Foreign object detection in multispectral X-ray images of food items using sparse discriminant analysis

Non-invasive food inspection and quality assurance are becoming viable techniques in food production due to the introduction of fast and accessible multispectral X-ray scanners. However, the novel devices produce massive amount of data and there is a need for fast and accurate algorithms for processing it. We apply a sparse classifier for foreign object detection and segmentation in multispectral X-ray. Using sparse methods makes it possible to potentially use fewer variables than traditional methods and thereby reduce acquisition time, data volume and classification speed. We report our results on two datasets with foreign objects, one set with spring rolls and one with minced meat. Our results indicate that it is possible to limit the amount of data stored to 50% of the original size without affecting classification accuracy of materials used for training. The method has attractive computational properties, which allows for fast classification of items in new images.
Statistical modelling of space-time processes with application to wind power.

Short-term wind power forecasts together with a quantification of uncertainties are required for the reliable operation of power systems with significant wind power penetration. A challenge for utilizing wind power as a source of energy is the intermittent and hardly predictable nature of wind. This thesis aims at contributing to the wind power literature by building and evaluating new statistical techniques for producing forecasts at multiple locations and lead times using spatio-temporal information. By exploring the features of a rich portfolio of wind farms in western Denmark, we investigate different types of models and provide several forms of predictions. Starting with spatial prediction, we then extend the methodology to spatio-temporal prediction of individual wind farms and aggregated wind power at monitored locations as well as at locations where recent observations are not available. We propose spatial models for predicting wind power generation at two different time scales: for annual average wind power generation and for a high temporal resolution (typically wind power averages over 15-min time steps). In both cases, we use a spatial hierarchical statistical model in which spatial correlation is captured by a latent Gaussian field. We explore how such models can be handled with stochastic partial differential approximations of Matérn Gaussian fields together with integrated nested Laplace approximations. We show that complex hierarchical spatial models are well suited for wind power data and provide results in reasonable computational time. Moreover, the hierarchical approach for obtaining predictions at a high temporal resolution is found to produce accurate predictions with improved performance compared to a standard geostatistical method at a small additional computational cost. The use of the integrated nested Laplace approximations is motivated by the desire to produce forecasts on large data sets with hundreds of locations, which is critical during periods of high wind penetration. Subsequently, the extension from spatial to spatio-temporal models is given. Three different hierarchical models are developed for obtaining probabilistic wind power forecasts. First, a time series model consisting of an autoregressive process with a location specific intercept is considered. This approach gives satisfactory results for individual forecasts but fails to generate calibrated aggregated forecasts. The second approach has a common intercept for all farms and a spatio-temporal model that varies in time with first order autoregressive dynamics and has spatially correlated innovations given by a zero mean Gaussian process. The third model, which also has a common intercept as well as an autoregressive process to capture the local variability and the spatio-temporal term from the second approach, is able to produce reliable individual and aggregated forecasts for multiple lead times. Finally, very-short-term wind power forecasting is considered. Probabilistic forecasts from 15 minutes up to two hours ahead are produced by using anisotropic spatio-temporal correlation models to account for the propagation of weather fronts and a transformed latent Gaussian field is used to accommodate the probability masses that occur in wind power distribution due to chains of zero measurements. Using what is called kriging equations, even the simplest proposed covariance model is able to produce calibrated spatio-temporal predictions of wind power production.

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Image Analysis for X-ray Imaging of Food

X-ray imaging systems are increasingly used for quality and safety evaluation both within food science and production. They offer non-invasive and nondestructive penetration capabilities to image the inside of food.

This thesis presents applications of a novel grating-based X-ray imaging technique for quality and safety evaluation of food products. In this effort the fields of statistics, image analysis and statistical learning are combined, to provide analytical tools for determining the aforementioned food traits.

The work demonstrated includes a quantitative analysis of heat induced changes in microstructure of meat products. A segmentation framework is presented, from which geometrical parameters are assessed. The grating-based method embraces the complicated microstructure of the meat products, allowing for an analysis of the full three dimensional...
The results illustrate that the combination of grating-based X-ray imaging and advanced analysis provides a valuable tool for microstructure analysis. Thus, the method can be considered as an alternative to other existing imaging techniques.

Furthermore, the thesis presents the application of grating-based X-ray imaging for novelty and defect detection in food. Compared to the complex three dimensional analysis of microstructure, here two dimensional images are considered, making the method applicable for an industrial setting. The advantages obtained by grating-based imaging are compared to conventional X-ray imaging, for both foreign object and defect detection. The results further emphasize the applicability of grating-based imaging for evaluation of food quality and food safety.
described in fish. The pattern of CD163 expression in the present study is consistent with the expected timing of presence of M2c macrophages in the wound. CD163 may thus potentially prove a valuable marker of M2 macrophages - or a subset hereof - in fish.

We subjected a group of fish to bathing in an immunomodulatory β-glucan product during wound healing, but found this to have very limited effect on wound healing in contrast to a previously published study on common carp.
Novelty detection of foreign objects in food using multi-modal X-ray imaging

In this paper we demonstrate a method for novelty detection of foreign objects in food products using grating-based multimodal X-ray imaging. With this imaging technique three modalities are available with pixel correspondence, enhancing organic materials such as wood chips, insects and soft plastics not detectable by conventional X-ray absorption radiography. We conduct experiments, where several food products are imaged with common foreign objects typically found in the food processing industry. To evaluate the benefit from using this multi-contrast X-ray technique over conventional X-ray absorption imaging, a novelty detection scheme based on well known image- and statistical analysis techniques is proposed. The results show that the presented method gives superior recognition results and highlights the advantage of grating-based imaging.
X-ray radiography, Dark-field imaging, Phase-contrast imaging, Foreign object detection, Novelty detection, Texture analysis

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Analysis of data from the MariCare Smartfloor at Skovhuset Care Home

In this project data is analysed from a smartfloor which is installed in an elderly care home. Two lines of investigation are carried out. The first uses “event data” from the smartfloor. This data contains every event (bathroom visits, people entering/exiting the room etc.) registered by the floor over a one year period. Control charts are used to investigate a link between the event data and UTI incidence. A clear predictor for UTI is not found, but the value of control charts in this setting is demonstrated. In the second line of investigation “position data” is analysed. The position data is more limited than the event data in that it is extracted manually using image analysis on the smartfloor user interface program. Using the position data, the trajectories traced by a resident moving about their room are visualised and properties such as direction and speed are investigated. A method is found for comparison of trajectories to determine their degree of similarity and this method can identify unusual trajectories in the dataset.

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In cooperation with Charlotte Kock Petersen of Skovhuset Care Home and Palle Stevn of MariCare

Computer-aided diagnosis of pulmonary diseases using x-ray darkfield radiography

In this work we develop a computer-aided diagnosis (CAD) scheme for classification of pulmonary disease for grating-based x-ray radiography. In addition to conventional transmission radiography, the grating-based technique provides a dark-field imaging modality, which utilizes the scattering properties of the x-rays. This modality has shown great potential for diagnosing early stage emphysema and fibrosis in mouse lungs in vivo. The CAD scheme is developed to assist radiologists and other medical experts to develop new diagnostic methods when evaluating grating-based images. The scheme consists of three stages: (i) automatic lung segmentation; (ii) feature extraction from lung shape and dark-field image intensities; (iii) classification between healthy, emphysema and fibrosis lungs. A study of 102 mice was conducted with 34 healthy, 52 emphysema and 16 fibrosis subjects. Each image was manually annotated to build an experimental dataset. System performance was assessed by: (i) determining the quality of the segmentations; (ii) validating emphysema and fibrosis recognition by a linear support vector machine using leave-one-out cross-validation. In terms of segmentation quality, we obtained an overlap percentage (Ω) 92.63 ± 3.65%, Dice Similarity Coefficient (DSC) 89.74 ± 8.84% and Jaccard Similarity Coefficient 82.39 ± 12.62%. For classification, the accuracy, sensitivity and specificity of diseased lung recognition was 100%. Classification between emphysema and fibrosis resulted in an accuracy of 93%, whilst the sensitivity was 94% and specificity 88%. In addition to the automatic classification of lungs, deviation maps created by the CAD scheme provide a visual aid for medical experts to further assess the severity of pulmonary disease in the lung, and highlights regions affected.

