisher: Technical University of Denmark (DTU)
Original language: English
Series: IMM-PhD-2012
Number: 275
ISSN: 0909-3192
Main Research Area: Technical/natural sciences
Electronic versions:
phd275_Seliz_Karadogan.pdf
Publication: Research › Ph.D. thesis – Annual report year: 2012

Towards Predicting Expressed Emotion in Music from Pairwise Comparisons

We introduce five regression models for the modeling of expressed emotion in music using data obtained in a two alternative forced choice listening experiment. The predictive performance of the proposed models is compared using learning curves, showing that all models converge to produce a similar classification error. The predictive ranking of the models is compared using Kendall's tau rank correlation coefficient which shows a difference despite similar classification error. The variation in predictions across subjects and the difference in ranking is investigated visually in the arousal-valence space and quantified using Kendall's tau.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Madsen, J. (Intern), Jensen, B. S. (Intern), Larsen, J. (Intern), Nielsen, J. B. (Intern)
Pages: 350-357
Publication date: 2012

Host publication Information
Title of host publication: Proceedings of the 9th Sound and Music Computing Conference
Main Research Area: Technical/natural sciences
Conference: 9th Sound and Music Computing Conference (SMC 2012), Copenhagen, Denmark, 11/07/2012 - 11/07/2012
Electronic versions:
SMC2012.pdf

Bibliographical note
This is an open-access article distributed under the terms of the Creative Commons Attribution 3.0 Unported License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.
Source: dtu
Source-ID: u::5377
Publication: Research - peer-review › Article in proceedings – Annual report year: 2012
Analysis of Pregerminted Barley Using Hyperspectral Image Analysis

Pregermination is one of many serious degradations to barley when used for malting. A pregerminated barley kernel can under certain conditions not regerminate and is reduced to animal feed of lower quality. Identifying pregermination at an early stage is therefore essential in order to segregate the barley kernels into low or high quality. Current standard methods to quantify pregerminated barley include visual approaches, e.g. to identify the root sprout, or using an embryo staining method, which use a time-consuming procedure. We present an approach using a near-infrared (NIR) hyperspectral imaging system in a mathematical modeling framework to identify pregerminated barley at an early stage of approximately 12 h of pregermination. Our model only assigns pregermination as the cause for a single kernel’s lack of germination and is unable to identify dormancy, kernel damage etc. The analysis is based on more than 750 Rosalina barley kernels being pregerminated at 8 different durations between 0 and 60 h based on the BRF method. Regerminating the kernels reveals a grouping of the pregerminated kernels into three categories: normal, delayed and limited germination. Our model employs a supervised classification framework based on a set of extracted features insensitive to the kernel orientation. An out-of-sample classification error of 32% (CI95%: 29–35%) is obtained for single kernels when grouped into the three categories, and an error of 3% (CI95%: 0–15%) is achieved on a bulk kernel level. The model provides class probabilities for each kernel, which can assist in achieving homogeneous germination profiles. This research can further be developed to establish an automated and faster procedure as an alternative to the standard procedures for pregerminated barley.

General information
State: Published
Authors: Arngren, M. (Intern), Hansen, P. W. (Ekstern), Eriksen, B. (Ekstern), Larsen, J. (Intern), Larsen, R. (Intern)
Pages: 11385-11394
Publication date: 2011
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Agricultural and Food Chemistry
Volume: 59
Issue number: 21
ISSN (Print): 0021-8561
Ratings:
BFI (2018): BFI-level 2
BFI (2017): BFI-level 2
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.45 SJR 1.291 SNIP 1.344
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.236 SNIP 1.253 CiteScore 3.23
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.278 SNIP 1.421 CiteScore 3.25
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.423 SNIP 1.479 CiteScore 3.44
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.43 SNIP 1.471 CiteScore 3.2
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.384 SNIP 1.446 CiteScore 3.1
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Augmenting the Sound Experience at Music Festivals using Mobile Phones

In this paper we describe experiments carried out at the Nibe music festival in Denmark involving the use of mobile phones to augment the participants' sound experience at the concerts. The experiments involved N=19 test participants that used a mobile phone with a headset playing back sound received over FM from the PA audio mixer system. Based on the location of the participant (distance to the stage) a delay was estimated and introduced to the playback on the mobile phone in order to align the sound in the headset with that from the on-stage speakers. We report our findings from our initial "in-the-wild" experiments augmenting the sound experience at two concerts at this music festival.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling, CrossOverGlobal
Authors: Larsen, J. E. (Intern), Stopczynski, A. (Ekstern), Larsen, J. (Intern), Vesterskov, C. (Ekstern), Krogsgaard, P. (Ekstern), Sondrup, T. (Ekstern)
Publication date: 2011

Host publication information
Title of host publication: Proceedings of IUI 2011
ISBN (Print): 978-1-4503-0419-1
Main Research Area: Technical/natural sciences
Conference: International Conference on Intelligent User Interfaces, Palo Alto, California, USA, 01/01/2011
Links: http://portal.acm.org/citation.cfm?id=1943471
Source: orbit
Source-ID: 271176
Publication: Research - peer-review › Article in proceedings – Annual report year: 2011
Data representation and feature selection for colorimetric sensor arrays used as explosives detectors

Within the framework of the strategic research project Xsense at the Technical University of Denmark, we are developing a colorimetric sensor array which can be useful for detection of explosives like DNT, TNT, HMX, RDX and TATP and identification of volatile organic compounds in the presence of water vapor in air. In order to analyze colorimetric sensors with statistical methods, the sensory output must be put into numerical form suitable for analysis. We present new ways of extracting features from a colorimetric sensor and determine the quality and robustness of these features using machine learning classifiers. Sensors, and in particular explosive sensors, must not only be able to classify explosives, they must also be able to measure the certainty of the classifier regarding the decision it has made. This means there is a need for classifiers that not only give a decision, but also give a posterior probability about the decision. We will compare K-nearest neighbor, artificial neural networks and sparse logistic regression for colorimetric sensor data analysis. Using the sparse solutions we perform feature selection and feature ranking and compare to Gram-Schmidt orthogonalization.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling, Department of Micro- and Nanotechnology
Authors: Alstrøm, T. S. (Intern), Larsen, J. (Intern), Kostesha, N. (Intern), Jakobsen, M. H. (Intern), Boisen, A. (Intern)
Publication date: 2011

Host publication information
Title of host publication: 2011 IEEE International Workshop on Machine Learning for Signal Processing (MLSP)
Publisher: IEEE
ISBN (Print): 978-1-4577-1621-8
Series: Machine Learning for Signal Processing
ISSN: 1551-2541
Main Research Area: Technical/natural sciences
DOIs:
10.1109/MLSP.2011.6064615
Links:
http://mlsp2011.conwiz.dk/
Source: orbit
Source-ID: 314146
Publication: Research - peer-review › Article in proceedings – Annual report year: 2011

Efficient preference learning with pairwise continuous observations and Gaussian Processes

Human preferences can effectively be elicited using pairwise comparisons and in this paper current state-of-the-art based on binary decisions is extended by a new paradigm which allows subjects to convey their degree of preference as a continuous but bounded response. For this purpose, a novel Betatype likelihood is proposed and applied in a Bayesian regression framework using Gaussian Process priors. Posterior estimation and inference is performed using a Laplace approximation. The potential of the paradigm is demonstrated and discussed in terms of learning rates and robustness by evaluating the predictive performance under various noise conditions on a synthetic dataset. It is demonstrated that the learning rate of the novel paradigm is not only faster under ideal conditions, where continuous responses are naturally more informative than binary decisions, but also under adverse conditions where it seemingly preserves the robustness of the binary paradigm, suggesting that the new paradigm is robust to human inconsistency.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Jensen, B. S. (Intern), Nielsen, J. B. (Intern), Larsen, J. (Intern)
Publication date: 2011

Host publication information
Title of host publication: 2011 IEEE International Workshop on Machine Learning for Signal Processing (MLSP)
Publisher: IEEE
ISBN (Print): 978-1-4577-1621-8
Series: Machine Learning for Signal Processing
ISSN: 1551-2541
Main Research Area: Technical/natural sciences
Laplace Approximation, Gaussian Processes, Continuous Response, Pairwise Comparisons
How efficient is estimation with missing data?
In this paper, we present a new evaluation approach for missing data techniques (MDTs) where the efficiency of those are investigated using listwise deletion method as reference. We experiment on classification problems and calculate misclassification rates (MR) for different missing data percentages (MDP) using a missing completely at random (MCAR) scheme. We compare three MDTs: pairwise deletion (PW), mean imputation (MI) and a maximum likelihood method that we call complete expectation maximization (CEM). We use a synthetic dataset, the Iris dataset and the Pima Indians Diabetes dataset. We train a Gaussian mixture model (GMM). We test the trained GMM for two cases, in which test dataset is missing or complete. The results show that CEM is the most efficient method in both cases while MI is the worst performer of the three. PW and CEM proves to be more stable, in particular for higher MDP values than MI.

Hyperspectral Image Analysis of Food Quality
Assessing the quality of food is a vital step in any food processing line to ensure the best food quality and maximum profit for the farmer and food manufacturer. Traditional quality evaluation methods are often destructive and labour-intensive procedures relying on wet chemistry or subjective human inspection. Near-infrared spectroscopy can address these issues by offering a fast and objective analysis of the food quality. A natural extension to these single spectrum NIR systems is to include image information such that each pixel holds a NIR spectrum. This augmented image information offers several extensions to the analysis of food quality. This dissertation is concerned with hyperspectral image analysis used to assess the quality of single grain kernels. The focus is to highlight the benefits and challenges of using hyperspectral imaging for food quality presented in two research directions. Initially, the visualisation and interpretation of hyperspectral images are discussed. A Bayesian based unmixing method is presented as a novel approach to decompose a hyperspectral image into interpretable components. Secondly, hyperspectral imaging is applied to a dedicated application of predicting the degree of pre-germination in single barley kernels using a customised classification framework. Both contributions serve to illustrate the improvement of adding image information to NIR systems in food quality assessment applications.
IEEE International Workshop on Machine Learning for Signal Processing: Preface
The 21st IEEE International Workshop on Machine Learning for Signal Processing will be held in Beijing, China, on September 18–21, 2011. The workshop series is the major annual technical event of the IEEE Signal Processing Society's Technical Committee on Machine Learning for Signal Processing. This year the workshop is held in the National Laboratory of Pattern Recognition (NLPR), Institute of Automation, Chinese Academy of Sciences.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Publication date: 2011

Publication information
Publisher: IEEE
Original language: English
Series: Uden navn
ISSN: 2161-0371
Main Research Area: Technical/natural sciences
DOI:
10.1109/MLSP.2011.6064499
Source: orbit
Source-ID: 316260
Publication: Research - peer-review › Book – Annual report year: 2011

Multi-colorimetric sensor array for detection of explosives in gas and liquid phase
In the framework of the research project "Xsense" at the Technical University of Denmark (DTU) we are developing a simple colorimetric sensor array which can be useful in detection of explosives like DNT, TATP, HMX, RDX and identification of reagents needed for making homemade explosives. The technology is based on an array of chemoselective compounds immobilized on a solid support. Upon exposure to the analyte in suspicion the colorimetric array changes color. Each chosen compound reacts chemo-selectively with analytes of interest. A change in a color signature indicates the presence of unknown explosives and volatile organic compounds (VOCs). We are working towards the selection of compounds that undergo color changes in the presence of explosives and VOCs, as well as the development of an immobilization method for the molecules. Digital imaging of the colorimetric array before and after exposure to the analytes creates a color difference map which gives a unique fingerprint for each explosive and VOCs. Such sensing technology can be used for screening relevant explosives in a complex background as well as to distinguish mixtures of volatile organic compounds distributed in gas and liquid phases. This sensor array is inexpensive, and can potentially be produced as single use disposable.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Cognitive Systems, Department of Informatics and Mathematical Modeling, Nanoprobes Group, NanoSystems Engineering Section, Surface Engineering Group, Polymer Micro and Nano Engineering Section, University of Southern Denmark
On Sparse Multi-Task Gaussian Process Priors for Music Preference Learning

In this paper we study pairwise preference learning in a music setting with multitask Gaussian processes and examine the effect of sparsity in the input space as well as in the actual judgments. To introduce sparsity in the inputs, we extend a classic pairwise likelihood model to support sparse, multi-task Gaussian process priors based on the pseudo-input.
formulation. Sparsity in the actual pairwise judgments is potentially obtained by a sequential experimental design approach, and we discuss the combination of the sequential approach with the pseudo-input preference model. A preliminary simulation shows the performance on a real-world music preference dataset which motivates and demonstrates the potential of the sparse Gaussian process formulation for pairwise likelihoods.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Nielsen, J. B. (Intern), Jensen, B. S. (Intern), Larsen, J. (Intern)
Publication date: 2011
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 316484
Publication: Research › Paper – Annual report year: 2011

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
State: Published
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)
Publication date: 2011

Host publication information
Title of host publication: Proceedings of the tenth International Conference on Machine Learning and Applications (ICMLA’11)
Publisher: IEEE
Main Research Area: Technical/natural sciences
Electronic versions:
imm6197.pdf
Links:
http://www.icmla-conference.org/icmla11/
Source: orbit
Source-ID: 314886
Publication: Research - peer-review › Article in proceedings – Annual report year: 2011

The Xsense project: The application of an intelligent sensor array for high sensitivity handheld explosives detectors
Multiple independent sensors are used in security and military applications in order to increase sensitivity, selectivity and data reliability. The Xsense project has been initiated at the Technical University of Denmark in collaboration with a number of partners in an effort to produce a handheld sensor for trace detection of explosives. We are using micro- and nano technological approaches for integrating four sensing principles into a single device. At the end of the project, the consortium aims at having delivered a sensor platform consisting of four independent detector principles capable of identifying concentrations of TNT, DNT, HMX and RDX at sub parts-per-billion (ppb) levels and with a false positive rate less than 1 parts-per-thousand. The specificity, sensitivity, reliability and the speed of responses are ensured by the use of advanced data processing, surface functionalization and nanostructured sensors and sensor design.

General information
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
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Karadogan, S. (Intern), Marchegiani, L. (Intern), Larsen, J. (Intern), Hansen, L. K. (Intern)
Publication date: 2011

Host publication information
Title of host publication: 2011 IEEE International Workshop on Machine Learning for Signal Processing (MLSP)
Publisher: IEEE
ISBN (Print): 978-1-4577-1621-8
Series: Machine Learning for Signal Processing
ISSN: 1551-2541
Main Research Area: Technical/natural sciences
Missing data techniques, Attention modeling, Machine learning, Entropy
DOIs:
10.1109/MLSP.2011.6064577
Links:
http://mlsp2011.conwiz.dk/
Source: orbit
Source-ID: 286980
Publication: Research - peer-review › Article in proceedings – Annual report year: 2011
Trends in Machine Learning for Signal Processing

By putting the accent on learning from the data and the environment, the Machine Learning for SP (MLSP) Technical Committee (TC) provides the essential bridge between the machine learning and SP communities. While the emphasis in MLSP is on learning and data-driven approaches, SP defines the main applications of interest, and thus the constraints and requirements on solutions, which include computational efficiency, online adaptation, and learning with limited supervision/reference data.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling, University of Maryland, Alexander Technological Educational Institute of Thessaloniki, Pennsylvania State University
Authors: Adali, T. (Ekstern), Miller, D. J. (Ekstern), Diamantaras, K. I. (Ekstern), Larsen, J. (Intern)
Pages: 193-196
Publication date: 2011
Main Research Area: Technical/natural sciences

Publication information
Journal: IEEE - Signal Processing Magazine
Volume: 28
Issue number: 6
ISSN (Print): 1053-5888
Ratings:
BFI (2018): BFI-level 2
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 2.536 SNIP 5.388 CiteScore 8.96
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 2.713 SNIP 6.214 CiteScore 8.15
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.938 SNIP 5.349 CiteScore 5.86
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.631 SNIP 4.892 CiteScore 4.77
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.581 SNIP 4.009 CiteScore 4.19
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.43 SNIP 5.884 CiteScore 6.44
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.986 SNIP 5.144
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 2.005 SNIP 4.314
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 2.037 SNIP 4.006
Scopus rating (2007): SJR 2.255 SNIP 4.629
Scopus rating (2006): SJR 1.774 SNIP 4.867
Scopus rating (2005): SJR 2.404 SNIP 6.878
Scopus rating (2004): SJR 2.148 SNIP 8.212
Scopus rating (2001): SJR 2.699 SNIP 5.353
Scopus rating (2000): SJR 1.489 SNIP 4.007
Unmixing of Hyperspectral Images using Bayesian Non-negative Matrix Factorization with Volume Prior

Hyperspectral imaging can be used in assessing the quality of foods by decomposing the image into constituents such as protein, starch, and water. Observed data can be considered a mixture of underlying characteristic spectra (endmembers), and estimating the constituents and their abundances requires efficient algorithms for spectral unmixing. We present a Bayesian spectral unmixing algorithm employing a volume constraint and propose an inference procedure based on Gibbs sampling. We evaluate the method on synthetic and real hyperspectral data of wheat kernels. Results show that our method perform as good or better than existing volume constrained methods. Further, our method gives credible intervals for the endmembers and abundances, which allows us to assess the confidence of the results.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Arngren, M. (Intern), Schmidt, M. N. (Intern), Larsen, J. (Intern)
Pages: 479-496
Publication date: 2011
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Signal Processing Systems
Volume: 65
Issue number: 3
ISSN (Print): 1939-8018
Ratings:
BFI (2018): BFI-level 1
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
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
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.252 SNIP 0.717 CiteScore 0.92
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.288 SNIP 0.829
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.293 SNIP 0.849
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.314 SNIP 0.661
Xsense: a miniaturised multi-sensor platform for explosives detection

Realizing that no one sensing principle is perfect we set out to combine four fundamentally different sensing principles into one device. The reasoning is that each sensor will complement the others and provide redundancy under various environmental conditions. As each sensor can be fabricated using microfabrication the inherent advantages associated with MEMS technologies such as low fabrication costs and small device size allows us to integrate the four sensors into one portable device at a low cost.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Cognitive Systems, Department of Informatics and Mathematical Modeling, University of Southern Denmark, University of Alberta
Pages: 803123-7
Publication date: 2011
Main Research Area: Technical/natural sciences

Publication information
Journal: Proceedings of SPIE, the International Society for Optical Engineering
Volume: 8031
Issue number: 1
ISSN (Print): 0277-786X
Ratings:
BFI (2018): BFI-level 1
BFI (2017): BFI-level 1
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 0.42 SNIP 0.245
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.187 SNIP 0.224 CiteScore 0.3
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.188 SNIP 0.231 CiteScore 0.3
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.2 SNIP 0.259 CiteScore 0.26
ISI indexed (2013): ISI indexed no
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.194 SNIP 0.243 CiteScore 0.27
ISI indexed (2012): ISI indexed no
In this paper we investigate the steady-state performance of semisupervised regression models adjusted using a modified RLS-like algorithm, identifying the situations where the new algorithm is expected to outperform standard RLS. By using an adaptive combination of the supervised and semisupervised methods, the resulting adaptive filter is guaranteed to perform at least as well as the best contributing filter, therefore achieving universal performance. The analysis and behavior of the methods is illustrated through a set of examples in a plant identification setup, analyzing both steady-state and convergence situations.

**General information**

State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling, Universidad Carlos III de Madrid
Authors: Arenas-Garía, J. (Ekstern), Moriana-Varo, C. (Ekstern), Larsen, J. (Intern)
Publication date: 2010

**Host publication information**

Publisher: IEEE Press
Main Research Area: Technical/natural sciences
semi-supervised learning
Electronic versions:
6729anav.pdf
Links:
http://ieeexplore.ieee.org
Source: orbit
Source-ID: 275356
Publication: Research - peer-review › Article in proceedings – Annual report year: 2010

**Data-driven modeling of nano-nose gas sensor arrays**

We present a data-driven approach to classification of Quartz Crystal Microbalance (QCM) sensor data. The sensor is a nano-nose gas sensor that detects concentrations of analytes down to ppm levels using plasma polymerized coatings. Each sensor experiment takes approximately one hour hence the number of available training data is limited. We suggest a data-driven classification model which work from few examples. The paper compares a number of data-driven
Data–driven modeling of nano-nose gas sensor arrays

We present a data-driven approach to classification of Quartz Crystal Microbalance (QCM) sensor data. The sensor is a nano-nose gas sensor that detects concentrations of analytes down to ppm levels using plasma polymorized coatings. Each sensor experiment takes approximately one hour hence the number of available training data is limited. We suggest a data-driven classification model which work from few examples. The paper compares a number of data-driven classification and quantification schemes able to detect the gas and the concentration level. The data-driven approaches are based on state-of-the-art machine learning methods and the Bayesian learning paradigm.

Development of the colorimetric sensor array for detection of explosives and volatile organic compounds in air

In the framework of the research project 'Xsense' at the Technical University of Denmark (DTU) we are developing a simple colorimetric sensor array which can be useful in detection of explosives like DNT and TNT, and identification of volatile organic compounds in the presence of water vapor in air. The technology is based on an array of chemoresponsive dyes immobilized on a solid support. Upon exposure to the analyte in suspicion the dye array changes color. Each chosen dye reacts chemo selectively with analytes of interest. A change in a color signature indicates the presence of unknown explosives and volatile organic compounds (VOCs). We are working towards the selection of dyes that undergo color changes in the presence of explosives and VOCs, as well as the development of an immobilization method.
for the molecules. Digital imaging of the dye array before and after exposure to the analytes creates a color difference
map which gives a unique fingerprint for each explosive and volatile organic compound. Such sensing technology can be
used to screen for relevant explosives in a complex background as well as to distinguish mixtures of volatile organic
compounds distributed in gas phase. This sensor array is inexpensive, and can potentially be produced as single use
disposable.

General information
State: Published
Organisations: Nanoprobes Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology,
Cognitive Systems, Department of Informatics and Mathematical Modeling, Surface Engineering Group, Polymer Micro
and Nano Engineering Section, University of Southern Denmark
Authors: Kostesha, N. (Intern), Alstrøm, T. S. (Intern), Johnsen, C. (Ekstern), Nilesen, K. A. (Ekstern), Jeppesen, J. O.
(Ekstern), Larsen, J. (Intern), Jakobsen, M. H. (Intern), Boisen, A. (Intern)
Pages: 76730I
Publication date: 2010
Conference: Advanced Environmental, Chemical, and Biological Sensing Technologies VII, USA, Orlando, FL, 01/01/2010
Main Research Area: Technical/natural sciences

Publication information
Journal: Proceedings of the SPIE - The International Society for Optical Engineering
Volume: 7673
ISSN (Print): 0277-786X
Ratings:
BFI (2018): BFI-level 1
BFI (2017): BFI-level 1
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 0.42 SNIP 0.245
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.187 SNIP 0.224 CiteScore 0.3
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.188 SNIP 0.231 CiteScore 0.3
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.2 SNIP 0.259 CiteScore 0.26
ISI indexed (2013): ISI indexed no
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.194 SNIP 0.243 CiteScore 0.27
ISI indexed (2012): ISI indexed no
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.197 SNIP 0.264 CiteScore 0.31
ISI indexed (2011): ISI indexed no
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.208 SNIP 0.241
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.211 SNIP 0.271
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.222 SNIP 0.289
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.227 SNIP 0.37
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.308 SNIP 0.701
Scopus rating (2005): SJR 0.158 SNIP 0.343
Web of Science (2004): Indexed yes
Web of Science (2002): Indexed yes
Original language: English
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
State: Published
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)
Publication date: 2010

Host publication information
Title of host publication: IEEE International Workshop on Machine Learning for Signal Processing
Publisher: IEEE
ISBN (Print): 978-1-4244-7875-0
Main Research Area: Technical/natural sciences
DOIs: 10.1109/MLSP.2010.5588997
Source: orbit
Source-ID: 263951
Publication: Research - peer-review › Article in proceedings – Annual report year: 2010

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.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Jensen, B. S. (Intern), Larsen, J. (Intern), Hansen, L. K. (Intern), Larsen, J. E. (Intern), Jensen, K. (Intern)
Publication date: 2010

Host publication information
Title of host publication: 21st European Conference on Machine Learning : Mining Ubiquitous and Social Environments Workshop
Main Research Area: Technical/natural sciences
Conference: 21st European Conference on Machine Learning : Mining Ubiquitous and Social Environments Workshop, Barcelona, Spain, 01/01/2010
Source: orbit
Source-ID: 265863
Publication: Research - peer-review › Article in proceedings – Annual report year: 2010
**Xsense: using nanotechnology to combine detection methods for high sensitivity handheld explosives detectors**

In an effort to produce a handheld explosives sensor the Xsense project has been initiated at the Technical University of Denmark in collaboration with a number of partners. Using micro- and nano technological approaches it will be attempted to integrate four detection principles into a single device. At the end of the project, the consortium aims at having delivered a sensor platform consisting of four independent detector principles capable of detecting concentrations of TNT at sub parts-per-billion (ppb) concentrations and with a false positive rate less than 1 parts-per-thousand. The specificity, sensitivity and reliability are ensured by the use of clever data processing, surface functionalisation and nanostructured sensors and sensor surfaces.

**General information**

State: Published  
Organisations: Nanoprobes Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Cognitive Systems, Department of Informatics and Mathematical Modeling, Surface Engineering Group, Polymer Micro and Nano Engineering Section, University of Southern Denmark, Oak Ridge National Laboratory  
Pages: 76641H  
Publication date: 2010  
Conference: Detection and Sensing of Mines, Explosive Objects, and Obscured Targets XV, USA, Orlando, FL, 01/01/2010  
Main Research Area: Technical/natural sciences

**Publication information**

Journal: Proceedings of the SPIE - The International Society for Optical Engineering  
Volume: 7664  
ISSN (Print): 0277-786X  
Ratings:  
BFI (2018): BFI-level 1  
BFI (2017): BFI-level 1  
BFI (2016): BFI-level 1  
Scopus rating (2016): CiteScore 0.42 SNIP 0.245  
Web of Science (2016): Indexed yes  
BFI (2015): BFI-level 1  
Scopus rating (2015): SJR 0.187 SNIP 0.224 CiteScore 0.3  
BFI (2014): BFI-level 1  
Scopus rating (2014): SJR 0.188 SNIP 0.231 CiteScore 0.3  
BFI (2013): BFI-level 1  
Scopus rating (2013): SJR 0.2 SNIP 0.259 CiteScore 0.26  
ISI indexed (2013): ISI indexed no  
Web of Science (2013): Indexed yes  
BFI (2012): BFI-level 1  
Scopus rating (2012): SJR 0.194 SNIP 0.243 CiteScore 0.27  
ISI indexed (2012): ISI indexed no  
Web of Science (2012): Indexed yes  
BFI (2011): BFI-level 1  
Scopus rating (2011): SJR 0.197 SNIP 0.264 CiteScore 0.31  
ISI indexed (2011): ISI indexed no  
BFI (2010): BFI-level 1  
Scopus rating (2010): SJR 0.208 SNIP 0.241  
Web of Science (2010): Indexed yes  
BFI (2009): BFI-level 1  
Scopus rating (2009): SJR 0.211 SNIP 0.271  
BFI (2008): BFI-level 1  
Scopus rating (2008): SJR 0.222 SNIP 0.289  
Web of Science (2008): Indexed yes  
Scopus rating (2007): SJR 0.227 SNIP 0.37  
Web of Science (2007): Indexed yes  
Scopus rating (2006): SJR 0.308 SNIP 0.701
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)
Publication date: Dec 2009

Publication information
Place of publication: Kgs. Lyngby, Denmark
Publisher: Technical University of Denmark (DTU)
Original language: English
Series: IMM-PHD-2009-218
Main Research Area: Technical/natural sciences
Electronic versions: phd218_llm.pdf
Source: orbit
Source-ID: 277932
Publication: Research › peer-review › Conference article – Annual report year: 2010
Bayesian Nonnegative Matrix Factorization with Volume Prior for Unmixing of Hyperspectral Images

In hyperspectral image analysis the objective is to unmix a set of acquired pixels into pure spectral signatures (endmembers) and corresponding fractional abundances. The Non-negative Matrix Factorization (NMF) methods have received a lot of attention for this unmixing process. Many of these NMF based unmixing algorithms are based on sparsity regularization encouraging pure spectral endmembers, but this is not optimal for certain applications, such as foods, where abundances are not sparse. The pixels will theoretically lie on a simplex and hence the endmembers can be estimated as the vertices of the smallest enclosing simplex. In this context we present a Bayesian framework employing a volume constraint for the NMF algorithm, where the posterior distribution is numerically sampled from using a Gibbs sampling procedure. We evaluate the method on synthetic and real hyperspectral data of wheat kernels.