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Multivariate Analysis Techniques for Optimal Vision System Design

The present thesis considers optimization of the spectral vision systems used for quality inspection of food items. The relationship between food quality, vision based techniques and spectral signature are described. The vision instruments for food analysis as well as datasets of the food items used in this thesis are described. The methodological strategies are outlined including sparse regression and pre-processing based on feature selection and extraction methods, supervised
versus unsupervised analysis and linear versus non-linear approaches.

One supervised feature selection algorithm based on the existing sparse regression methods (EN and lasso) and one unsupervised feature selection strategy based on the local maxima of the spectral 1D/2D signals of food items are proposed. In addition, two novel feature extraction and selection strategies are introduced; sparse supervised PCA (SSPCA) and DCT based characterization of the spectral diffused reflectance images for wavelength selection and discrimination.

These methods together with some other state-of-the-art statistical and mathematical analysis techniques are applied on datasets of different food items; meat, diaries, fruits and vegetables. These datasets are acquired using three different vision systems; a spectral imaging device called VideometerLab, spectroscopy, and diffused reflectance imaging systems called Static Light Scattering (SLS).

These analyses result in significant reduction in the number of required wavelengths and simplification of the design of practical vision systems.
tomograms the different constituents in the emulsions were segmented using a multivariate segmentation method. From this, a quantitative analysis was performed between the different samples, determining properties such as percent object volumes, porosity, average structure thickness and cooking loss. The grating-based X-ray technique and multivariate segmentation made the analysis of the microstructure possible which further gives insight to how both heat treatment, and the use of different lipid types, affect the final protein network quality.

Industrial relevance: Meat emulsions have previously been thoroughly studied, and the use of various fat substitutes and protein stabilizers has been investigated. The grating-based multimodal X-ray tomography method presented here is a feasible method to investigate the microstructural changes induced by heat treatment. It provides high-resolution three-dimensional spatial information and in contrast to 2D imaging methods, quantitative parameters can be extracted by image analysis for the entire sample volume. Additionally, the non-destructive method allows for imaging the same sample before and after cooking.
Can We Find Organic Materials in Food Using X-rays?

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How do student evaluations of courses and of instructors relate?

Course evaluations are widely used by educational institutions to assess the quality of teaching. At the course evaluations, students are usually asked to rate different aspects of the course and of the teaching. We propose to apply canonical correlation analysis (CCA) in order to investigate the degree of association between how students evaluate the course and how students evaluate the teacher. Additionally it is possible to reveal the structure of this association. Student evaluations data is characterized by high correlations between the variables within each set of variables, therefore two modifications of the CCA method; regularized CCA and sparse CCA, together with classical CCA were applied to find the most interpretable model. Both methods give results with increased interpretability over traditional CCA on the present student evaluation data. The method shows robustness when evaluations over several years are examined.
Hyperspectral imaging based on diffused laser light for prediction of astaxanthin coating concentration

We present a study on predicting the concentration level of synthetic astaxanthin in fish feed pellet coating using multi- and hyperspectral image analysis. This was done in parallel using two different vision systems. A new instrument for hyperspectral imaging, the SuperK setup, using a super-continuum laser as the light source was introduced. Furthermore, a parallel study with the commercially available multispectral VideometerLab imaging system was performed. The SuperK setup used 113 spectral bands (455–1,015 nm), and the VideometerLab used 20 spectral bands (385–1,050 nm). To predict the astaxanthin concentration from the spectral image data, the synthetic astaxanthin content in the pellets was measured with the established standard technique; high-pressure liquid chromatography (HPLC). Regression analysis was done using partial least squares regression (PLSR) and the sparse regression method elastic net (EN). The ratio of standard error of prediction (RPD) is the ratio between the standard deviation of the reference values and the prediction error, and for both PLSR and EN both devices gave RPD values between 4 and 24, and with mean prediction error of 1.4–8.0 parts per million of astaxanthin concentration. The results show that it is possible to predict the synthetic astaxanthin concentration in the coating well enough for quality control using both multi- and hyperspectral image analysis, while the SuperK setup performs with higher accuracy than the VideometerLab device for this particular problem. The spectral resolution made it possible to identify the most significant spectral regions for detection of astaxanthin. The results also imply that the presented methods can be used in general for quality inspection of various coating substances using similar coating methods.
It has been demonstrated that phase contrast imaging provides superior contrast of soft tissues in biological material over typical absorption tomography [1-2]. In meat science, this imaging modality can provide valuable information of the effects of heat treatment on muscle tissue. Although microtomography provides high resolution, the thin structures of the connective tissues are difficult to segment. This is mainly due to partial object voxels, image noise and artifacts. The segmentation of connective tissue is important for quantitative analysis purposes. Factors such as the surface area, relative volume and the statistics of the electron density of the connective tissue could prove useful for understanding the structural changes occurring in the meat sample due to heat treatment.

In this study a two step segmentation algorithm was implemented in order to segment connective tissue from phase contrast microtomograms obtained by a grating interferometer. This segmentation has previously been demonstrated for the segmentation of the optic nerve head from microscopic images of stained slices [3]. The first step is to model the data as a mixture of Gaussians using an expectation-maximization (EM) algorithm [4]. This iterative process finds the maximum likelihood of parameters where the model depends on unobserved latent variables. The spatial information of the data is next incorporated into the segmentation process by modeling the data as a Markov random field (MRF) [5]. It models the a priori probability of neighborhood dependencies, and the field can either be isotropic or anisotropic. For the segmentation of connective tissue, the local information of the structure orientation and coherence is extracted to steer the smoothing (anisotropy) of the final segmentation.

The results show that the segmentation provides a superior classification of connective tissue over conventional threshold segmentation. Additionally modeling the data as a mixture of Gaussians made it possible to segment the connective tissue into two separate classes. The segmentation results provide the means for further analysis of the structural changes in the meat due to heat treatment.
Short mandible - a possible risk factor for cleft palate with/without a cleft lip

Structured Abstract

Objectives To estimate the influence of a short mandible on the risk of developing a cleft palate with/without a cleft lip (CP). Setting and sample population The retrospective sample consisted of 115 2-month-old Danish infants with CP, and 70 control infants with unilateral incomplete cleft lip (UICL). Material and Methods Cephalometric X-rays were obtained. Mandibular length (L-m) was measured and corrected for body length (L-b) to remove influence of varying body length in the sample. Logistic regression was applied to the corrected mandibular length (L-mc) to calculate the risk of having a cleft palate. Results The mean mandibular length in the group with CP was about 4mm shorter than in the control group. Odds ratio (OR) was calculated to be 0.58 (95% confidence interval 0.48-0.68), implying that an individual's risk of cleft palate with/without a cleft lip increases about 50% per mm decrease in mandibular length.

Conclusions A special facial type including a short mandible is a possible risk factor for cleft palate, and it was found that the risk of cleft palate increases 58% per mm decreases in mandibular length.
Status for NEXIM New X-ray Imaging Modalities for safe and high quality food

The main objectives of the NEXIM project are to develop the novel X-ray grating interferometry technique (Weitkamp et al. 2005; Pfeiffer et al. 2008) specifically towards food application and to identify the areas within the Danish food industry with the highest technological and commercial impact. The main focuses are determined to be threefold:

1) Improving the detectability of low density foreign bodies incidentally present in food products.
2) Development of new modalities for assessment of quality traits in food production, for instance connective tissue and fatty acid composition.
3) Develop a proof-of-principle of a conveyor belt solution that can form the basis for real product development.

In the past year the NEXIM project has focused on these three objectives, studying the applicability of GBI to meat quality assessment and foreign object detection. Some efforts have been put to developing laboratory-based setups further towards an in-line scanning system. Additionally, close co-operation with industrial partners has further emphasized the need for new techniques for quality control, product development and foreign object detection.