Independent component analysis applied to pulse oximetry in the estimation of the arterial oxygen saturation (SpO2) - a comparative study

We examine various independent component analysis (ICA) digital signal processing algorithms for estimating the arterial oxygen saturation (SpO2) as measured by a reflective pulse oximeter. The ICA algorithms examined are FastICA, Maximum Likelihood ICA (ICAML), Molgedey and Schuster ICA (ICAMS), and Mean Field ICA (ICAMF). The signal processing includes pre-processing bandpass filtering to eliminate noise, and post-processing by calculating the SpO2. The algorithms are compared to the commercial state-of-the-art algorithm Discrete Saturation Transform (DST) by Masimo Corporation. It is demonstrated that ICAMS and ICAMF perform up to 13% better than DST. PPG recordings are done with a reflective pulse oximetry sensor integrated in an Electronic Patch. This system is intended for patients with chronic heart and lung conditions.
Modeling of Ship Propulsion Performance

Full scale measurements of the propulsion power, ship speed, wind speed and direction, sea and air temperature, from four different loading conditions has been used to train a neural network for prediction of propulsion power. The network was able to predict the propulsion power with accuracy between 0.8-2.8%, which is about the same accuracy as for the measurements. The methods developed are intended to support the performance monitoring system SeaTrend® developed by FORCE Technology (FORCE (2008)).

Prediction of Full-Scale Propulsion Power using Artificial Neural Networks

Full scale measurements of the propulsion power, ship speed, wind speed and direction, sea and air temperature from four different loading conditions, together with hind cast data of wind and sea properties; and noon report data has been used to train an Artificial Neural Network for prediction of propulsion power. The model was optimized using a double cross validation procedure. The network was able to predict the propulsion power with accuracy between 0.8-1.7% using onboard measurement system data and 7% from manually acquired noon reports.
Temporal analysis of text data using latent variable models

Detecting and tracking of temporal data is an important task in multiple applications. In this paper, we study temporal text mining methods for Music Information Retrieval. We compare two ways of detecting the temporal latent semantics of a corpus extracted from Wikipedia, using a stepwise Probabilistic Latent Semantic Analysis (PLSA) approach and a global multiway PLSA method. The analysis indicates that the global analysis method is able to identify relevant trends which are difficult to get using a step-by-step approach. Furthermore, we show that inspection of PLSA models with different numbers of factors may reveal the stability of temporal clusters making it possible to choose the relevant number of factors.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling, National Research Council of Canada
Authors: Mølgaard, L. L. (Intern), Larsen, J. (Intern), Goutte, C. (Ekstern)
Publication date: 2009

Cognitive Systems
The tutorial will discuss the definition of cognitive systems as the possibilities to extend the current systems engineering paradigm in order to perceive, learn, reason and interact robustly in open-ended changing environments. I will also address cognitive systems in a historical perspective and its relation and potential over current artificial intelligence architectures. Machine learning models that learn from data and previous knowledge will play an increasingly important role in all levels of cognition as large real world digital environments (such as the Internet) usually are too complex to be modeled within a limited set of predefined specifications. There will inevitably be a need for robust decisions and behaviors in novel situations that include handling of conflicts and ambiguities based on the capability and knowledge of the artificial cognitive system. Further, there is a need for automatic extraction and organization of meaning, purpose, and intentions in interplay with the environment (machines, artifacts and users) beyond current systems with build-in semantic representations and ontologies—in particular in terms of the interaction with users (users-in-the-loop models) through user models and user interaction models. Research in cognitive information processing is inherently multi-disciplinary and
involves natural science and technical disciplines, e.g., control, automation, and robot research, physics and computer science, as well as humanities such as social sciences, cognitive psychology, and semantics. However, machine learning for signal processing plays a key role at all the levels of the cognitive processes, and we expect this to be a new emerging trend in our community in the coming years. Current examples of the use of machine learning for signal processing in cognitive systems include e.g. personalized information systems, sensor network systems, social dynamics system and Web2.0, and cognitive components analysis. I will use example from our own research and link to other research activities.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Larsen, J. (Intern)
Publication date: 2008

Publication information
Original language: English
Main Research Area: Technical/natural sciences
cognitive systems, machine learning, cognitive architecture, examples
Electronic versions:
imm5705.pdf
Links:
http://mlsp2008.conwiz.dk
Source: orbit
Source-ID: 233507
Publication: Research › Sound/Visual production (digital) – Annual report year: 2008

Convolutional Blind Source Separation Methods
During the past decades, much attention has been given to the separation of mixed sources, in particular for the blind case where both the sources and the mixing process are unknown and only recordings of the mixtures are available. In several situations it is desirable to recover all sources from the recorded mixtures, or at least to segregate a particular source. Furthermore, it may be useful to identify the mixing process itself to reveal information about the physical mixing system. In some simple mixing models each recording consists of a sum of differently weighted source signals. However, in many real-world applications, such as in acoustics, the mixing process is more complex. In such systems, the mixtures are weighted and delayed, and each source contributes to the sum with multiple delays corresponding to the multiple paths by which an acoustic signal propagates to a microphone. Such filtered sums of different sources are called convolutional mixtures. There are already a number of partial reviews available on this topic so the purpose of this chapter is to provide a complete survey of convolutional BSS and identify a taxonomy that can organize the large number of available algorithms. This may help practitioners and researchers new to the area of convolutional source separation obtain a complete overview of the field. Hopefully those with more experience in the field can identify useful tools, or find inspiration for new algorithms.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Pedersen, M. S. (Intern), Larsen, J. (Intern), Kjems, U. (Intern), Parra, L. C. (Ekstern)
Number of pages: 1,176
Publication date: 2008

Host publication information
Title of host publication: Springer Handbook of Speech
Volume: Chap. 52
Publisher: Springer
ISBN (Print): 978-3-540-49125-5
Main Research Area: Technical/natural sciences
cia, blind source separation, convolutive
Electronic versions:
imm4924.pdf
Links:
http://www2.imm.dtu.dk/pubdb/p.php?4924
Source: orbit
Source-ID: 200657
Publication: Research - peer-review › Book chapter – Annual report year: 2008
Data processing framework for decision making
The aim of the talk is *to provide insight into some of the issues in data processing and detection systems* *to hint at possible solutions using statistical signal processing and machine learning methodologies*

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Larsen, J. (Intern)
Publication date: 2008
Event: Abstract from NDRF workshop on Molecular and Odour Detection, University of Southern Denmark.
Main Research Area: Technical/natural sciences
data processing, decision making, explosive detection, statistical learning
Electronic versions:
WMOD_JL.pdf
Links:
http://www.ndrf.dk
Source: orbit
Source-ID: 211606
Publication: Research › Conference abstract for conference – Annual report year: 2008

Introduction to detection systems
Presentation of the information processing pipeline for detection including discussing of various issues and the use of mathematical modeling. A simple example of detection a signal in noise illustrated that simple modeling outperforms human visual and auditory perception. Participants are going to discuss issues in detection which is followed by an auditory object recognition exercise. The results of the exercise and its relation to issues in the information processing pipeline is also discussed.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Larsen, J. (Intern)
Publication date: 2008
Main Research Area: Technical/natural sciences
detection, statistics, machine learning, auditory exercise
Electronic versions:
imm5699.pdf
Links:
http://www.ndrf.dk
Source: orbit
Source-ID: 233510
Publication: Research › Paper – Annual report year: 2008

Machine Learning for Signal Processing

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Van Hulle, M. M. (Ekstern), Larsen, J. (Intern)
Pages: 1-2
Publication date: 2008
Main Research Area: Technical/natural sciences

Publication information
Journal: Neurocomputing
Volume: 72
Issue number: 1-3
ISSN (Print): 0925-2312
Ratings:
BFI (2018): BFI-level 1
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Reduction of Non-stationary Noise using a Non-negative Latent Variable Decomposition

We present a method for suppression of non-stationary noise in single channel recordings of speech. The method is based on a non-negative latent variable decomposition model for the speech and noise signals, learned directly from a noisy mixture. In non-speech regions an over complete basis is learned for the noise that is then used to jointly estimate the speech and the noise from the mixture. We compare the method to the classical spectral subtraction approach, where the noise spectrum is estimated as the average over non-speech frames. The proposed method significantly outperforms the classic approach, especially when the noise is highly non-stationary and at low signal-to-noise ratios.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Schmidt, M. N. (Intern), Larsen, J. (Intern)
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 overabundance 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 and 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.

General information
State: Published
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

Statistical methods for decision making in mine action

The design and evaluation of mine clearance equipment – the problem of reliability * Detection probability – tossing a coin * Requirements in mine action * Detection probability and confidence in MA * Using statistics in area reduction * Improving performance by information fusion and combination of methods * Advantages * Methodology * DeFuse and Xsense projects

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Larsen, J. (Intern)
Publication date: 2008
Two-Microphone Separation of Speech Mixtures

Separation of speech mixtures, often referred to as the cocktail party problem, has been studied for decades. In many source separation tasks, the separation method is limited by the assumption of at least as many sensors as sources. Further, many methods require that the number of signals within the recorded mixtures be known in advance. In many real-world applications, these limitations are too restrictive. We propose a novel method for underdetermined blind source separation using an instantaneous mixing model which assumes closely spaced microphones. Two source separation techniques have been combined, independent component analysis (ICA) and binary time–frequency (T–F) masking. By estimating binary masks from the outputs of an ICA algorithm, it is possible in an iterative way to extract basis speech signals from a convolutive mixture. The basis signals are afterwards improved by grouping similar signals. Using two microphones, we can separate, in principle, an arbitrary number of mixed speech signals. We show separation results for mixtures with as many as seven speech signals under instantaneous conditions. We also show that the proposed method is applicable to segregate speech signals under reverberant conditions, and we compare our proposed method to another state-of-the-art algorithm. The number of source signals is not assumed to be known in advance and it is possible to maintain the extracted signals as stereo signals.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Pedersen, M. S. (Intern), Wang, D. (Ekstern), Larsen, J. (Intern), Kjems, U. (Intern)
Pages: 475-492
Publication date: 2008
Main Research Area: Technical/natural sciences

Publication information
Journal: IEEE Transactions on Neural Networks
Volume: 19
Issue number: 3
ISSN (Print): 1045-9227
Ratings:
BFI (2018): BFI-level 2
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 2.49 SNIP 2.408 CiteScore 5.9
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 2.698 SNIP 3.066 CiteScore 6.34
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.635 SNIP 3.342 CiteScore 5.73
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 2.474 SNIP 3.604 CiteScore 5.5
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 2.156 SNIP 3.068
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.039 SNIP 2.716
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.328 SNIP 2.143
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.455 SNIP 3.092
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.929 SNIP 3.32
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.925 SNIP 3.203
Independent Component Analysis, Source separation, Underdetermined, Speech, Convolutative mixing

Xsense: Miniaturized sensors for explosives detection in air
In the future development of sensor based explosives detectors we find that the key challenges to address are: reliability, selectivity, stability and cost. Our hypothesis is that only by combining several independent and sensitive measuring principles can the reliability be improved. We will do this by creating a strategic research network with significant pre-existing know-how and strong competences in: miniaturized sensors, synthetic chemistry, surface functionalization, data processing and validation.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Larsen, J. (Intern)
Publication date: 2008
Event: Abstract from NDRF Miniseminar, University of Southern Denmark, .
Main Research Area: Technical/natural sciences
Data processing, cantilever sensors, colorimetric sensor arrays, SERS
Electronic versions:
Xsense_NDRF_miniseminar.pdf
Links:
http://www.ndrf.dk
Source: orbit
Source-ID: 211605
Publication: Research › Conference abstract for conference – Annual report year: 2008

Signal Processing for Improved Wireless Receiver Performance
This thesis is concerned with signal processing for improving the performance of wireless communication receivers for well-established cellular networks such as the GSM/EDGE and WCDMA/HSPA systems. The goal of doing so, is to improve the end-user experience and/or provide a higher system capacity by allowing an increased reuse of network resources. To achieve this goal, one must first understand the nature of the problem and an introduction is therefore provided. In addition, the concept of graph-based models and approximations for wireless communications is introduced along with various Belief Propagation (BP) methods for detecting the transmitted information, including the Turbo principle. Having established a framework for the research, various approximate detection schemes are discussed. First, the general form of linear detection is presented and it is argued that this may be preferable in connection with parameter estimation. Next, a realistic framework for interference whitening is presented, allowing flexibility in the selection of whether interference is accounted for via a discrete or a Gaussian distribution. The approximate method of sphere detection and decoding is outlined and various suggestions for improvements are presented. In addition, methods for using generalized BP to perform approximate joint detection and decoding in systems with convolutional codes are outlined. One such method is a natural generalization of the traditional Turbo principle and a generalized Turbo principle can therefore be established. For realistic wireless communication scenarios, a multitude of parameters are not known and must instead be estimated. A general variational Bayesian EM-algorithm is therefore presented to provide such estimates. It generalizes previously known methods for communication systems by estimating parameter densities instead of point-estimates and can therefore account for uncertainty in the parameter estimates. Finally, an EM-algorithm for band-
Toeplitz covariance estimation is presented as such an estimate is desirable for noise and interference whitening. Using simulations, the method is shown to be near-optimal in the sense that it achieves the unbiased Cramer-Rao lower-bound for medium and large sample-sizes.

**General information**
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Christensen, L. P. (Intern), Højen-Sørensen, P. (Intern), Larsen, J. (Intern)
Publication date: Sep 2007

**Publication information**
Original language: English
Series: IMM-PHD-2007-175
Main Research Area: Technical/natural sciences
Electronic versions:
Christensen.pdf
Source: orbit
Source-ID: 209881
Publication: Research › Ph.D. thesis – Annual report year: 2007

**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.

**General information**
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Arenas-Garcia, J. (Ekstern), Parrado-Hernandez, E. (Ekstern), Meng, A. (Intern), Larsen, J. (Intern), Hansen, L. K. (Intern)
Publication date: 2007
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 209992
Publication: Research › Poster – Annual report year: 2007

**Extracting meaning from audio signals - a machine learning approach**
* Machine learning framework for sound search * Genre classification * Music and audio separation * Wind noise suppression

**General information**
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Larsen, J. (Intern)
Publication date: 2007

**Publication information**
Original language: English
Main Research Area: Technical/natural sciences
audio, search, sound, machine learning, signal processing
Electronic versions:
imm5266.pdf
imm5266.zip
Source: orbit
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.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Hansen, L. K. (Intern), Lehn-Schiøler, T. (Intern), Petersen, K. B. (Ekstern), Arenas-Garcia, J. (Ekstern), Larsen, J. (Intern), Jensen, S. H. (Intern)
Publication date: 2007

Proceedings of the IEEE Machine Learning for Signal Processing XVII

The seventeenth of a series of workshops sponsored by the IEEE Signal Processing Society and organized by the Machine Learning for Signal Processing Technical Committee (MLSP-Tc). The field of machine learning has matured considerably in both methodology and real-world application domains and has become particularly important for solution of problems in signal processing. As reflected in this collection, machine learning for signal processing combines many ideas from adaptive signal/image processing, learning theory and models, and statistics in order to solve complex real-world signal processing applications. High quality across such topical diversity can only be maintained through a rigorous and selective review process. This volume contains 73 papers presented at the Workshop, including 70 accepted submissions, an overview paper on feature selection for genomics by Sun-Yuan Kung, our plenary speaker, and two papers from the winners of the Data Analysis Competition. The program included papers in the following areas: genomic signal processing, pattern recognition and classification, image and video processing, blind signal processing, models, learning algorithms, and applications of machine learning. The program featured a Special Session on Genomic Signal Processing, chaired by Prof. Man-Wai Mak from Hong Kong Polytechnic University, Hong Kong. The session included four refereed papers by leading experts in the field. We also continued the tradition of the Data Analysis Competition thanks to the efforts of Deniz Erdogmus, Vince Calhoun, and Kenneth Hild. The program also included a tutorial talk on regularization path, sparsity and Pareto frontier in statistical learning, delivered by Stephane Canu from LITIS - INSA de Rouen, France. Our warmest thanks go to our tutorial speaker, and to our plenary speakers, Prof. Sun-Yuan Kung from Princeton University, USA, and Prof. Erkki Oja from Helsinki University of Technology, Finland. Also our special thanks go to our emerging technologies keynote speaker Prof. Danilo Mandic from Imperial College, London, UK.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Publication date: 2007
Scientific Foundations of the Demining by Fusion of Techniques Project
The Nordic Demining Research Forum (NDRF) has initiated a pilot project Demining by Fusion of Techniques (DeFuse), which will investigate the correlation between different methods used in mine action. While the ultimate purpose is to suggest new mine clearance operation practices, DeFuse will focus on achieving scientific and general knowledge about the coherence between different methods. This talk provides the scientific foundations for the project.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Larsen, J. (Intern)
Publication date: 2007
Main Research Area: Technical/natural sciences
Electronic versions:
imm5449.pdf
Links:
http://www.ndrf.dk
Source: orbit
Source-ID: 210011
Publication: Research › Paper – Annual report year: 2007

Statistical framework for decision making in mine action
The lecture discusses the basics of statistical decision making in connection with humanitarian mine action. There is special focus on: 1) requirements for mine detection; 2) design and evaluation and confidence of mine equipment; 3) efficient mine action by hierarchical approaches; 4) performance improvement by statistical learning and information fusion; 5) the advantage of using combined methods.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Larsen, J. (Intern)
Publication date: 2007
Main Research Area: Technical/natural sciences
Electronic versions:
imm5491.pdf
Links:
http://www.ndrf.dk
Source: orbit
Source-ID: 210012
Publication: Research › Paper – Annual report year: 2007

Statistical framework for decision making in mine action
The lecture discusses the basics of statistical decision making in connection with humanitarian mine action. There is special focus on: 1) requirements for mine detection; 2) design and evaluation and confidence of mine equipment; 3) efficient mine action by hierarchical approaches; 4) performance improvement by statistical learning and information fusion; 5) the advantage of using combined methods.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Larsen, J. (Intern)
Publication date: 2007

Publication information
Original language: English
Publisher: ISP Gorup, Informatics and Mathematical Modelling, Tehcnical University of Denmark
Main Research Area: Technical/natural sciences
Electronic versions:
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.

Wind Noise Reduction using Non-negative Sparse Coding

We introduce a new speaker independent method for reducing wind noise in single-channel recordings of noisy speech. The method is based on non-negative sparse coding and relies on a wind noise dictionary which is estimated from an isolated noise recording. We estimate the parameters of the model and discuss their sensitivity. We then compare the algorithm with the classical spectral subtraction method and the Qualcomm-ICSI-OGI noise reduction method. We optimize the sound quality in terms of signal-to-noise ratio and provide results on a noisy speech recognition task.
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.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Meng, A. (Intern), Larsen, J. (Intern), Hansen, L. K. (Intern)
Publication date: Jun 2006

Publication information
Original language: English
Series: IMM-PHD-2006-165
Main Research Area: Technical/natural sciences
Electronic versions:
imm4502.pdf
Source: orbit
Source-ID: 191707
Publication: Research › Ph.D. thesis – Annual report year: 2006

Approaches to better context modeling and categorization

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Madsen, R. E. (Intern), Hansen, L. K. (Intern), Larsen, J. (Intern)
Publication date: Mar 2006

Publication information
Original language: English
Series: IMM-PHD-2005-155
Main Research Area: Technical/natural sciences
Electronic versions:
phd155_rem-ny.pdf
Source: orbit
Source-ID: 185929
Publication: Research › Ph.D. thesis – Annual report year: 2006

Basics of Bayesian Learning - Basically Bayes

Tutorial presented at the IEEE Machine Learning for Signal Processing Workshop 2006, Maynooth, Ireland, September 8, 2006. The tutorial focuses on the basic elements of Bayesian learning and its relation to classical learning paradigms. This includes a critical discussion of the pros and cons. The theory is illustrated by specific models and examples.
Clustering via Kernel Decomposition

Methods for spectral clustering have been proposed recently which rely on the eigenvalue decomposition of an affinity matrix. In this work it is proposed that the affinity matrix is created based on the elements of a non-parametric density estimator. This matrix is then decomposed to obtain posterior probabilities of class membership using an appropriate form of nonnegative matrix factorization. The troublesome selection of hyperparameters such as kernel width and number of clusters can be obtained using standard cross-validation methods as is demonstrated on a number of diverse data sets.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
probabilistic clustering, aggregated Markov models, spectral clustering, kernel principal component analysis, kernel decomposition

Electronic versions:
imm2809.pdf

DOIs:
10.1109/TNN.2005.860840

Bibliographical note
Correlation Functions and Power Spectra
The present lecture note is a supplement to the textbook Digital Signal Processing by J. Proakis and D.G. Manolakis used in the IMM/DTU course 02451 Digital Signal Processing and provides an extended discussion of correlation functions and power spectra. The definitions of correlation functions and spectra for discrete-time and continuous-time (analog) signals are pretty similar. Consequently, we confine the discussion mainly to real discrete-time signals. The Appendix contains detailed definitions and properties of correlation functions and spectra for analog as well as discrete-time signals. It is possible to define correlation functions and associated spectra for aperiodic, periodic and random signals although the interpretation is different. Moreover, we will discuss correlation functions when mixing these basic signal types. In addition, the note include several examples for the purpose of illustrating the discussed methods.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Larsen, J. (Intern)
Publication date: 2006

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Electronic versions:
imm4932.pdf
Links:
http://www2.imm.dtu.dk/pubdb/p.php?4932
Source: orbit
Source-ID: 193344
Publication: Education › Compendium/lecture notes – Annual report year: 2006

Introductory note

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Barros, A. (Ekstern), Mandic, D. (Ekstern), Larsen, J. (Intern)
Pages: 5-6
Publication date: 2006
Main Research Area: Technical/natural sciences

Publication information
Volume: 45
Issue number: 1-2
ISSN (Print): 0922-5773
Ratings:
BFI (2008): BFI-level 1
Web of Science (2006): Indexed yes
Web of Science (2000): Indexed yes
Original language: English
Source: orbit
Source-ID: 214586
Publication: Research - peer-review › Journal article – Annual report year: 2006

New Applications of Learning Machines
* Machine learning framework for sound search * Genre classification * Music separation * MIMO channel estimation and symbol detection

General information
On Data and Parameter Estimation Using the Variational Bayesian EM-algorithm for Block-fading Frequency-selective MIMO Channels

A general Variational Bayesian framework for iterative data and parameter estimation for coherent detection is introduced as a generalization of the EM-algorithm. Explicit solutions are given for MIMO channel estimation with Gaussian prior and noise covariance estimation with inverse-Wishart prior. Simulation of a GSM-like system provides empirical proof that the VBEM-algorithm is able to provide better performance than the EM-algorithm. However, if the posterior distribution is highly peaked, the VBEM-algorithm approaches the EM-algorithm and the gain disappears. The potential gain is therefore greatest in systems with a small amount of observations compared to the number of parameters to be estimated.

Optimal filtering of dynamics in short-time features for music organization

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Proceedings of IEEE Machine Learning for Signal Processing Workshop XVI

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Publication date: 2006

Separating Underdetermined Convolutive Speech Mixtures

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Pedersen, M. S. (Intern), Wang, D. (Ekstern), Larsen, J. (Intern), Kjems, U. (Intern)
Pages: 674-681
Publication date: 2006

Host publication information
Title of host publication: ICA 2006
Publisher: Springer Berlin / Heidelberg
Main Research Area: Technical/natural sciences
Electronic versions:
imm4068.pdf
Links:
http://www.springerlink.com/(5mek2yi4tyyq455f5gmu245)/app/home/contribution.asp?referrer=parent&backto=issue,84,1;journal,10,3313;linkingpublicationresults,1:105633,1
Source: orbit
Source-ID: 191560
Publication: Research - peer-review › Article in proceedings – Annual report year: 2006

Separating Underdetermined Convolutive Speech Mixtures

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Pedersen, M. S. (Intern), Wang, D. (Ekstern), Larsen, J. (Intern), Kjems, U. (Intern)
Publication date: 2006
Main Research Area: Technical/natural sciences
Electronic versions:
imm4469.pdf
Source: orbit
Source-ID: 201233
Publication: Research › Poster – Annual report year: 2006
Skin cancer detection

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Larsen, J. (Intern)
Publication date: 2006

Publication information
Publisher: Informatics and Mathematical Modelling, Technical University of Denmark, DTU
Main Research Area: Technical/natural sciences
Electronic versions:
imm4931.pdf
Links:
http://www2.imm.dtu.dk/pubdb/views/publication_details.php?id=4931
Source: orbit
Source-ID: 193345
Publication: Research › Report – Annual report year: 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

Statistical methods for decision making in mine action
The lecture discusses the basics of statistical decision making in connection with humanitarian mine action. There is special focus on: 1) requirements for mine detection; 2) design and evaluation of mine equipment; 3) performance improvement by statistical learning and information fusion; 4) the advantage of using combined methods.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Larsen, J. (Intern)
Publication date: 2006
Event: Poster session presented at NDRF Post Graduate Education: Introduction to Mine Action, Hevring, Denmark
Main Research Area: Technical/natural sciences
humanitarian mine action, combined methods, fusion, bayesian learning, signal processing, statistics
Electronic versions:
imm4904.pdf
Links:
Two-microphone Separation of Speech Mixtures


General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Pedersen, M. S. (Intern), Wang, D. (Ekstern), Larsen, J. (Intern), Kjems, U. (Intern)
Publication date: 2006

Publication information
Original language: English
Publisher: IMM
Main Research Area: Technical/natural sciences
Source code, underdetermined ICA
Electronic versions:
imm4399.zip
Links:
http://www2.imm.dtu.dk/pubdb/p.php?4399
Source: orbit
Source-ID: 201181
Publication: Research - peer-review › Computer programme – Annual report year: 2006

Two-microphone Separation of Speech Mixtures


General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Pedersen, M. S. (Intern), Wang, D. (Ekstern), Larsen, J. (Intern), Kjems, U. (Intern)
Publication date: 2006

Publication information
Original language: English
Publisher: IMM
Main Research Area: Technical/natural sciences
Underdetermined ICA
Links:
Source: orbit
Source-ID: 202507
Publication: Research › Interactive production – Annual report year: 2006

Condition Monitoring and Management from Acoustic Emissions

In the following, I will use technical terms without explanation as it gives the freedom to describe the project in a shorter form for those who already know. The thesis is about condition monitoring of large diesel engines from acoustic emission signals. The experiments have been focused on a specific and severe fault called scuffing. The fault is generally assumed to arise from increased interaction between the piston and liner. For generating experimental data destructive tests with no lubrication, oil has been carried out. Focus has been on modeling the normal condition and detecting the increased
interaction due to the lack of lubrication as a deviation from the normal. Linear instantaneous blind source separation is capable of picking out the relevant hidden signals. Those hidden signals and the estimated noise level can be used to model the normal-condition, and faults can be detected as outliers in that model. Among the investigated methods the Mean field independent component analysis with diagonal noise covariance matrix models is best at modeling the observed signals. Nevertheless, this does not imply that this is the best model to detect the outliers. Another contribution of this work is the analysis of the angular position changes of the engine related events such as fuel injection and valve openings, caused by operational load changes. With inspiration from speech recognition and voice effects the angular timing changes have been inverted with the event alignment framework. With the event alignment framework it is shown that non-stationary condition monitoring can be achieved.