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Supervised feature selection for linear and non-linear regression of Lab color from multispectral images of meat

In food quality monitoring, color is an important indicator factor of quality. The CIELab (Lab) color space as a device independent color space is an appropriate means in this case. The commonly used colorimeter instruments can neither measure the Lab color in a wide area over the target surface nor in a contact-less mode. However, developing algorithms for conversion of food items images into Lab color space can solve both of these issues. This paper addresses the problem of Lab color prediction from multispectral images of different types of raw meat. The efficiency of using multispectral images instead of the standard RGB is investigated. In addition, it is demonstrated that due to the fiber structure and transparency of raw meat, the prediction models built on the standard color patches do not work for raw meat test samples. As a result, multispectral images of different types of meat samples (430–970 nm) were used for training and testing of the Lab prediction models. Finding a sparse solution or the use of a minimum number of bands is of particular interest to make an industrial vision set-up simpler and cost effective. In this paper, a wide range of linear, non-linear, kernel-based regression and sparse regression methods are compared. In order to improve the prediction results of these models, we propose a supervised feature selection strategy which is compared with the Principal component analysis (PCA) as a pre-processing step. The results showed that the proposed feature selection method outperforms the PCA for both linear and non-linear methods. The highest performance was obtained by linear ridge regression applied on the selected features from the proposed Elastic net (EN) -based feature selection strategy. All the best models use a reduced number of wavelengths for each of the Lab components.
X-ray computed tomography is increasingly used as a nondestructive method for studying three-dimensional food structures. For meat products, studies have focused mainly on fat and protein content due to limited contrast capabilities.
of absorption based techniques. Recent advances in X-ray imaging have made novel X-ray image modalities available, where the refraction and scattering of X-rays is obtained simultaneously with the absorption properties, providing enhanced contrast for soft biological tissues. This paper demonstrates how data obtained from grating-based imaging can be segmented by means of multivariate and contextual methods to improve the classification of soft tissues in meat products. The results show that the presented segmentation method provides improved classification over univariate segmentation.

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**DCT-Based Characterization of Milk Products Using Diffuse Reflectance Images**

We propose to use the two-dimensional Discrete Cosine Transform (DCT) for decomposition of diffuse reflectance images of laser illumination on milk products in different wavelengths. Based on the prior knowledge about the characteristics of the images, the initial feature vectors are formed at each wavelength. The low order DCT coefficients are used to quantify the optical properties. In addition, the entropy information of the higher order DCT coefficients is used to include the illumination interference effects near the incident point. The discrimination powers of the features are computed and used to do wavelength and feature selection. Using the selected features of just one band, we could characterize and discriminate eight different milk products. Comparing this result with the current characterization method based of a fitted log-log linear model, shows that the proposed method can discriminate milk from yogurt products better.

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Effects of mid-term student evaluations of teaching as measured by end-of-term evaluations: An empirical study of course evaluations

Universities have varying policies on how and when to perform student evaluations of courses and teachers. More empirical evidence of the consequences of such policies on quality enhancement of teaching and learning is needed. A study (35 courses at the Technical University of Denmark) was performed to illustrate the effects caused by different handling of mid-term course evaluations on student's satisfaction as measured by end-of-term evaluations. Midterm and end-of-term course evaluations were carried out in all courses. Half of the courses were allowed access to the midterm results. The evaluations generally showed positive improvements over the semester for courses with access, and negative improvements for those without access. Improvements related to: Student learning, student satisfaction, teaching activities, and communication showed statistically significant average differences of 0.1-0.2 points between the two groups. These differences are relatively large compared to the standard deviation of the scores when student effect is removed (approximately 0.7). We conclude that university policies on course evaluations seem to have an impact on the development of the teaching and learning quality as perceived by the students and discuss the findings.

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Improvement of the ΔσH Model

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Multispectral Image Analysis for Robust Prediction of Astaxanthin Coating
The aim of this study was to investigate the possibility of predicting the type and concentration level of astaxanthin coating of aquaculture feed pellets using multispectral image analysis. We used both natural and synthetic astaxanthin, and we used several different concentration levels of synthetic astaxanthin in combination with four different recipes of feed pellets. We used a VideometerLab with 20 spectral bands in the range of 385-1050 nm. We used linear discriminant analysis and sparse linear discriminant analysis for classification and variable selection. We used partial least squares regression (PLSR) for prediction of the concentration level. The results show that it is possible to predict the level of synthetic astaxanthin coating using PLSR on either the same recipe, or when calibrating on all recipes. The concentration
prediction is adequate for screening for all recipes. Moreover, it shows that it is possible to predict the type of astaxanthin used in the coating using only ten spectral bands. Finally, the most selected spectral bands for astaxanthin prediction are in the visible range of the spectrum.
Optimal vision system design for characterization of apples using US/ VIS/NIR spectroscopy data

Quality monitoring of the food items by spectroscopy provides information in a large number of wavelengths including highly correlated and redundant information. Although increasing the information, the increase in the number of wavelengths causes the vision set-up to be more complex and expensive. In this paper, three sparse regression methods; lasso, elastic-net and fused lasso are employed for estimation of the chemical and physical characteristics of one apple cultivar using their high dimensional spectroscopic measurements. The use of sparse regression reduces the number of required wavelengths for prediction and thus, simplifies the required vision set-up. It is shown that, considering a tradeoff between the number of selected bands and the corresponding validation performance during the training step can result in a significant reduction in the number of bands at a small price in the test performance. Furthermore, appropriate regression methods for different number of bands and spectrophotometer design are determined.

PorkCAD: Case study of the design of a pork product prototyper

With the help of industry experts we developed porkCAD, an application intended to aid in the communication process between producer and retailer when developing new meat products for a constantly evolving market. The application
interface allows the user to make planar cuts to a virtual pig formed from CT-scans of a real-world pig carcass. We present a case study of the design process from conceptualization to intended introduction into the work flow of a meat production company. We discuss critical design decisions during development and present perspectives for future development.

To determine the usability of porkCAD, we tested it with personnel from the pork industry, using two different controller interfaces, one being a traditional mouse and keyboard input, and the other a six degrees of freedom haptic feedback device. The accurate depiction of pig anatomy guided trained professionals to re-create standardized pig products using porkCAD. The quantitative results of the usability test with sales personnel did not lean significantly in favor of either interface.

Since one interface was extremely well known and the other highly unfamiliar, the fact that users did not express a clear preference for the known input modality is deemed important. We report on the observed user experience regarding the two interfaces.

Quantitative Analysis of Micro-Structure in Meat Emulsions from Grating-Based Multimodal X-Ray Tomography
Using novel X-ray techniques, based on grating-interferometry, new imaging modalities can be obtained simultaneously with absorption computed tomography (CT). These modalities, called phase contrast and dark field imaging, measure the electron density and the diffusion length of the sample. Enhanced contrast capabilities of this X-ray technique makes studies on materials with similar attenuation properties possible. In this paper the focus is set on processing grating-based X-ray tomograms of meat emulsions to quantitatively measure micro-structural changes due to heat treatment. The emulsion samples were imaged both in a raw and cooked state. Additionally, different fat types were used in the emulsions in order to compare micro-structural differences when either pork fat or sunflower oil was used. From the reconstructed tomograms the different ingredients in the emulsions were segmented using a multivariate segmentation method. From this, a quantitative analysis was performed between the different samples, determining properties such as percentage object volumes and cooking loss. Additionally, the porosity, degree of anisotropy and average structure thickness of the protein networks were determined. Analyzing the multivariate dataset instead of the single univariate absorption modality gave superior segmentation results. The quantitative analysis of the micro-structure gives insight to how both heat treatment, and the use of different lipid types, affect the final protein network.
Quantitative assessment of course evaluations

Student evaluation of teaching has been used in educational institutions around the world as a means of providing feedback on the quality of teaching. Nowadays, it is one of the most widespread tools used to inform teachers and administration about the instruction given in an institution.

The goal of the thesis is to develop efficient tools to analyze the data from student evaluations of teaching and courses at the Technical University of Denmark.

The thesis explores both classical and modern methods of multivariate statistical data analysis to address different issues of student evaluation of teaching (SET). In particular, the thesis includes results on the investigation of the association between the student evaluations of the course and the student evaluations of the teachers, the investigation of the effects of the mid-term evaluation on the end-of-term evaluations and the investigation of the student non-response on SETs. In order to utilize information from open-ended qualitative student answers, text-mining methods were applied in order to extract points of students praise and complaints.

The methods proposed contribute to the knowledge about student evaluation at the Technical University of Denmark. The results provided some new information that will help teachers and university managers to better understand results of course evaluations.

Mid-term course evaluation was found to be able to capture both types of course issues: issues that can be addressed during the semester and also issues that can only be addressed at the next semester. Therefore, it seems to be preferable to conduct general mid-term evaluations instead of end-of-term evaluation, so the current course students can benefit. Additionally, it might be beneficial to conduct a short end-of-term evaluation with very limited number of questions that focus on general course issues after the final exams in order to obtain student feedback on the entire teaching and learning process, including the alignment of assessment of students' learning with course objectives and teaching activities.

Student-specific and course-specific characteristics was found to be related with whether students participate in SETs and with how students evaluate courses and teachers. The DTU administrations should be aware that high achievers are more likely to participate in course evaluation survey and are more likely to give higher scores to courses. Students diversity on the course should be taken into account while making comparisons of evaluation results between courses.

In the student written feedback was found be able to provide additional knowledge of student point of satisfaction or dissatisfaction. However, in order to build an automated tool that can help to extract patterns from student comments higher quality of the collected data is needed.

General information

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Organisations: Department of Applied Mathematics and Computer Science, Statistics and Data Analysis
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Electronic versions:
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Publication: Research › Ph.D. thesis – Annual report year: 2014
Statistical Quality Assessment of Pre-fried Carrots Using Multispectral Imaging

Multispectral imaging is increasingly being used for quality assessment of food items due to its non-invasive benefits. In this paper, we investigate the use of multispectral images of pre-fried carrots, to detect changes over a period of 14 days. The idea is to distinguish changes in quality from spectral images of visible and NIR bands. High dimensional feature vectors were formed from all possible ratios of spectral bands in 9 different percentiles per piece of carrot. We propose to use a multiple hypothesis testing technique based on the Benjamini-Hachberg (BH) method to distinguish possible significant changes in features during the inspection days. Discrimination by the SVM classifier supported these results. Additionally, 2-sided t-tests on the predictions of the elastic-net regressions were carried out to compare our results with previous studies on fried carrots. The experimental results showed that the most significant changes occurred in day 2 and day 14.

General information
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Organisations: Department of Applied Mathematics and Computer Science, Statistics and Data Analysis, National Food Institute, Division of Industrial Food Research
Authors: Sharifzadeh, S. (Intern), Clemmensen, L. K. H. (Intern), Løje, H. (Intern), Ersbøll, B. K. (Intern)
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Multispectral imaging, Multiple hypothesis testing, Segmentation, Food quality assessment, SVM classification, Elastic-net regression

Text mining in students' course evaluations: Relationships between open-ended comments and quantitative scores

Extensive research has been done on student evaluations of teachers and courses based on quantitative data from evaluation questionnaires, but little research has examined students' written responses to open-ended questions and their relationships with quantitative scores. This paper analyzes such kind of relationship of a well established course at the Technical University of Denmark using statistical methods. Keyphrase extraction tool was used to find the main topics of students' comments, based on which the qualitative feedback was transformed into quantitative data for further statistical analysis. Application of factor analysis helped to reveal the important issues and the structure of the data hidden in the students' written comments, while regression analysis showed that some of the revealed factors have a significant impact on how students rate a course.

General information
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Organisations: Department of Applied Mathematics and Computer Science, Statistics and Data Analysis
Authors: Sliusarenko, T. (Intern), Clemmensen, L. K. H. (Intern), Erbsøll, B. K. (Intern)
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Main Research Area: Technical/natural sciences
Using Multispectral Imaging for Spoilage Detection of Pork Meat

The quality of stored minced pork meat was monitored using a rapid multispectral imaging device to quantify the degree of spoilage. Bacterial counts of a total of 155 meat samples stored for up to 580 h have been measured using conventional laboratory methods. Meat samples were maintained under two different storage conditions: aerobic and modified atmosphere packages as well as under different temperatures. Besides bacterial counts, a sensory panel has judged the spoilage degree of all meat samples into one of three classes. Results showed that the multispectral imaging device was able to classify 76.13% of the meat samples correctly according to the defined sensory scale. Furthermore, the multispectral camera device was able to predict total viable counts with a standard error of prediction of 7.47%. It is concluded that there is a good possibility that a setup like the one investigated will be successful for the detection of spoilage degree in minced pork meat.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Statistics and Data Analysis, Image Analysis & Computer Graphics, Agricultural University of Athens, Institute of Technology of Agricultural Products
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Multispectral imaging, Meat spoilage, Chemometrics, Computational biology, Meat quality, Non-invasive methods, Converging technologies, Predictive modelling
Automatic Quality Measurement and Parameter Selection for Example-based Texture Synthesis

Texture synthesis algorithms have been researched extensively in the past decade. However, most synthesis algorithms are governed by a set of parameters and produce different results depending on which parameter settings are chosen in conjunction with an exemplar used as a basis for synthesis. So far, automatically selecting parameters suitable for synthesis has been a relatively unexplored topic. In effect, this makes texture synthesis supervised rather than fully automatic.

In this technical paper, we propose automatic parameter optimization methods for example based texture synthesis. We cover research to directly estimate specific texture synthesis parameters, such as patch size and iteration convergence, based on input textures. We also examine various similarity measures and evaluate their effectiveness. The goal for each measure is to properly evaluate how well the resulting synthesis compares to the original input.

A good similarity measure will enable the search for the optimal texture synthesis parameters by maximizing the quality of the synthesis as a function of parameters. We apply presented methods to a state of the art texture synthesis algorithm, namely the one proposed by Kopf et al [14].
It is easy to find a set of exemplars for which there is no single optimal set of settings. The results show a promising foundation for further research in establishing an automated optimal synthesis for a multitude of textures.

**Classical Astaxanthin Colouration of Salmonid Fish using Spectral Imaging and Tricolour Measurement**

The goal of this study was to investigate if it is possible to differentiate between rainbow trout (Oncorhynchus mykiss) having been fed with natural or synthetic astaxanthin. Three different techniques were used for visual inspection of the surface colour of the fish meat: multi-spectral image capturing, tricolour CIELAB measurement, and manual SalmoFan inspection. Furthermore it was tested whether the best predictions come from measurements of the steak or the fillet of the fish. Methods used for classification were linear discriminant analysis (LDA), quadratic discriminant analysis (QDA), and sparse linear discriminant analysis (SLDA).

**Developmental toxicity effects in experimental animals after mixed exposure to endocrine disrupting pesticides**

The study investigated the effects of mixing pesticides on developmental toxicity in experimental animals.
Matching Two-dimensional Gel Electrophoresis' Spots
This paper describes an approach for matching Two-Dimensional Electrophoresis (2-DE) gels' spots, involving the use of image registration. The number of false positive matches produced by the proposed approach is small, when compared to academic and commercial state-of-the-art approaches. This article contributes to solving one of the greatest bottlenecks in the 2-DE analysis pipeline.

Multispectral Image Analysis for Astaxanthin Coating Classification
Industrial quality inspection using image analysis on astaxanthin coating in aquaculture feed pellets is of great importance for automatic production control. The pellets were divided into two groups: one with pellets coated using synthetic astaxanthin in fish oil and the other with pellets coated only with fish oil. In this study, multispectral image analysis of pellets captured reflection in 20 wavelengths (385–1050 nm). Linear discriminant analysis (LDA), principal component analysis, and support vector machine were used as statistical analysis. The features extracted from the multispectral images were pixel spectral values as well as using summary statistics such as the mean or median value of each pellet. Classification using LDA on pellet mean or median values showed overall good results. Multispectral imaging is a promising technique for noninvasive on-line quality food and feed products with optimal use of pigment and minimum amount of waste.
Multivariate image analysis for quality inspection in fish feed production

Aquaculture is today one of the fastest growing food producing sectors in the world. Access to good and effective fish feed is a condition for optimised and sustainable aquaculture activity. In the aquaculture industry it is of utmost importance that the fish get feed of proper size and nutrition. The colour appearance of fish products is important for customers. Salmonid fish get their red colour from a natural pigment called astaxanthin. To ensure a similar red colour of fish in aquaculture astaxanthin is used as an additive coated on the feed pellets. Astaxanthin can either be of natural origin, or synthesised chemically. Common for both types is that they are relatively expensive in comparison to the other feed ingredients. This thesis investigates multi-variate data collection for visual inspection and optimisation of industrial production in the fish feed industry. Quality parameters focused on here are: pellet size, type and concentration level of astaxanthin in pellet coating, as well as astaxanthin type detected in salmonid fish. Methods used are three different devices for multi- and hyper-spectral imaging, together with shape analysis and multi-variate statistical analysis. The results of the work demonstrate a high potential of image analysis and spectral imaging for assessing the product quality of fish feed pellets, astaxanthin and fish meat. We show how image analysis can be used to inspect the pellet size,
and how spectral imaging can be used to inspect the surface quality of biological materials. This technology and method can be a useful tool for optimising the industrial process, e.g. the utilisation of the expensive astaxanthin. The development of automatic quality inspection methods by machine vision can improve the industry's position in the competition for high quality products and efficient processes.