**General information**

State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Pontoppidan, N. H. B. (Intern), Fog, T. L. (Intern), Larsen, J. (Intern)
Publication date: Nov 2005

**Publication information**

Original language: English
Main Research Area: Technical/natural sciences
Electronic versions: imm3887.pdf
Links: http://www2.imm.dtu.dk/pubdb/p.php?3887
Source: orbit
Source-ID: 185936
Publication: Research › Ph.D. thesis – Annual report year: 2005

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**A comparative and combined study of EMIS and GPR detectors by the use of Independent Component Analysis**

**General information**

State: Published
Organisations: Department of Automation, Department of Electrical Engineering, Cognitive Systems, Department of Informatics and Mathematical Modeling, Biomedical Engineering
Authors: Morgenstjerne, A. (Intern), Karlsen, B. (Intern), Larsen, J. (Intern), Sørensen, H. B. D. (Intern), Jakobsen, K. B. (Intern)
Publication date: 2005

**Host publication information**

Title of host publication: Proceedings of the 2005 Detection and Remediation Technologies for Mines and Mine-Like Targets, AeroSense 2005
Publisher: SPIE
Main Research Area: Technical/natural sciences
Conference: AeroSense 2005, 01/01/2005
Electronic versions: imm3665.pdf
Source: orbit
Source-ID: 185720
Publication: Research - peer-review › Article in proceedings – Annual report year: 2005

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**Clever Toolbox - the Art of Automated Genre Classification**

Automatic musical genre classification can be defined as the science of finding computer algorithms that a digitized sound clip as input and yield a musical genre as output. The goal of automated genre classification is, of course, that the musical genre should agree with the human classification. This demo illustrates an approach to the problem that first extract frequency-based sound features followed by a “linear regression” classifier. The basic features are the so-called mel-frequency cepstral coefficients (MFCCs), which are extracted on a time-scale of 30 msec. From these MFCC features, auto-regressive coefficients (ARs) are extracted along with the mean and gain to get a single (30 dimensional) feature vector on the time-scale of 1 second. These features have been used because they have performed well in a previous study (Meng, Ahrendt, Larsen (2005)). Linear regression (or single-layer linear NN) is subsequently used for classification. This classifier is rather simple; current research investigates more advanced methods of classification.

**General information**

State: Published
Condition monitoring with Mean field independent components analysis

Co-occurrence Models in Music Genre Classification

Music genre classification has been investigated using many different methods, but most of them build on probabilistic models of feature vectors $x_r$ which only represent the short time segment with index $r$ of the song. Here, three different co-occurrence models are proposed which instead consider the whole song as an integrated part of the probabilistic model. This was achieved by considering a song as a set of independent co-occurrences $(s, x_r)$ ($s$ is the song index) instead of just a set of independent $(x_r)$'s. The models were tested against two baseline classification methods on a difficult 11 genre data set with a variety of modern music. The basis was a so-called AR feature representation of the music. Besides the benefit of having proper probabilistic models of the whole song, the lowest classification test errors were found using one of the proposed models.
Improving Music Genre Classification by Short Time Feature Integration

Many different short-time features (derived from 10-30ms of audio) have been proposed for music segmentation, retrieval and genre classification. Often the available time frame of the music to make a decision (the decision time horizon) is in the range of seconds instead of milliseconds. The problem of making new features on the larger time scale from the short-time features (feature integration) has only received little attention. This paper investigates different methods for feature integration (early information fusion) and late information fusion (assembling of probabilistic outputs or decisions from the classifier, e.g. majority voting) for music genre classification.

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Meng, A. (Intern), Ahrendt, P. (Intern), Larsen, J. (Intern)
Publication date: 2005
Main Research Area: Technical/natural sciences
Information Fusion, Music genre, Autoregressive Model
Electronic versions:
imm3659.pdf
Source: orbit
Source-ID: 201247
Publication: Research › Poster – Annual report year: 2005

Improving Music Genre Classification by Short-Time Feature Integration

Many different short-time features, using time windows in the size of 10-30 ms, have been proposed for music segmentation, retrieval and genre classification. However, often the available time frame of the music to make the actual decision or comparison (the decision time horizon) is in the range of seconds instead of milliseconds. The problem of making new features on the larger time scale from the short-time features (feature integration) has only received little attention. This paper investigates different methods for feature integration and late information fusion for music genre classification. A new feature integration technique, the AR model, is proposed and seemingly outperforms the commonly used mean-variance features.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Meng, A. (Intern), Ahrendt, P. (Intern), Larsen, J. (Intern)
Pages: 497-500
Publication date: 2005

Host publication information
Title of host publication: IEEE International Conference on Acoustics, Speech, and Signal Processing
ISBN (Print): 0-7803-8874-7
Main Research Area: Technical/natural sciences
Audio classification, early/late Information fusion,, Feature Integration
Electronic versions:
imm3309.pdf
DOIs: 10.1109/ICASSP.2005.1416349

Bibliographical note
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Source: orbit
Source-ID: 185719
Publication: Research - peer-review › Article in proceedings – Annual report year: 2005
Non-stationary Condition Monitoring of large diesel engines with the AEWATT toolbox

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Pontoppidan, N. H. (Intern), Larsen, J. (Intern), Sigurdsson, S. (Intern)
Publication date: 2005

Host publication information
Title of host publication: 59th meeting of the Society for Machinery Failure Prevention Technology
Publisher: Society for Machinery Failure Prevention Technology
Main Research Area: Technical/natural sciences
Electronic versions:
imm3351.pdf
Links:
http://www2.imm.dtu.dk/pubdb/p.php?3351
Source: orbit
Source-ID: 185737
Publication: Research - peer-review › Article in proceedings – Annual report year: 2005

On the difference between updating the mixing matrix and updating the separation matrix

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Pedersen, M. S. (Intern), Larsen, J. (Intern), Kjems, U. (Intern)
Pages: 297-300
Publication date: 2005

Host publication information
Title of host publication: International Conference on Acoustics, Speech and Signal Processing (ICASSP'05)
Main Research Area: Technical/natural sciences
Electronic versions:
imm3392.pdf
imm3392.ps
Links:
http://www2.imm.dtu.dk/pubdb/p.php?3392
On the difference between updating the mixing matrix and updating the separation matrix

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Pedersen, M. S. (Intern), Larsen, J. (Intern), Kjems, U. (Intern)
Publication date: 2005
Main Research Area: Technical/natural sciences

Overcomplete Blind Source Separation by Combining ICA and Binary Time-Frequency Masking
A limitation in many source separation tasks is that the number of source signals has to be known in advance. Further, in order to achieve good performance, the number of sources cannot exceed the number of sensors. In many real-world applications these limitations are too strict. We propose a novel method for over-complete blind source separation. Two powerful source separation techniques have been combined, independent component analysis and binary time-frequency masking. Hereby, it is possible to iteratively extract each speech signal from the mixture. By using merely two microphones we can separate up to six mixed speech signals under anechoic conditions. The number of source signals is not assumed to be known in advance. It is also possible to maintain the extracted signals as stereo signals.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Pedersen, M. S. (Intern), Wang, D. (Ekstern), Larsen, J. (Intern), Kjems, U. (Intern)
Pages: 15-20
Publication date: 2005

Host publication information
Title of host publication: IEEE International workshop on Machine Learning for Signal Processing
Publisher: IEEE
ISBN (Print): 0-7803-9517-4
Main Research Area: Technical/natural sciences
Overcomplete, Time-Frequency (T-F) Masking, BSS, ICA, Underdetermined, Blind Source separation
Electronic versions:
imm3894.pdf
DOIs:
10.1109/MLSP.2005.1532867

Bibliographical note
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Source: orbit
Source-ID: 185733
Publication: Research - peer-review › Article in proceedings – Annual report year: 2005

Proceedings of IEEE Machine Learning for Signal Processing Workshop XV

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Publication date: 2005
Supervised and unsupervised condition monitoring of non-stationary acoustic emission signals

Cognitive Component Analysis

Towards Cognitive Component Analysis

Bibliographical note
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.

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

Publication Information
Original language: English
Main Research Area: Technical/natural sciences
Electronic versions: imm2821.pdf
Links:
Source: orbit
Source-ID: 58679
Publication: Research › Ph.D. thesis – Annual report year: 2004

Decision time horizon for music genre classification using short time features

In this paper music genre classification has been explored with special emphasis on the decision time horizon and ranking of tapped-delay-line short-time features. Late information fusion as e.g. majority voting is compared with techniques of early information fusion such as dynamic PCA (DPCA). The most frequently suggested features in the literature were employed including mel-frequency cepstral coefficients (MFCC), linear prediction coefficients (LPC), zero-crossing rate (ZCR), and MPEG-7 features. To rank the importance of the short time features consensus sensitivity analysis is applied. A Gaussian classifier (GC) with full covariance structure and a linear neural network (NN) classifier are used.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Ahrendt, P. (Intern), Meng, A. (Intern), Larsen, J. (Intern)
Pages: 1293-1296
Publication date: 2004

Host publication Information
Title of host publication: EUSIPCO
Main Research Area: Technical/natural sciences
Electronic versions:
**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: IEEE Transactions on Biomedical Engineering
Volume: 51
Issue number: 10
ISSN (Print): 0018-9294
Ratings:
BFI (2018): BFI-level 2
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4.2 SJR 1.214 SNIP 1.995
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
Scopus rating (2011): SJR 0.7 SNIP 1.715 CiteScore 3.04
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 0.686 SNIP 1.637
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 0.81 SNIP 1.94
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.826 SNIP 1.719
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.144 SNIP 2.187
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.317 SNIP 2.426
Scopus rating (2005): SJR 1.023 SNIP 2.252
Scopus rating (2004): SJR 0.73 SNIP 1.689
Non-stationary condition monitoring through event alignment

We present an event alignment framework which enables change detection in non-stationary signals. Classical condition monitoring frameworks have been restrained to laboratory settings with stationary operating conditions, which are not resembling real world operation. In this paper we apply the technique for non-stationary condition monitoring of large diesel engines based on acoustical emission sensor signals. The performance of the event alignment is analyzed in an unsupervised probabilistic detection framework based on outlier detection with either Principal Component Analysis or Gaussian Processes modeling. We are especially interested in the true performance of the condition monitoring performance with mixed aligned and unaligned data, e.g., detection of fault condition of unaligned examples versus false alarms of aligned normal condition data. Further, we expect that the non-stationary model can be used for wear trending due to longer and continuous monitoring across operating condition changes.

General information

State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Pontoppidan, N. H. (Intern), Larsen, J. (Intern)
Pages: 499-508
Publication date: 2004

Host publication information

Title of host publication: IEEE Workshop on Machine Learning for Signal Processing
Publisher: IEEE Press
ISBN (Print): 0-7803-8608-4
Main Research Area: Technical/natural sciences
Condition Monitoring, Non-stationarity, Diesel Engine

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.
Proceedings of IEEE Workshop on Machine Learning for Signal Processing XIV

This proceeding contains refereed papers presented at the fourteenth IEEE Workshop on Machine for Signal Processing (MLSP'2004), held at São Luís, Maranhão, Brazil, September 29-October 1, 2004. This is a continuation of the IEEE workshops on Neural Networks for Signal Processing (NNSP) organized by the NNSP technical committee of the Signal Processing society. The name of the technical committee, hence of the workshop, has been changed to Machine Learning for Signal Processing in September 2003 to better reflect the areas represented by the technical committee. The conference is organized by the Machine Learning for Signal Processing Technical Committee with sponsorship of the IEEE Signal Processing Society. Following the practice started last year, the bound volume of the proceedings is going to be published by IEEE following the workshop, and we are pleased to offer to conference attendees the proceeding in a CDROM electronic format, which maintains the same standard as the printed version and facilitates the reading and searching of the papers. The field of machine learning has matured considerably in both methodology and real-world application domains and has become particularly important for solution of problems in signal processing. As reflected in this collection, machine learning for signal processing combines many ideas from adaptive signal/image processing, learning theory and models, and statistics in order to solve complex real-world signal processing applications. High quality across such topical diversity can only be maintained through a rigorous and selective review process. This year, 171 full papers (10 pages) were submitted, out of which 79 (resulting in an acceptance rate of approximately 50%) were selected for oral or poster presentation, after reviews by three referees for each. We would like to thank the MLSP'2004 Technical Committee for taking the time to provide quality reviews. Special thanks also go to Drs. Guilherme Barreto, Osvaldo Saavedra, and Hani Yehia of the Organizing Committee for their commitment, handling of the workshop budget, registration, and the CDROM copy of the proceedings. This year, the workshop featured research work in the areas of nonlinear signal processing, system identification, blind source separation, learning theory and models, neural networks, applications in image and video processing, speech processing, as well as implementation and other applications of machine learning. We would like to express our appreciation and gratitude to UFMA, EMAP, ELETROBRÁS, ELETRONORTE, ALUMAR and BASA, who contributed to the workshop by providing technical and financial support in various forms. Our warmest, special thanks go to our plenary speakers: Prof. Petar M. Djuric of Stony Brook University (USA), Prof. Sun-Yuan Kung of Princeton University (USA), and Prof. Erkki Oja of Helsinki University of Technology (Finland). Continuing the tradition of paperless and easy communication, many of the details of the MLSP'2004 Workshop were handled electronically through the workshop webpage (http://isp.imm.dtu.dk/mlsp2004), which, among other features, included web-based submissions, review, and registration.
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

Host publication information
Volume: 2
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
Electronic versions:
Madsen.pdf
DOIs: 10.1109/ICPR.2004.1334270

Bibliographical note
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Source: orbit
Source-ID: 257054
Publication: Research - peer-review › Article in proceedings – Annual report year: 2004

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.