**General information**
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Organisations: Division of Industrial Food Research, Department of Informatics and Mathematical Modeling, DTU Data Analysis, National Food Institute
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Original language: English

**Near-Infrared Hyper-spectral Image Analysis of Astaxanthin Concentration in Fish Feed Coating**
The aim of this study was to investigate the possibility of predicting concentration levels of synthetic astaxanthin coating of aquaculture feed pellets by hyper-spectral image analysis in the near infra-red (NIR) range and optical filter design. The imaging devices used were a VideometerLab with 20 wavelengths in the range of 385-1050 nm, and a Specim camera with 256 wavelengths in the range of 970-2500 nm. Linear discriminant analysis (LDA), partial least squares regression (PLSR), and a modified stepwise random selection with ordinary least squares (OLS) for filter selection was used for prediction of the concentration level. The results show that it is possible to predict the level of synthetic astaxanthin coating using either hyper-spectral imaging or three bandpass filters (BPF).

**General information**
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Organisations: Department of Informatics and Mathematical Modeling, DTU Data Analysis, National Food Institute, Division of Industrial Food Research, Toyohashi University of Technology
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Source: dtu
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**Realistic Virtual Cuts**
Pigs and pig meat are major sources of income for Denmark. As one of the country's primary exports, it is no wonder that Denmark strives to maintain its competitive edge in the meat market. As part of an on-going effort to lower costs and maintain high standards, X-ray computed tomography (CT), along with image analysis, is being deployed in Danish abattoirs. The data made available from scanning pig carcasses paves the way for new means to optimize the production process.

This thesis is concerned with the development of a communication tool intended to make use of the aforementioned
technology in the product prototyping process. In broad terms, the focus can be divided into two areas of focus: visualization and interaction.

Visualizing volume data, obtained via CT-scanning, is a common area of research within other areas of research, e.g. for medical applications. The availability of graphics processing units, and the subsequent programmability of the unit, has allowed for computationally heavy visualization algorithms to execute in real-time. Despite the flexibility of modern GPUs, their architecture still poses problems that require further study. The thesis presents research within the area of texture synthesis and data interpolation in an effort to create even more realistic volume data visualization.

The potential advantages provided by volume data, is exponentially expanded when we are free to interact with it. The food industry sees a significant benefit in volume interaction when concerned with product development. Product earnings projection, product specifications, and interactive training are just a few of the applicable areas. In this thesis we present an interaction method intended for the commercial development of meat product prototypes. The interaction method is evaluated in a thorough usability study with eight volunteer participants from the target user group.

This thesis presents technology and research which, combined with the advent of using CT in the abattoir, paves the way for new possibilities and advantages when designing meat product prototypes. I have no doubt that this is just the tip of the iceberg in regards to modernizing and optimizing the way animal carcasses are processed and handled before becoming consumer goods.

General information
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Organisations: DTU Data Analysis, Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Laursen, L. F. (Intern), Ersbøll, B. K. (Intern), Bærentzen, J. A. (Intern)
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Regression and Sparse Regression Methods for Viscosity Estimation of Acid Milk From it’s Sls Features
Statistical solutions find wide spread use in food and medicine quality control. We investigate the effect of different regression and sparse regression methods for a viscosity estimation problem using the spectro-temporal features from new Sub-Surface Laser Scattering (SLS) vision system. From this investigation, we propose the optimal solution for
regression estimation in case of noisy and inconsistent optical measurements, which is the case in many practical measurement systems. The principal component regression (PLS), partial least squares (PCR) and least angle regression (LAR) methods are compared with sparse LAR, lasso and Elastic Net (EN) sparse regression methods. Due to the inconsistent measurement condition, Locally Weighted Scatter plot Smoothing (Loess) has been employed to alleviate the undesired variation in the estimated viscosity. The experimental results of applying different methods show that, the sparse regression lasso outperforms other methods. In addition, the use of local smoothing has improved the results considerably for all regression methods. Due to the sparsity of lasso, this result would assist to design a simpler vision system with less spectral bands.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, DTU Data Analysis, Image Analysis and Computer Graphics
Authors: Sharifzadeh, S. (Intern), Skytte, J. L. (Intern), Nielsen, O. H. A. (Intern), Ersbøll, B. K. (Intern), Clemmensen, L. K. H. (Intern)
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Anisotropic 3D texture synthesis with application to volume rendering
We present a novel approach to improving volume rendering by using synthesized textures in combination with a custom transfer function. First, we use existing knowledge to synthesize anisotropic solid textures to fit our volumetric data. As input to the synthesis method, we acquire high quality images using a 12.1 megapixel camera. Next, we extend the volume rendering pipeline by creating a transfer function which yields not only color and opacity from the input intensity, but also texture coordinates for our synthesized 3D texture. Thus, we add texture to the volume rendered images. This method is applied to a high quality visualization of a pig carcass, where samples of meat, bone, and fat have been used to produce the anisotropic 3D textures.

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Organisations: DTU Data Analysis, Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
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Classification Methods for CT-Scanned Carcass Midsections: A Study of Noise Stability
Computed tomography (CT) has successfully been applied in medical environments for decades. In recent years CT has also made its entry to the industrial environments, including the slaughterhouses. In this paper we investigate classification methods for an online CT system, in order to assist in the segmentation of the outer fat layer in the mid- section of CT-scanned pig carcasses. Prior information about the carcass composition can potentially be applied for a fully automated solution, in order to optimize the slaughter line. The methods comprise Markov Random Field and contextual Bayesian classification, and are adapted to use neighbourhood information in 2D and 3D. Artificial Poisson noise is added to the
provided dataset to determine how well each of the methods handles noise. Good noise handling will allow lower dose scannings. The investigated methods did not perform better than the reference model in terms of classification, but the MRF segmentation showed promising results in a case with extreme simulated noise.

**Computed Tomography in the Modern Slaughterhouse**

The Danish pig meat industry has been seeing a growing international competition in the past years. In the quest to maintain both competitive prices and high product standards in spite of the higher Danish factor costs, a substantial effort is being put into innovation, research and development of technology. Recently, the use of X-ray computed tomography (CT) coupled with methods from image analysis has been introduced as a powerful means to optimise production, by providing detailed information on the raw materials. This thesis covers two aspects of the application of CT in the modern abattoir. In the first aspect we use CT to analyse the biological diversity of carcass populations. The results provide valuable input to assist the development of an automated robotic tool for trimming the rind off pig backs. The second aspect concerns measurements of each single carcass, to improve the raw material utilisation by individually adapted processing. Measurements performed online in the abattoir demand fast, robust and cost-effective imaging. We propose a tomographic reconstruction algorithm, enabling a substantial reduction of the subject-specific X-ray data needed to produce high quality images for accurate measurements. This is very beneficial for the abattoirs, as a reduction in acquired data translates directly into higher speed and a lower cost. The thesis demonstrates the great potential of CT as a technology for improving the yield of the Danish pig meat industry. An introduction of efficient online CT will especially open a vast number of possibilities for optimising the production.

**Computed Tomography in the Modern Slaughterhouse**

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**Computed Tomography in the Modern Slaughterhouse**

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Determination of astaxanthin concentration in Rainbow trout (Oncorhynchus mykiss) by multispectral image analysis.
Astaxanthin is the single most expensive constituent in salmonide fish feed. Therefore control and optimization of the astaxanthin concentration from feed to fish is of paramount importance for a cost effective salmonide production. Traditionally, methods for astaxanthin determination include extraction of astaxanthin from the minced sample into a suitable solvent such as acetone or hexane before further analysis. The existing methods have several drawbacks including being destructive and labour consuming. Current state-of-the-art vision systems for quality and process control in the fish processing industries are typically based on traditional trichromatic (Red Green Blue) imaging. The relative presence of some wavelengths and absence of others is a specific characteristic of many material properties. Consequently, the adaption of multispectral imaging technology can reveal relevant information and measurement of more biological quality parameters such as fat, astaxanthin and cartilage content, simultaneously. A multispectral image may also be referred to as a surface chemistry map where a set of neighbouring spectra are recorded, revealing information about the surface chemistry to a larger degree than in a trichromatic image. In this study multispectral imaging has been evaluated for characterization of the concentration of astaxanthin in rainbow trout fillets. Rainbow trout’s (Oncorhynchus mykiss), were filleted and imaged using a rapid multispectral imaging device. The multispectral imaging device captures reflection properties in 19 distinct wavelength bands. Subsequently, the astaxanthin concentration was determined by a traditional chemical method. The astaxanthin concentration of the analysed samples ranged from 0.20 to 4.34 ppm. In total 7 samples were detected as outliers and removed from the data set before further analysis. A partial least squares regression (PLSR) model was build to predict the astaxanthin concentration from novel images. The obtained model was evaluated with a test set. The root mean square error of prediction obtained from the test set was 0.27 ppm and a goodness of fit of 0.86. The PLSR model made it possible to predict the astaxanthin concentration in each pixel of the image – surface chemistry map - and thereby show the astaxanthin distribution in the fillet. The projected images clearly show a difference in astaxanthin distribution, showing that the upper part of the fillet contains the highest concentration of astaxanthin. This study has shown that multispectral imaging is a promising method for rapid and non-destructive analysis of astaxanthin concentration of rainbow trout, and thereby a qualified candidate for replacement of traditional laborious and destructive analysis of the astaxanthin concentration.