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)
Pages: 80-85
Publication date: 2004
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. In Danish: Denne Ph.d. afhandling fokuserer på a objektive metoder til diagnosering af hudkræft fra Raman spektra. En metode til dæmpning af hud fluorisence og dimensions reduktion af Raman spektra er foreslået. En robust Bayesiansk fremgangsmåde til træning af neural netværk er foreslået, som indeholder outlier kontrol og overfitting håndtering. Endelig, er der defineret en visualisering metode af vigtige features fra det trænede neural netværk, baseret på indgangs/ udgangs følsomheds analyse. Diagnose resultater for det neurale netværk for to typer hudkræft viser, at 97.9% af basal cell carcinoma og 85.5% af malignant melanoma er korrekt klassificeret. Visualisering viser at frekvensbånd i Raman spektra, som hudlæger havde identificeret som vigtige, også blev identificeret som vigtige af det neurale netværk. Endvidere, finder det neurale netværk frekvens bånd som ikke før er brugt til diagnoserings af hudkræft. Disse vigtige frekvensbånd stammer fra forskel i molekyle struktur i lipider og proteiner. Selv om temaet for denne afhandling er hudkræft diagnosering fra Raman spektra, kan dimensions reduceringen og det neurale netværk bruges til andre mønster genkendelses problemer uden videre tiltag.
Distribution of the Density of a Gaussian Mixture

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

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Electronic versions:
imm1755.pdf
imm1755.zip
Links:
Source: orbit
Source-ID: 58700
Publication: Research - peer-review › 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:
Source: orbit
Source-ID: 58720
Publication: Research › Report – Annual report year: 2003

Gaussian Integrals

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

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Electronic versions:
imm1522.pdf
Links:
GPR Detection of Buried Symmetrically Shaped Mine-like Objects using Selective Independent Component Analysis

General information
State: Published
Organisations: Electronics & Signal Processing, Department of Electrical Engineering, Cognitive Systems, Department of Informatics and Mathematical Modeling, Electromagnetic Systems
Authors: Karlsen, B. (Intern), Sørensen, H. B. D. (Intern), Larsen, J. (Intern), Jakobsen, K. B. (Intern)
Pages: 375-386
Publication date: 2003

Host publication information
Volume: 5089
Main Research Area: Technical/natural sciences
Conference: AeroSense 2003, 05/11/1829
Electronic versions:
imm2428.pdf
Links:
Source: orbit
Source-ID: 58534
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

Independent component analysis for detection of condition changes in large diesels

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems, MAN B&W Diesel A/S
Authors: Pontoppidan, N. H. (Intern), Larsen, J. (Intern), Fog, T. L. (Ekstern)
Pages: 493-502
Publication date: 2003

Host publication information
Title of host publication: COMADEM 2003 16th Condition Monitoring and Diagnostic Engineering Management August27-29, Växjö University
Publisher: Växjö University Press
Main Research Area: Technical/natural sciences
Independent Component Analysis in Multimedia Modeling

Modeling of multimedia and multimodal data becomes increasingly important with the digitalization of the world. The objective of this paper is to demonstrate the potential of independent component analysis and blind sources separation methods for modeling and understanding of multimedia data, which largely refers to text, images/video, audio and combinations of such data. We review a number of applications within single and combined media with the hope that this might provide inspiration for further research in this area. Finally, we provide a detailed presentation of our own recent work on modeling combined text/image data for the purpose of cross-media retrieval.

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

Proceedings of the IEEE 2003 Neural Networks for Signal Processing Workshop
This proceeding contains refereed papers presented at the thirteenth IEEE Workshop on Neural Networks for Signal Processing (NNSP'2003), held at the Atria-Mercure Conference Center, Toulouse, France, September 17-19, 2003. The Neural Networks for Signal Processing Technical Committee of the IEEE Signal Processing Society organized the workshop with sponsorship of the Signal Processing Society and the co-operation of the IEEE Neural Networks Society. The IEEE Press published the previous twelve volumes of the NNSP Workshop proceedings in a hardbound volume. This year, the bound volume is to be published by IEEE following the workshop, and we are pleased to inaugurate a new CDROM electronic format, which maintains the same standard as the printed version and facilitates the reading and searching of the papers. In recent years, the field of neural networks has matured considerably in both methodology and real-world application domains and is widely entering into everyday solutions adopted by research and industry, going far beyond "traditional" neural networks and academic examples. As reflected in this collection, contemporary neural networks for signal processing combine many ideas from adaptive signal/image processing, machine learning, and statistics in order to solve complex real-world signal processing applications. This year, two topics attracting particular interest were
presented at two special sessions; one on bioinformatics and a second one on space and aeronautics. High quality across such topical diversity can only be maintained through a rigorous and selective review process. This year, 149 full papers (10 pages) were submitted, out of which 88 (resulting in an acceptance rate of 59%) were selected for oral or poster presentation, after reviews by three referees for each. Following the cancellation of the ICASSP'03 IEEE conference, we have also accepted and included in the CDROM copy of the proceedings 17 papers for presentation from ICASSP'2003. We would like to thank the NNSP'2003 Technical Committee for taking the time to provide quality reviews. Special thanks also go to Dr. Bernard Michot of the Organizing Committee for his commitment, and the members of the PROGEP association, Florence Foucaud, Marlène Pauly and Vincent Gerbaud, for the handling of the workshop budget and registration. This year, the workshop featured research work in the areas of nonlinear signal processing, system identification, blind source separation, theory of neural networks, applications in image and video processing, speech processing, as well as implementation and other applications of neural networks. In addition to regular and special sessions, the NNSP'2003 Workshop was fortunate to have the participation of three companies - IBM Life Science, Research Systems Inc., and Spotfire - with stands presenting their products related to signal processing and neural networks. We are also grateful to the Toulouse City Council and to Sanofi-Synthelabo for their generous financial support. We would like to express our appreciation and gratitude to all these contributors. Our warmest, special thanks go to our organizers for the special sessions and plenary speakers: Dr. Edgardo Ferran of Sanofi-Synthelabo Recherche Labège (France), Professor Gérard Dreyfus of L'ESPCI, Paris (France), Professor Rita Casadio of University of Bologna (Italy), Professor Manuel Samuelides of Ecole Nationale Supérieure de l'Aéronautique et de l'Espace, Toulouse (France), and Professor Mahesan Niranjan of Sheffield University (UK). Continuing the tradition of paperless and easy communication, many of the details of the NNSP'2003 Workshop were handled electronically through the workshop webpage (http://isp.imm.dtu.dk/nnsp2003), which, among other features, included web-based submissions, review, and registration.

Christophe Molina, Sanofi-Synthelabo, Recherche, France Tülasy Adali, University of Maryland, Baltimore County, USA Jan Larsen, Technical University of Denmark Marc Van Hulle, Katholieke Universiteit Leuven, Belgium Scott Douglas, Southern Methodist University, USA Jean Rouat, Université de Sherbrooke, Canada.

### General information
- **State:** Published
- **Organisations:** Cognitive Systems, Department of Informatics and Mathematical Modeling
- **Publication date:** 2003

### Publication information
- **Publisher:** IEEE Press
- **Original language:** English
- **Main Research Area:** Technical/natural sciences
- **Links:**
  - Source: orbit
  - Source-ID: 58589
- **Publication:** Research - peer-review › Book – Annual report year: 2003

### Propagation of Uncertainty in Bayesian Kernel Models - Application to Multiple-Step Ahead Forecasting

The object of Bayesian modelling is predictive distribution, which, in a forecasting scenario, enables evaluation of forecasted values and their uncertainties. We focus on reliably estimating the predictive mean and variance of forecasted values using Bayesian kernel based models such as the Gaussian process and the relevance vector machine. We derive novel analytic expressions for the predictive mean and variance for Gaussian kernel shapes under the assumption of a Gaussian input distribution in the static case, and of a recursive Gaussian predictive density in iterative forecasting. The capability of the method is demonstrated for forecasting of time-series and compared to approximate methods.

### General information
- **State:** Published
- **Organisations:** Department of Informatics and Mathematical Modeling, Cognitive Systems
- **Authors:** Quinonero, J. (Intern), Girard, A. (Ekstern), Larsen, J. (Intern), Rasmussen, C. E. (Intern)
- **Pages:** 701-704
- **Publication date:** 2003

### Host publication information
- **Title of host publication:** International Conference on Acoustics, Speech and Signal Processing
- **Publisher:** IEEE
- **ISBN (Print):** 0-7803-7663-3
- **Main Research Area:** Technical/natural sciences
- **Relevance Vector Machine, Gaussian Process, Time-Series Prediction, Uncertain Inputs**

### Electronic versions:
Unsupervised Condition Change Detection In Large Diesel Engines
This paper presents a new method for unsupervised change detection which combines independent component modeling and probabilistic outlier detection. The method further provides a compact data representation, which is amenable to interpretation, i.e., the detected condition changes can be investigated further. The method is successfully applied to unsupervised condition change detection in large diesel engines from acoustical emission sensor signal and compared to more classical techniques based on principal component analysis and Gaussian mixture models.

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.

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.
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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Source: orbit
Source-ID: 58177
Publication: Research - peer-review › Article in proceedings – Annual report year: 2002


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 (2018): BFI-level 2
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
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.

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
Independent Component Analysis for Clutter Reduction in Ground Penetrating Radar Data

General information
State: Published
Organisations: Department of Electrical Engineering, Biomedical Engineering, Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Karlsen, B. (Intern), Sørensen, H. B. D. (Intern), Larsen, J. (Intern), Jackobsen, K. B. (Ekstern)
Pages: 378-389
Publication date: 2002

Host publication information
Title of host publication: Proceedings of the SPIE, AeroSense, Orlando FL, April
Publisher: SPIE
Main Research Area: Technical/natural sciences
Conference: Proceedings of the SPIE, AeroSense, 01/01/2002
Electronic versions:
imm1194.pdf
Links:
Source: orbit
Source-ID: 58181
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.
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.

Probabilistic Hierarchical Clustering with Labeled and Unlabeled Data

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Larsen, J. (Intern), Have, A. S. (Intern), Hansen, L. K. (Intern)
Proceedings of the 2002 IEEE Workshop on Neural Networks for Signal Processing

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Publication date: 2002

Publication information
Publisher: IEEE Press
Original language: English
Main Research Area: Technical/natural sciences
Links:
Statistical Signal Processing in Humanitarian Mine Clearance Systems

General information
State: Published
Organisations: Department of Electrical Engineering, Biomedical Engineering, Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Karlsen, B. (Intern), Sørensen, H. B. D. (Intern), Larsen, J. (Intern), Jakobsen, K. B. (Intern)
Pages: 1-
Publication date: 2002
Main Research Area: Technical/natural sciences

Publication information
Journal: DSP Tidende
Issue number: 13
Original language: English
Electronic versions:
imm1751.pdf
Links:
Source: orbit
Source-ID: 58135
Publication: Research › Journal article – Annual report year: 2002

Statistisk Signalbehandling i Humanitære Minerydningssystemer

General information
State: Published
Organisations: Department of Electrical Engineering, Department of Informatics and Mathematical Modeling
Authors: Karlsen, B. (Intern), Sørensen, H. B. D. (Intern), Larsen, J. (Intern), Jakobsen, K. B. (Intern)
Pages: 13-14
Publication date: 2002
Main Research Area: Technical/natural sciences

Publication information
Journal: DSP Tidende
Issue number: 13
Original language: Danish
Links:
Source: orbit
Source-ID: 60560
Publication: Research › Journal article – Annual report year: 2002

Webmining: Learning from the World Wide Web

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Larsen, J. (Intern), Hansen, L. K. (Intern), Have, A. S. (Intern), Christiansen, T. (Intern), Kolenda, T. (Intern)
Pages: 517-532
Publication date: 2002
Main Research Area: Technical/natural sciences

Publication information
Journal: Computational Statistics & Data Analysis
Volume: 38
Issue number: 4
ISSN (Print): 0167-9473
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
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.

Comparison of PCA and ICA based clutter reduction in GPR systems for anti-personal landmine detection

This paper presents statistical signal processing approaches for clutter reduction in stepped-frequency ground penetrating radar (SF-GPR) data. In particular, we suggest clutter/signal separation techniques based on principal and independent component analysis (PCA/ICA). The approaches are successfully evaluated and compared on a real SF-GPR time-series. Field-test data are acquired using a monostatic S-band rectangular waveguide antenna.
Hierarchical Clustering for Data Mining

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

Host publication information
Title of host publication: Proceedings of The IEEE Signal Processing Society Workshop on Neural Networks for Signal Processing XI
Publisher: IEEE Press
ISBN (Print): 0-7803-7196-8
Main Research Area: Technical/natural sciences
sun-exposure, missing values, Imputation
Electronic versions:
hansen.pdf
DOIs:
10.1109/NNSP.2001.943153

Bibliographical note
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Proceedings of the 2001 IEEE Workshop on Neural Networks for Signal Processing

Signal Detection using ICA: Application to Chat Room Topic Spotting

Adaptive metric kernel regression
Antenna characteristics and air-ground interface deembedding methods for stepped-frequency ground-penetrating radar measurements

The result from field-tests using a Stepped-Frequency Ground Penetrating Radar (SF-GPR) and promising antenna and air-ground deembedding methods for a SF-GPR is presented. A monostatic S-band rectangular waveguide antenna was used in the field-tests. The advantages of the SF-GPR, e.g., amplitude and phase information in the SF-GPR signal, is used to deembed the characteristics of the antenna. We propose a new air-to-ground interface deembedding technique based on Principal Component Analysis which enables enhancement of the SF-GPR signal from buried objects, e.g., anti-personal landmines. The methods are successfully evaluated on field-test data obtained from measurements on a large-scale in-door test field.
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

Host publication information
Title of host publication: IEEE Proceedings of Acoustics, Speech, and Signal Processing
Volume: 6
Place of publication: Istanbul, Turkey
Publisher: IEEE
ISBN (Print): 0-7803-6293-4
Main Research Area: Technical/natural sciences

Electronic versions:
Lars.pdf
DOIs:
10.1117/12.396230

Bibliographical note
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Source: orbit
Source-ID: 176481
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.

On Independent Component Analysis for Multimedia Signals

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Proceedings of the 2000 IEEE Workshop on Neural Networks for Signal Processing

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Publication date: 2000

Publication information
Publisher: IEEE Press, Piscataway, New Jersey
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 200624
Publication: Research - peer-review › Book – 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: Mads.pdf
Source: orbit
Source-ID: 200797
Publication: Research › Ph.D. thesis – Annual report year: 1999

Adaptive metric kernel regression.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Goutte, C. (Intern), Larsen, J. (Intern)
Number of pages: 26
Publication date: 1999

Publication information
Original language: English
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).