General information
State: Published
Organisations: Division of Industrial Food Research, National Food Institute, Department of Informatics and Mathematical Modeling, DTU Data Analysis
Authors: Frosch, S. (Intern), Dissing, B. S. (Intern), Ersbøll, B. K. (Intern), Nielsen, M. E. (Intern)
Publication date: 2011
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Direct arithmetic method versus statistical way of estimating weighted prevalences and confidence intervals: based on a method developed in connection to the DRUID roadside surveys

General information
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Organisations: Department of Informatics and Mathematical Modeling, DTU Data Analysis, Department of Transport, Traffic Safety
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http://www.statistiksymposium.dk

Bibliographical note
Does an association between student evaluations of related CDIO courses exist?
This paper analyses routine course evaluation performed by students in the computer science related professional bachelor degree educations at DTU. Specifically, a set of two related courses are considered. The courses are: “Introductory Programming” and “Development Methods for IT-Systems”. Both courses include lectures and lab work. It is seen that both similarities and differences in the evaluations can be found. The similarities and differences can in part be used to assess if the CDIO concept has been implemented as it was intended and possible adjustments can be suggested.

General information
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Organisations: DTU Data Analysis, Department of Informatics and Mathematical Modeling
Authors: Ersbøll, B. K. (Intern), Sliusarenko, T. (Intern), Clemmensen, L. K. H. (Intern)
Publication date: 2011

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Links:
http://www.cdio2011.dtu.dk/

Image Analysis of Pellet Size for a Control System in Industrial Feed Production
When producing aquaculture fish feed pellets, the size of the output product is of immense importance. As the production method cannot produce pellets of constant and uniform size using constant machine settings, there is a demand for size control. Fish fed with feed pellets of improper size are prone to not grow as expected, which is undesirable to the aquaculture industry. In this paper an image analysis method is proposed for automatic size-monitoring of pellets. This is called granulometry and the method used here is based on the mathematical morphological opening operation. In the proposed method, no image object segmentation is needed. The results show that it is possible to extract a general size distribution from an image of piled disordered pellets representing both length and diameter of the pellets in combination as an area.

General information
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Organisations: DTU Data Analysis, Department of Informatics and Mathematical Modeling, Division of Industrial Food Research, National Food Institute
Authors: Ljungqvist, M. G. (Intern), Nielsen, M. E. (Intern), Ersbøll, B. K. (Intern), Frosch, S. (Intern)
Pages: e26492
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Web of Science (2016): Indexed yes
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Scopus rating (2015): SJR 1.414 SNIP 1.131 CiteScore 3.32
Multi-spectral Image Analysis for Astaxanthin Coating Classification

Industrial quality inspection using image analysis on astaxanthin coating in aquaculture feed pellets is of great importance for automatic production control. In this study multi-spectral image analysis of pellets was performed using LDA, QDA, SNV and PCA on pixel level and mean value of pixels for each pellet. Classification using LDA or QDA on pellet mean or median values showed better results than using the pixel values or PCA.

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Authors: Ljungqvist, M. G. (Intern), Ersbøll, B. K. (Intern), Nielsen, M. E. (Intern), Frosch, S. (Intern)
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Place of publication: Kgs. Lyngby, Denmark
Publisher: Technical University of Denmark
Multispectral Imaging for Determination of Astaxanthin Concentration in Salmonids

Multispectral imaging has been evaluated for characterization of the concentration of a specific xanthophyll pigment; astaxanthin. 59 fillets of rainbow trout, Oncorhynchus mykiss, were filleted and imaged using a rapid multispectral imaging device for quantitative analysis. The multispectral imaging device captures reflection properties in 19 distinct wavelength bands, prior to determination of the true concentration of astaxanthin. The samples ranged from 0.20 to 4.34 μg per g fish. A PLSR model was calibrated to predict astaxanthin concentration from novel images, and showed good results with a RMSEP of 0.27. For comparison a similar model were built for normal color images, which yielded a RMSEP of 0.45. The acquisition speed of the multispectral imaging system and the accuracy of the PLSR model obtained suggest this method as a promising technique for rapid in-line estimation of astaxanthin concentration in rainbow trout fillets.

General information
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Organisations: DTU Data Analysis, Department of Informatics and Mathematical Modeling, National Food Institute
Authors: Dissing, B. S. (Intern), Nielsen, M. E. (Intern), Ersbøll, B. K. (Intern), Frosch, S. (Intern)
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  Web of Science (2016): Indexed yes
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  Web of Science (2012): Indexed yes
  BFI (2011): BFI-level 1
  Scopus rating (2011): SJR 2.369 SNIP 1.23 CiteScore 4.58
Multispectral imaging of wok fried vegetables

This paper shows how multispectral images can be used to assess color change over time in wok fried vegetables. We present results where feature selection was performed with sparse methods from the multispectral images to detect the color changes of wok fried carrots and celeriac stored at +5°C over 14 days. A pairwise t-test was used to detect if the differences over days were significant. For both the original as well as a follow experiment significant differences were seen in particular for celeriac, but also to some extend for carrots.

General information

State: Published
Organisations: Mathematical Statistics, National Food Institute, Department of Informatics and Mathematical Modeling, DTU Data Analysis
Authors: Løje, H. (Intern), Dissing, B. S. (Intern), Clemmensen, L. K. H. (Intern), Ersbøll, B. K. (Intern), Adler-Nissen, J. (Intern)
Pages: 59-62
Publication date: 2011

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Place of publication: Kgs. Lyngby, Denmark
Publisher: Technical University of Denmark

New Approach for Segmentation and Quantification of Two-Dimensional Gel Electrophoresis Images

Motivation: Detection of protein spots in two-dimensional gel electrophoresis images (2-DE) is a very complex task and current approaches addressing this problem still suffer from significant shortcomings. When quantifying a spot, most of the current software applications include a lot of background due to poor segmentation. Other software applications use a fixed window for this task, resulting in omission of part of the protein spot, or including background in the quantification. The approach presented here for the segmentation and quantification of 2-DE aims to minimize these problems. Results:
Five sections from different gels are used to test the performance of the presented method concerning the detection of protein spots, and three gel sections are used to test the quantification of sixty protein spots. Comparisons with a state-of-the-art commercial software and an academic state-of-the-art approach are presented. It is shown that the proposed approach for segmentation and quantification of 2-DE images can compete with the available commercial and academic software packages.
New vision technology for multidimensional quality monitoring of food processes