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, University of Hawaii
Authors: Andersen, L. N. (Intern), Au, W. (Ekstern), Larsen, J. (Intern), Hansen, L. K. (Intern)
Pages: 477-486
Publication date: 1999

Host publication information
Title of host publication: Proceedings of the IEEE Workshop on Neural Networks for Signal Processing IX
Place of publication: Piscataway
Publisher: IEEE
ISBN (Print): 0-7803-5673-x

Bibliographical note
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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. Á. (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 (2018): BFI-level 2
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Introduction to Artificial Neural Networks
On Condition Monitoring of Exhaust Values in Marine Diesel Engines

The paper is concerned with studying the very different behavior of the two data splits using hold-out cross-validation, K-fold cross-validation and randomized permutation cross-validation. First we describe the theoretical basics of various cross-validation techniques with the purpose of reliably estimating the generalization error and optimizing the model structure. The paper deals with the simple problem of estimating a single location parameter. This problem is tractable as non-asymptotic theoretical analysis is possible, whereas mainly asymptotic analysis and simulation studies are viable for the more complex AR-models and neural networks.

On Optimal Data Split for Generalization Estimation and Model Selection

The paper is concerned with studying the very different behavior of the two data splits using hold-out cross-validation, K-fold cross-validation and randomized permutation cross-validation. First we describe the theoretical basics of various cross-validation techniques with the purpose of reliably estimating the generalization error and optimizing the model structure. The paper deals with the simple problem of estimating a single location parameter. This problem is tractable as non-asymptotic theoretical analysis is possible, whereas mainly asymptotic analysis and simulation studies are viable for the more complex AR-models and neural networks.
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.

**General information**
- State: Published
- Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems, University of Hawaii
- Authors: Andersen, L. N. (Intern), Au, W. (Ekstern), Larsen, J. (Intern), Hansen, L. K. (Intern)
- Pages: 1121-1124
- Publication date: 1999

**Host publication information**
- Title of host publication: Proceedings of the IEEE International Conference on Acoustics, Speech, and Signal Processing
- Volume: 2
- Publisher: IEEE
- ISBN (Print): 0-7803-5041-3
- Main Research Area: Technical/natural sciences
- Electronic versions: Au.pdf
- DOIs: 10.1109/ICASSP.1999.759941

**Bibliographical note**
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Adaptive Metric Kernel Regression
Kernel smoothing is a widely used nonparametric pattern recognition technique. By nature, it suffers from the curse of dimensionality and is usually difficult to apply to high input dimensions. In this paper, we propose an algorithm that adapts the input metric used in multivariate regression by minimising a cross-validation estimate of the generalisation error. This allows one to automatically adjust the importance of different dimensions. The improvement in terms of modelling performance is illustrated on a variable selection task where the adaptive metric kernel clearly outperforms the standard approach.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Goutte, C. (Intern), Larsen, J. (Intern)
Pages: 184-193
Publication date: 1998

Host publication information
Place of publication: Piscataway
Publisher: IEEE
ISBN (Print): 0-7803-5060-X
Main Research Area: Technical/natural sciences
Electronic versions:
Goutte.pdf
DOIs:
10.1109/NNSP.1998.710648

Bibliographical note
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Source: orbit
Source-ID: 169861
Publication: Research - peer-review › Article in proceedings – 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

Adaptive Regularization of Neural Networks Using Conjugate Gradient
Andersen et al. (1997) and Larsen et al. (1996, 1997) suggested a regularization scheme which iteratively adapts regularization parameters by minimizing validation error using simple gradient descent. In this contribution we present an improved algorithm based on the conjugate gradient technique. Numerical experiments with feedforward neural networks successfully demonstrate improved generalization ability and lower computational cost.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Goutte, C. (Intern), Larsen, J. (Intern)
Pages: 1201-1204
Publication date: 1998
Correlation Functions and Power Spectra, Lecture Note for Course 04362, Digital Signal Processing, IMM, DTU

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Larsen, J. (Intern)
Number of pages: 22
Publication date: 1998

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 170420
Publication: Research - peer-review › Book – 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

Host publication information
Volume: 2
Publisher: IEEE
ISBN (Print): 0-7803-4428-6
Main Research Area: Technical/natural sciences
Conference: ICASSP'98, IEEE Int.Conf. on Acoustics, Speech, and Signal Processing, Seattle, USA, 01/01/1998
Electronic versions:
Neural Classifier 1.0 Software Documentation, IMM, DTU

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Larsen, J. (Intern)
Number of pages: 14
Publication date: 1998

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 170422
Publication: Research - peer-review › Book – Annual report year: 1998

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 (2018): BFI-level 2
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
Optimal Cross-Validation Split Ratio: Experimental Investigation

General Information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Goutte, C. (Intern), Larsen, J. (Intern)
Pages: 681-686
Publication date: 1998

Host publication information
Title of host publication: Proceedings of ICANN’98
Place of publication: London
Publisher: Springer
Main Research Area: Technical/natural sciences
Conference: ICANN’98, Proceedings of the 8th Int.Conf. on Artificial Neural Networks, Skoevde, Sweden, 01/01/1998
Source: orbit
Source-ID: 169862
Publication: Research - peer-review › Article in proceedings – 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
Problems, Lecture Note for Course 04362, Digital Signal Processing, IMM, DTU

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Larsen, J. (Intern), Sørensen, J. A. (Intern)
Number of pages: 33
Publication date: 1998

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 170416
Publication: Research - peer-review › Book – Annual report year: 1998

Problem Solutions, Lecture Note for Course 04362, Digital Signal Processing, IMM, DTU

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Larsen, J. (Intern), Sørensen, J. A. (Intern)
Number of pages: 58
Publication date: 1998

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 170418
Publication: Research - peer-review › Book – Annual report year: 1998

Proceedings of SPIE: Input/Output and Imaging Technologies

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Tsai, Y. (ed.) (Ekstern), Kung, T. (ed.) (Ekstern), Larsen, J. (ed.) (Intern)
Publication date: 1998

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 170850
Publication: Research - peer-review › Book – Annual report year: 1998

Solutions to Problems in Proakis and Manolakis, Lecture Note for Course 04362, Digital Signal Processing, IMM, DTU

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Larsen, J. (Intern)
Number of pages: 14
Publication date: 1998

Publication information
Original language: English
Main Research Area: Technical/natural sciences
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
Publisher: Aalborg University
Main Research Area: Technical/natural sciences
Source-ID: 169858
Publication date: 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 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 OBD 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 date: 1997

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
Links:
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

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

Correlation Functions and Power Spectra, Lecture Note for Course 04362
General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Larsen, J. (Intern)
Number of pages: 22
Publication date: 1997

Publication information
Original language: English
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.

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
DOIs:
10.1109/ICASSP.1997.595474

Bibliographical note
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Generalization: The Hidden Agenda of Learning.: The Past, Present and Future of Neural Networks for Signal

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Larsen, J. (Intern), Hansen, L. K. (Intern)
Pages: 43-45
Publication date: 1997
Main Research Area: Technical/natural sciences

Publication information
Journal: IEEE Signal Processing Magazine
Volume: 14
Issue number: 6
ISSN (Print): 1053-5888
Ratings:
BFI (2018): BFI-level 2
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 2.536 SNIP 5.388 CiteScore 8.96
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 2.713 SNIP 6.214 CiteScore 8.15
Interpretation of Recurrent Neural Networks

This paper addresses techniques for interpretation and characterization of trained recurrent nets for time series problems. In particular, we focus on assessment of effective memory and suggest an operational definition of memory. Further we discuss the evaluation of learning curves. Various numerical experiments on time series prediction problems are used to illustrate the potential of the suggested methods.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Pedersen, M. W. (Intern), Larsen, J. (Intern)
Pages: 82-91
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
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.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Hintz-Madsen, M. (Intern), Pedersen, M. W. (Intern), Hansen, L. K. (Intern), Larsen, J. (Intern)
Pages: 223-232
Publication date: 1996

Host publication information
Title of host publication: Proceedings of the IEEE Signal Processing Society Workshop Neural Networks for Signal Processing
Publisher: IEEE
ISBN (Print): 07-80-33550-3
Main Research Area: Technical/natural sciences
Conference: Neural Network for Signal Processing, Kyoto, 01/01/1996
Electronic versions:
With.pdf
DOIs:
10.1109/NNSP.1996.548352

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Source: orbit
Source-ID: 166763
Publication: Research - peer-review › Article in proceedings – Annual report year: 1996

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.

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), Ohlsson, B. O. M. (Intern)
Pages: 62-71
Publication date: 1996

Host publication information
Title of host publication: Proceedings of Neural Networks for Signal Processing VI
Publisher: IEEE
ISBN (Print): 07-80-33550-3
Main Research Area: Technical/natural sciences
Electronic versions:
Svarer.pdf
DOIs:
Detection of Malignant Melanoma using Neural Classifiers

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Hintz-Madsen, M. (Intern), Hansen, L. K. (Intern), Larsen, J. (Intern), Olesen, E. (Ekstern), Drzewiecki, K. T. (Ekstern)
Pages: 395-398
Publication date: 1996

Host publication information
Title of host publication: Solving Engineering Problems with Neural Networks. Proceedings of the International Conference on Engineering Applications of Neural Networks (EANN'96)
Publisher: Syst. Eng. Assoc
ISBN (Print): 9529075170
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 166767
Publication: Research - peer-review › Article in proceedings – Annual report year: 1996

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

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Hansen, L. K. (Intern), Larsen, J. (Intern)
Pages: 269-280
Publication date: 1996
Main Research Area: Technical/natural sciences

Publication information
Journal: Advances in Computational Mathematics
Volume: 5
Issue number: 2-3
ISSN (Print): 1019-7168
Ratings:
BFI (2018): BFI-level 1
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.848 SNIP 1.06 CiteScore 1.3
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.161 SNIP 1.354 CiteScore 1.33
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
Publisher: MIT Press
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 166769
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

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
Main Research Area: Technical/natural sciences
Conference: 1996 IEEE International Conference on Acoustics, Speech and Signal Processing, Atlanta, GA, United States, 07/05/1996 - 07/05/1996
Electronic versions: Kjems.pdf
DOIs: 10.1109/ICASSP.1996.550606

Bibliographical note
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Source: orbit
Source-ID: 164805
Publication: Research - peer-review › Article in proceedings – Annual report year: 1996

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.

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

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, The National Hospital of Denmark
Authors: Hintz-Madsen, M. (Intern), Hansen, L. K. (Intern), Larsen, J. (Intern), Olesen, E. (Ekstern), Drzewiecki, K. (Ekstern)
Pages: 484-493
Publication date: 1995

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 \(N(1-\gamma)\) is discussed. Asymptotically (large data seen), \(\gamma_{opt} \to 1\) such that a relatively larger amount is left for validation

**General information**

State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Larsen, J. (Intern), Hansen, L. K. (Intern)
Pages: 30-39
Publication date: 1995

**Host publication information**

Title of host publication: Proceedings of the 1995 IEEE Workshop on Neural Networks for Signal Processing
Publisher: IEEE
ISBN (Print): 07-80-32739-X
Main Research Area: Technical/natural sciences
Electronic versions: Jan.pdf
DOIs: 10.1109/NNSP.1995.514876

**Bibliographical note**

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Source: orbit
Source-ID: 265144
Publication: Research - peer-review > Article in proceedings – Annual report year: 1995

**Training and evaluation of neural networks for multi-variate time series processing**

We study the training and generalization for multi-variate 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 multi-variate case. A key ingredient is an algebraic expression for the generalization ability of a multi-variate model. The variability of the suggested techniques are successfully demonstrated in a multi-variate scenario involving the prediction of the cylinder pressure in a marine engine

**General information**

State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Fog, T. L. (Intern), Larsen, J. (Intern), Hansen, L. K. (Intern)
Pages: 1194-1199
Publication date: 1995

**Host publication information**

Title of host publication: Proceedings of the IEEE Workshop on Neural Networks
Volume: Volume 2
Publisher: IEEE
ISBN (Print): 07-80-32768-3
Main Research Area: Technical/natural sciences
Electronic versions: Fog.pdf
DOIs: 10.1109/ICNN.1995.487783

**Bibliographical note**

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Source: orbit
Source-ID: 265146
Publication: Research - peer-review > Article in proceedings – Annual report year: 1995
Design of Neural Network Filters

General information
State: Published
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling
Authors: Larsen, J. (Intern), Sørensen, J. A. (Intern)
Publication date: Feb 1994

Publication information
Place of publication: Kgs. Lyngby, Denmark
Publisher: Technical University of Denmark (DTU)
Original language: English
Main Research Area: Technical/natural sciences
Electronic versions:
Larsen.pdf
Source: orbit
Source-ID: 274579
Publication: Research › Ph.D. thesis – Annual report year: 1994

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.