Spectroscopy and spectral imaging in combination with multivariate data analysis and machine learning techniques have proven to be an outstanding tool for rapid analysis of different products. This may be utilized in various industries, but especially rapid assessment of food products in food research and industry is of importance in this thesis. The non-invasive spectroscopic imaging techniques are able to measure individual food components simultaneously in situ in the food matrix while pattern recognition techniques effectively are able to extract the quantitative information from the vast data amounts collected. Underlying qualitative features (latent structures) are extracted from multivariate spectral data in order to quantify desired quality parameters properly. Specifcally multispectral imaging which has been explored to a lesser extent than ordinary spectroscopy, having the possibility to exploit the inherent heterogeneity that exists in foodstuffs have been investigated here. An extra feature obtained by combining spectroscopy, imaging and chemometrics is exploratory analysis. This is central in food research, since novel hypotheses about the food systems under observation may be generated using this inductive analytical approach. For the food industry it is an additional advantage that the fast, non-invasive, remote sensing nature of the spectroscopic imaging methods allows on-line measurements. In this way spectroscopic imaging in combination with advanced data analysis meets the high throughput needs for quality control, process control and monitoring. In this Ph.D. project the possibilities provided by spectroscopic imaging and chemometrics have been utilized to improve the analysis and understanding of different food products. The work is presented in seven papers and two additional technical reports which make up the core of the thesis. Furthermore an introduction together with a linking of the contributions is presented in this thesis. The papers puts an emphasis on the use of multispectral imaging in the baking industry where especially the non-enzymatic browning appearance and features related to this are highlighted. These are features such as colour, water content and internal structure of bread. A paper presenting enzymatic browning in pre stir fried and thawed vegetables is also presented showing that imaging techniques such as the one investigated in this thesis is able to detect even subtle colour changes. The possibility for quantifying early as well as late spoilage in raw pork meat is investigated where use of the heterogenetic structure is utilized to obtain good results on predicting sensory evaluations as well on laboratory analysis. Colour in other settings such as in the shery industry is equally important, and a paper describing detection of cartenoid pigment in trouts using spectral images shows promising results. Finally, two technical papers present possible ways of mapping multispectral images to a visible colour space, as well as how an alternative multispectral imaging system, making use of iters, may be used to design new more broad ranged filters. Fewer filters will increase the speed of such systems. Methods for solving such problems is to the knowledge of the authors rarely covered in the literature.

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Project Supervision - An Engineering Approach

General Information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling, DTU Data Analysis
Authors: Paulsen, R. R. (Intern), Larsen, R. (Intern), Ersbøll, B. K. (Intern), Conradsen, K. (Intern)
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EngineeringProjectSupervisionExtAbstract.pdf
Links:
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Source-ID: 278621
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2011

Project Supervision – An Engineering Approach
For more than twenty years, a group based supervision strategy has been used when supervising engineering bachelor- and master thesis students at our research group. In recent years, we have formalised the approach and used our industry experience to create a very successful framework for project supervision. This paper is a best practice guide aiming at research groups that would like to try to implement our supervision approach or parts of it. The approach is based on the belief that engineering students should be prepared for their new role as development engineers or PhD students as part of their master thesis writing. The supervision principles are: Ownership: The student should feel that their project is their own. Ideally, they should formulate the project themselves. Write early: We strongly encourage the students to write and generate figures and images already from the first week of the project period. Management: The student is considered project manager of his own project. The supervisor is a guide or coach (or a project owner) Plans: The student is asked to write a project plan during the first week of the project together with a risk-analysis. Group Meetings: A group of students and supervisors meet every week on a fixed weekday. In our team, it is normal that one supervisor supervises three to five projects simultaneously. The core of the supervision is the weekly meetings where the students present what they have been doing and what they plan to do. By default, all students are present at all meetings. Weekly meetings are scheduled to be at a specific day at a specific place for the entire process.
Sparse discriminant analysis

We consider the problem of performing interpretable classification in the high-dimensional setting, in which the number of features is very large and the number of observations is limited. This setting has been studied extensively in the chemometrics literature, and more recently has become commonplace in biological and medical applications. In this setting, a traditional approach involves performing feature selection before classification. We propose sparse discriminant analysis, a method for performing linear discriminant analysis with a sparseness criterion imposed such that classification and feature selection are performed simultaneously. Sparse discriminant analysis is based on the optimal scoring interpretation of linear discriminant analysis, and can be extended to perform sparse discrimination via mixtures of Gaussians if boundaries between classes are nonlinear or if subgroups are present within each class. Our proposal also provides low-dimensional views of the discriminative directions. © 2011 American Statistical Association and the American Society for Qualitys.
β-glucans accelerate the closing of open wounds in carp, Cyprinus carpio

General information
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Organisations: Division of Industrial Food Research, National Food Institute, DTU Data Analysis, Department of Informatics and Mathematical Modeling
Authors: Schmidt, J. (Intern), Przybylska, D. A. (Intern), Ljungqvist, M. G. (Intern), Dissing, B. S. (Intern), Ersbøll, B. K. (Intern), Nielsen, M. E. (Intern)
Publication date: 2011
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 314119
Publication: Research - peer-review › Journal article – Annual report year: 2011

Trigeminal nerve injury associated with injection of local anesthetics: Needle lesion or neurotoxicity?
Background. The authors used comprehensive national registry and clinical data to conduct a study of adverse drug reactions (ADRs), in particular neurosensory disturbance (NSD), associated with local anesthetics used in dentistry.
Methods. The study included data sets of annual sales of local anesthetics (from 1995 through 2007), 292 reports to the Danish Medicines Agency, Copenhagen, Denmark, of adverse reactions to local anesthetic drugs, and a clinical sample of 115 patients with NSD associated with local anesthetics. The authors assessed lidocaine 2 percent, mepivacaine 2 percent and 3 percent, prilocaine 3 percent, and articaine 4 percent sold in cartridges. Results. The study results showed a highly significant overrepresentation of NSDs associated with articaine 4 percent, in particular with mandibular blocks. Conclusions. The distribution of NSDs was disproportionate to the market share of three of the four drugs in both national registry data and clinical data. These findings indicate that the main cause of injury was neurotoxicity resulting from administration of the local anesthetic rather than the needle penetration. Clinical Implications. Clinicians may consider avoiding use of high-concentration (4 percent) anesthetic formulations for block anesthesia in the trigeminal area in cases in which there are viable alternatives.
Using Image Analysis On Standardised Full-Thickness Wounds In Scattered Mirror Carp (Cyprinus Carpio) As A Model For Wound Healing
Visual effects of β-glucans on wound healing in fish

General information
State: Published
Organisations: Division of Industrial Food Research, National Food Institute, DTU Data Analysis, Department of Informatics and Mathematical Modeling
Authors: Schmidt, J. (Ekstern), Ljungqvist, M. G. (Intern), Frosch, S. (Intern), Ersbøll, B. K. (Intern), Nielsen, M. E. (Intern)
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Event: Abstract from 12th Scandinavian Symposium on Chemometrics, Billund, Denmark.
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 313966
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2011

Introduction
β-glucans are diverse polysaccharides that occur naturally in plants, fungi and bacteria. β-glucans have been shown to have an immunostimulatory effect1. In addition, β-glucans have been found to increase wound tensile strength and collagen synthesis2. This is likely to affect the filet quality3. With multispectral imaging we investigate the effect of adding β-glucans to the water during healing of open wounds in fish. Multispectral imaging is used in human diagnostic medicine for evaluating fx proriasis and chronic diabetic wounds, but has not yet been applied to wounds in fish.

Experimental set-up. The fish (common carp, Cyprinus carpio and rainbow trout, Oncorhynchus mykiss) were wounded with a biopsy punch (Miltex, York, USA), thus removing a cylinder of tissue. The resulting wound exposed the muscle. Fish were then kept for 14 days in either pure tap water or tap water supplemented with β-glucans (to a final concentration of 0.1mg/L). The experiment was then either terminated or continued with normal tap water. Multispectral images were acquired several times during the experiment using a VideometerLab (Videometer A/S, Horsholm, Denmark). Results and discussion Experiments are still underway, but some results are expected to be ready for the workshop.
Visualizing wound healing in fish

General information
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Organisations: Division of Industrial Food Research, National Food Institute, DTU Data Analysis, Department of Informatics and Mathematical Modeling
Authors: Ljungqvist, M. G. (Intern), Schmidt, J. (Intern), Ersbøll, B. K. (Intern), Frosch, S. (Intern), Nielsen, M. E. (Intern)
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Publication: Research › Poster – Annual report year: 2011

Data analysis in high-dimensional sparse spaces: Large p, small n problems
The present thesis considers data analysis of problems with many features in relation to the number of observations (large p, small n problems). The theoretical considerations for such problems are outlined including the curses and blessings of dimensionality, and the importance of dimension reduction. In this context the trade off between a rich solution which answers the questions at hand and a simple solution which generalizes to unseen data is described. For all of the given data examples labelled output exists and the analyses are therefore limited to supervised settings. Three novel classification techniques for high-dimensional problems are presented: Sparse discriminant analysis, sparse mixture discriminant analysis and orthogonality constrained support vector machines. The first two introduces sparseness to the well known linear and mixture discriminant analysis and thereby provide low-dimensional projections of data with few non-zero loadings which give improvements in classification. The latter adds a priori information of pairing between observations to the support vector machine and thereby give solutions with less variation and slight improvements in classification. The classification methods are applied to classifications of fish species, ear canal impressions used in the hearing aid industry, microbiological fungi species, and various cancerous tissues and healthy tissues. In addition, novel applications of sparse regressions (also called the elastic net) to the medical, concrete, and food industries via multi-spectral images for objective and automated systems are presented.