An Algorithm for Successive Identification of Reflections
A new algorithm for successive identification of seismic reflections is proposed. Generally, the algorithm can be viewed as a curve matching method for images with specific structure. However, in the paper, the algorithm works on seismic signals assembled to constitute an image in which the investigated reflections produce curves. In numerical examples, the authors work on signals assembled in CMP gathers. The key idea of the algorithm is to estimate the reflection curve parameters and the reflection coefficients along these curves by combining the multipulse technique and the generalized Radon transform. The multipulse technique is used for wavelet identification in each trace, and the generalized Radon transform...
is used to coordinate the wavelet identification between the individual traces. Furthermore, a stop criterion and a reflection validation procedure are presented. The stop criterion stops the reflection estimation when the actual estimated reflection is insignificant. The reflection validation procedure ensures that the estimated reflections follow the shape of the investigated reflection curves. The algorithm is successfully used in two numerical examples. One is based on a synthetic CMP gather, whereas the other is based on a real recorded CMP gather. Initially, the algorithm requires an estimate of the wavelet that can be performed by any wavelet estimation method.>

**General information**

State: Published  
Organisations: Cognitive Systems, Department of Informatics and Mathematical Modeling  
Authors: Hansen, K. V. (Intern), Larsen, J. (Intern)  
Pages: 281-291  
Publication date: 1994  
Main Research Area: Technical/natural sciences

**Publication information**

Journal: IEEE Transactions on Image Processing  
Volume: 3  
Issue number: 3  
ISSN (Print): 1057-7149  
Ratings:  
BFI (2018): BFI-level 2  
BFI (2017): BFI-level 2  
Web of Science (2017): Indexed Yes  
BFI (2016): BFI-level 2  
Scopus rating (2016): SJR 2.102 SNIP 3.318 CiteScore 6.73  
Web of Science (2016): Indexed yes  
BFI (2015): BFI-level 2  
Scopus rating (2015): SJR 2.1 SNIP 3.886 CiteScore 6.36  
Web of Science (2015): Indexed yes  
BFI (2014): BFI-level 2  
Scopus rating (2014): SJR 1.553 SNIP 4.347 CiteScore 5.81  
Web of Science (2014): Indexed yes  
BFI (2013): BFI-level 2  
Scopus rating (2013): SJR 1.67 SNIP 4.537 CiteScore 6.14  
ISI indexed (2013): ISI indexed yes  
Web of Science (2013): Indexed yes  
BFI (2012): BFI-level 2  
Scopus rating (2012): SJR 1.698 SNIP 4.694 CiteScore 5.58  
ISI indexed (2012): ISI indexed yes  
Web of Science (2012): Indexed yes  
BFI (2011): BFI-level 2  
Scopus rating (2011): SJR 1.735 SNIP 3.983 CiteScore 5.04  
ISI indexed (2011): ISI indexed yes  
BFI (2010): BFI-level 2  
Scopus rating (2010): SJR 1.939 SNIP 4.18  
Web of Science (2010): Indexed yes  
BFI (2009): BFI-level 2  
Scopus rating (2009): SJR 2.299 SNIP 4.318  
BFI (2008): BFI-level 2  
Scopus rating (2008): SJR 2.179 SNIP 3.856  
Scopus rating (2007): SJR 2.685 SNIP 4.622  
Web of Science (2007): Indexed yes  
Scopus rating (2006): SJR 2.224 SNIP 4.503  
Web of Science (2006): Indexed yes  
Scopus rating (2005): SJR 2.092 SNIP 5.444  
Scopus rating (2004): SJR 1.506 SNIP 4.644
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.
Designer networks for time series processing

The conventional tapped-delay neural net 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.
A generalization error estimate for nonlinear systems

A new estimate (GEN) of the generalization error is presented. The estimator is valid for both incomplete and nonlinear models. An incomplete model is characterized in that it does not model the actual nonlinear relationship perfectly. The GEN estimator has been evaluated by simulating incomplete models of linear and simple neural network systems. Within the linear system GEN is compared to the final prediction error criterion and the leave-one-out cross-validation technique. It was found that the GEN estimate of the true generalization error is less biased on the average. It is concluded that GEN is an applicable alternative in estimating the generalization at the expense of an increased complexity.
A neural architecture for nonlinear adaptive filtering of time series
A neural architecture for adaptive filtering which incorporates a modularization principle is proposed. It facilitates a sparse parameterization, i.e. fewer parameters have to be estimated in a supervised training procedure. The main idea is to use a preprocessor which determines the dimension of the input space and can be designed independently of the subsequent nonlinearity. Two suggestions for the preprocessor are presented: the derivative preprocessor and the principal component analysis. A novel implementation of fixed Volterra nonlinearities is given. It forces the boundedness of the polynomials by scaling and limiting the inputs signals. The nonlinearity is constructed from Chebychev polynomials. The authors apply a second-order algorithm for updating the weights for adaptive nonlinearities. Finally the simulations indicate that the two kinds of preprocessing tend to complement each other while there is no obvious difference between the performance of the ANL and FNL.
Phd Student:
Vording, Maximillian Fornitz (Intern)
Supervisor:
Alstrøm, Tommy Sonne (Intern)
Main Supervisor:
Larsen, Jan (Intern)

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

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

FindZebra - using machine learning to aid diagnosis of rare diseases
Department of Applied Mathematics and Computer Science
Period: 01/09/2014 → 31/10/2017
Number of participants: 5
Phd Student:
Svenstrup, Dan Tito (Intern)
Main Supervisor:
Winther, Ole (Intern)
Examiner:
Larsen, Jan (Intern)
Ohlsson, Mattias (Ekstern)
Søgaard, Anders (Ekstern)
Financing sources
Source: Internal funding (public)
Name of research programme: Offentlig finansiering

Relations
Publications:
FindZebra - using machine learning to aid diagnosis of rare diseases
Project: PhD

Large Scale Computing for the Modelling of Whole Brain Connectivity
Department of Applied Mathematics and Computer Science
Period: 01/11/2013 → 22/09/2017
Number of participants: 6
Phd Student:
Albers, Kristoffer Jon (Intern)
Supervisor:
Mørup, Morten (Intern)
Main Supervisor:
Schmidt, Mikkel Nørgaard (Intern)
Examiner:
Larsen, Jan (Intern)
Igel, Christian (Ekstern)
Tresp, Volker (Ekstern)

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

Relations
Publications:
Large Scale Computing for the Modelling of Whole Brain Connectivity
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

Design of cognitive interfaces for personal informatics feedback
Department of Applied Mathematics and Computer Science
Period: 15/08/2012 → 09/12/2015
Number of participants: 6
Phd Student:
Jensen, Camilla Birgitte Falk (Intern)
Supervisor:
Petersen, Michael Kai (Intern)
Main Supervisor:
Larsen, Jakob Eg (Intern)
Examiner:
Larsen, Jan (Intern)
Murray-Smith, Roderick (Intern)
Serafin, Stefania (Ekstern)

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

Relations
Publications:
Design of Cognitive Interfaces for Personal Informatics Feedback
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

Systemer til personalisering af høreapparater
Department of Applied Mathematics and Computer Science
Period: 01/01/2011 → 20/03/2014
Number of participants: 6
Phd Student:
Nielsen, Jens Brehm (Intern)
Supervisor:
Nielsen, Jacob (Ekstern)
Main Supervisor:
Larsen, Jan (Intern)
Examiner:
Winther, Ole (Intern)
Murray-Smith, Roderick (Intern)
Zacharov, Nick (Ekstern)

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

Antennas and Propagation for Body-Centric Wireless Communications
Department of Electrical Engineering
Period: 15/10/2009 → 19/02/2014
Number of participants: 6
Phd Student:
Kvist, Søren Helstrup (Intern)
Supervisor:
Thaysen, Jesper (Intern)
Main Supervisor:
Jakobsen, Kaj Bjarne (Intern)
Examiner:
Larsen, Jan (Intern)
Johansson, Anders J. (Ekstern)
Vardaxoglou, Yiannis C. (Ekstern)

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

Cognizant Hearing Aids
Department of Informatics and Mathematical Modeling
Period: 02/06/2009 → 21/09/2012
Number of participants: 5
Phd Student:
Karadogan, Seliz Gülzen (Intern)
Main Supervisor:
Larsen, Jan (Intern)
Examiner:
Winther, Ole (Intern)
Jensen, Søren Holdt (Intern)
Schuller, Björn Wolfgang (Ekstern)

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)
Main Supervisor:
Larsen, Jan (Intern)
Examiner:
Winther, Ole (Intern)
Cemgil, Ali Taylan (Ekstern)
Plumbley, Mark David (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)
Main Supervisor:
Larsen, Jan (Intern)
Examiner:
Hansen, Lars Kai (Intern)
Kidmose, Preben (Intern)
Mandic, Danilo P. (Ekstern)

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

Vessel Performance Control

Department of Mechanical Engineering
Period: 01/03/2007 → 19/03/2015
Number of participants: 7
Phd Student:
Pedersen, Benjamin Pjedsted (Intern)
Supervisor:
Larsen, Jan (Intern)
Intelligent Analysis and Compression of Multi-sensor Data

Department of Informatics and Mathematical Modeling
Period: 01/08/2006 → 01/06/2009
Number of participants: 3
Phd Student: Francke, Mathias (Intern)
Supervisor: Hallundbæk, Jørgen (Intern)
Main Supervisor: Larsen, Jan (Intern)

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

Learning Based Compensation of Nonlinearities in Microspeakers

Department of Informatics and Mathematical Modeling
Period: 01/10/2005 → 15/04/2007
Number of participants: 5
Phd Student: Larsen, Allan Renneberg (Ekstern)
Supervisor: Agerkvist, Finn T. (Intern)
Munk, Steen M. (Intern)
Rasmussen, Karsten Bo (Intern)
Main Supervisor:
Larsen, Jan (Intern)

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

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

Capacity Improvements in Cellular Systems
Department of Informatics and Mathematical Modeling
Period: 01/09/2003 → 03/09/2007
Number of participants: 6
Phd Student:
Christensen, Lars P.B. (Intern)
Supervisor:
Hejen-Sørensen, Pedro (Intern)
Main Supervisor:
Larsen, Jan (Intern)
Examiner:
Winther, Ole (Intern)
Fleury, Bernard H. (Ekstern)
Hejen-Sørensen, Pedro (Intern)

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

Computational Auditory Scene analysis for Hearing Aids
Department of Informatics and Mathematical Modeling
Period: 01/06/2003 → 20/11/2006
Number of participants: 6
Phd Student:
Pedersen, Michael Syskind (Intern)
Supervisor:
Kjems, Ulrik (Intern)
Main Supervisor:
Larsen, Jan (Intern)
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: Ansat eksternt
Project: PhD

Klassifikation af naturligt forekommende lydmiljøer

Department of Informatics and Mathematical Modeling
Period: 01/02/2003 → 30/06/2006
Number of participants: 4
Phd Student:
Ahrendt, Peter (Intern)
Main Supervisor:
Larsen, Jan (Intern)
Examiner:
Winther, Ole (Intern)
Jensen, Søren Holdt (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU, Samfinansiering
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

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

System design for vision-based dermatological measurements
Department of Informatics and Mathematical Modeling
Period: 07/08/2001 → 31/01/2002
Number of participants: 4
PhD Student:
Karras, Panagiotis (Intern)
Supervisor:
Ersbøll, Bjarne Kjær (Intern)
Datamining in distributed medical 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: Forskningsrådsstipendium
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: Ansat eksternt CAMP
Project: PhD

THALAMUS

THALAMUS is a EUREKA-project with Swedish and Danish partners based on an in depth analysis of present in the health care system regarding patient information. The complexity of acquisition and exchange, journal administration, image administration in regards to digitizing of information and various electronic formats. The lack of opportunities for free flow of information is a significant obstacle for further rationalization of the daily operation at any hospital department and minor health care units. At the same time the opportunity for quality and assurance is disabled. The introduction of the electronic patient journal has only resolved a limited part of the mentioned problem where Thalamus aims towards a complete solution with facilities making digitizing of all types of patient information, text, images, sound, film and at the same time integration these, with the possibility for immediate acquisition and transmission.
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 cooperation between scientists from DTU and several departments from different hospitals and university clinics.

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

Modelling, 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)
Roland, Per Ebbe (Ekstern)

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

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)

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)
Neural process optimization of pulse plating in the electronic industry

The purpose of the project is to optimize the pulse plating process using mathematical models. The traditional electronic industry uses a chemical bath with additives to make the through-hole plating on printed circuit boards. The pulse plating process can make the through plating without the additives and even improve the quality of the copper. So there is both a solution to an environmental problem and a quality problem. Based on the measurements from plated printed circuit boards, the mathematical model is used to find the optimal pulse parameters. In this project, there is used artificial neural nets to solve the problem. With the final model, it should be possible to "feed" the neural net with a CAD-design. Based on the design and the "knowledge" of the neural net, it will be possible to compute the optimal pulse parameters.

Computer Science and Engineering

Department of Informatics and Mathematical Modeling

Department of Manufacturing Engineering

Department of Management Engineering

CHEMBO Overfladeteknik A/S

Elcon Pcb Technology A/S

AXA Axel Åkerman A/S

Period: 01/02/1998 → …

Number of participants: 3

Project participant:

Helbo, Carsten (Intern)

Møller, Per (Intern)

Project Manager, organisational:

Larsen, Jan (Intern)

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:

Højen-Sørensen, Pedro (Intern)

Larsen, Jan (Intern)

Project Manager, organisational:

Hansen, Lars Kai (Intern)

Statistisk analyse af Dynamiske hjerneskan

Department of Informatics and Mathematical Modeling
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)
Høje, Jens (Ekstern)

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:
Larsen, Jan (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Dalsgaard, Paul (Ekstern)
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)
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 → 31/08/1997
Number of participants: 3
Project participant:
Larsen, Jan (Intern)
Pedersen, Morten With (Intern)
Project Manager, organisational:
Hansen, Lars Kai (Intern)

Financing sources
Source: Unknown
Name of research programme: Ukendt
Amount: 1,200,000.00 Danish Kroner
Project

Signalbehandling med feedback netværk
Department of Informatics and Mathematical Modeling
Period: 01/09/1994 → 31/10/1997
Number of participants: 5
Phd Student:
Pedersen, Morten With (Intern)
Supervisor:
Larsen, Jan (Intern)
Main Supervisor:
Hansen, Lars Kai (Intern)
Examiner:
Lautrup, Benny (Ekstern)
Sørensen, Helge Bjarup Dissing (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Program Stipendium-SU, Eksp
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
**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 Alshede (Intern)

Rasmussen, Carl Edward (Intern)

Larsen, Jan (Intern)

Paulson, 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)
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)
Mørch, 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
Design of neural network filters
Department of Informatics and Mathematical Modeling
Period: 01/02/1990 → …
Number of participants: 2
Phd Student:
Larsen, Jan (Intern)
Main Supervisor:
Sørensen, John Aasted (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Gammel ordning u/skema-SU
Project: PhD

Activities:

NDRF Post Graduate Education Seminar
Jan Larsen (Participant)
Department of Informatics and Mathematical Modeling
Cognitive Systems

Description
Statistical framework for decision making in mine action
Links:
http://www2.imm.dtu.dk/pubdb/views/publication_details.php?id=5491

Related event
NDRF Post Graduate Education Seminar
06/10/2007 → 07/10/2007
Hevring, Denmark
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.