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Authors: Clemmensen, L. K. H. (Intern), Ersbøll, B. K. (Intern)
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A comparison of dimension reduction methods with application to multi-spectral images of sand used in concrete
This paper presents a comparison of dimension reduction methods based on a novel machine vision application for estimating moisture content in sand used to make concrete. For the application in question it is very important to know the moisture content of the sand so as to ensure good-quality concrete. In order to achieve a continuous in-line approach for the concrete mixing, digital image analysis is used. Multi-spectral images, consisting of nine spectral bands in the visible and near infrared (NIR) range, were acquired. Each image consists of approximately 9 million pixels. Five different sand types were examined with 20-60 images for each type. To reduce the amount of data, features were extracted from the multi-spectral images; the features were summary statistics on single bands and pairs of bands as well as morphological summaries. The number of features (2,016) is high in relation to the number of observations and, therefore, dimension reductive methods are needed. Furthermore, speed, which is an important consideration, is aided by the use of a small number of variables. On top of that, fewer dimensions tend to give more robust results. Two traditional statistical methods
for dimension reduction (forward selection and principal components) combined with ordinary least squares and one sophisticated chemometrics algorithm (genetic algorithm-partial least squares) are compared to the recently proposed least angle regression-elastic net (LARS-EN) model selection method.

**General information**

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Organisations: DTU Data Analysis, Department of Informatics and Mathematical Modeling
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BFI (2014): BFI-level 1
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BFI (2013): BFI-level 1
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BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.44 SNIP 1.429 CiteScore 1.59
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Scopus rating (2011): SJR 0.581 SNIP 1.991 CiteScore 1.85
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Scopus rating (2010): SJR 0.678 SNIP 1.759
Web of Science (2010): Indexed yes
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Scopus rating (2005): SJR 0.461 SNIP 1.524
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Scopus rating (2003): SJR 0.517 SNIP 1.561
Scopus rating (2002): SJR 0.214 SNIP 0.432
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Analysis of Astaxanthin in Fish Feed Pellets

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Pages: 59-60
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Main Research Area: Technical/natural sciences
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astaxanthin, multispectral
Links:
http://www.wefta.org/
Source: orbit
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Publication: Research › Conference abstract in proceedings – Annual report year: 2010

Canonical correlation analysis of course and teacher evaluation
At the Technical University of Denmark course evaluations are performed by the students on a questionnaire. On one form the students are asked specific questions regarding the course. On a second form they are asked specific questions about the teacher. This study investigates the extent to which information obtained from the course evaluation form overlaps with information obtained from the teacher evaluation form. Employing canonical correlation analysis it was found that course and teacher evaluations are correlated. However, the structure of the canonical correlation is subject to change with changes in teaching methods from one year to another.

General information
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Organisations: DTU Data Analysis, Department of Informatics and Mathematical Modeling
Authors: Sliusarenko, T. (Intern), Ersbøll, B. K. (Intern)
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Main Research Area: Technical/natural sciences
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course evaluation, teacher evaluation, student questionnaire, canonical correlation, higher education
Electronic versions:
TamaraSliusarenko.pdf
Source: orbit
Source-ID: 274394
Publication: Research - peer-review › Article in proceedings – Annual report year: 2010

Comparison of sparse point distribution models
This paper compares several methods for obtaining sparse and compact point distribution models suited for data sets containing many variables. These are evaluated on a database consisting of 3D surfaces of a section of the pelvic bone obtained from CT scans of 33 porcine carcasses. The superior model w.r.t. sparsity, reconstruction error and interpretability is found to be a varimax rotated model with a threshold applied to small loadings. The models describe the biological variation in the database and is used for developing robotic tools when automating labor intensive procedures in slaughterhouses.

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling, Danish Meat Research Institute
Authors: Erbou, S. G. H. (Intern), Vester-Christensen, M. (Intern), Larsen, R. (Intern), Christensen, L. B. (Ekstern), Ersbøll, B. K. (Intern)
Effects of beta-glucans on wound healing in carp, Cyprinus carpio

General information
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Organisations: National Food Institute, Department of Informatics and Mathematical Modeling
Overcoming trends in irregularly spaced locations by regional polish - exemplified by estimation of the range of influence between Salmonella Dublin-seropositive cattle herds

The aim of the study was to develop a procedure to remove spatial trends in irregularly spaced data, with trends partly due to regional differences. Median polish is often used on regularly spaced (lattice) data where column and row medians are removed. For irregularly spaced data a low-resolution map of the spatial locations is often used where data locations are...
assigned to the nearest lattice node followed by median polish. In this study regional polish was developed. The inverse distance weighted median was calculated based on observations from locations in the neighbourhood of the actual observation. The regional polish residual is obtained as the difference between the observed value and the weighted median. The regional polish procedure was applied to Salmonella Dublin data showing strong regional trends. Estimation of the range of influence between cattle herds with positive S. Dublin herd status was considerably improved with a stable parameter estimate and reduced standard error.

General information
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Organisations: Department of Informatics and Mathematical Modeling, DTU Data Analysis
Authors: Ersbøll, A. K. (Intern), Ersbøll, B. K. (Intern)
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Web of Science (2016): Indexed yes
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Scopus rating (2015): SJR 1.341 SNIP 1.079 CiteScore 2.29
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.288 SNIP 1.026 CiteScore 2.19
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.313 SNIP 1.126 CiteScore 2.57
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.42 SNIP 1.175 CiteScore 2.69
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.327 SNIP 1.223 CiteScore 2.71
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
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Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.053 SNIP 1.192
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.051 SNIP 1.052
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.928 SNIP 1.059
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.994 SNIP 1.228
Web of Science (2006): Indexed yes
Spatial modelling of the between-herd infection dynamics of bovine virus diarrhoea virus (BVDV) in dairy herds in Denmark

According to the current literature BVDV-infected neighbours probably impose a high risk of infection of susceptible cattle herds. In the present study, the objective was to evaluate the risk of a dairy herd changing infection status (from not having persistently infected (PI) animals to having PI-animals) in relation to location and infection status of neighbouring cattle herds in Denmark. In total, 7921 dairy herds were included in the analysis of spatial and non-spatial risk factors. The spatial risk factors were derived based on the cattle herds in the neighbourhood (N = 36,639 cattle herds). The neighbourhood was defined as the first order neighbouring cattle herds using a Delauney triangulization. In total, 13.3% of the dairy herds changed herd status to PI-herds during the study period that lasted from January 1, 1995, to June 30, 1996. The risk of becoming a PI-herd was negatively associated with the mean distance to the neighbouring herds (OR = 0.7 for an increase of 1 km). Presence of PI-herds in the neighbourhood increased the risk of becoming a PI-herd (OR = 1.37, 1.40, 1.70 for 1, 2, ≥3 PI-herds in the neighbourhood). Increasing herd size increased the risk of becoming a PI-herd (OR = 3.9 for an increase of 10 cows). Regional differences were seen.

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Organisations: Department of Informatics and Mathematical Modeling, DTU Data Analysis, Danish Meat Association, University of Copenhagen, Danish Cattle Federation
Authors: Ersbøll, A. K. (Intern), Ersbøll, B. K. (Intern), Houe, H. (Ekstern), Alban, L. (Ekstern), Kjeldsen, A. M. (Ekstern)
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On parameterized deformations and unsupervised learning

The work presented here consists of contributions in three areas. An efficient algorithm for calculating the entire regularization path of the support vector domain description (SVDD) is presented. The ability to calculate the entire path with a complexity in the same order as solving the original quadratic problems gives inspiration to utilize the extra information available from the entire path. A method for hierarchical support vector clustering, based on information from the entire regularization path, and multiple Gaussian kernels is described. Bayesian methods are applied in the attempt to draw direct statistical conclusions from the SVDD analysis.

In the context of image registration, different assumptions on the warp fields, namely diffeomorphism and a linear elastic potential in the form of regularization are discussed. A new warp representation which allows statistical analysis on an unrestricted linear parameter space, where all derivatives are defined, is introduced. Furthermore, it is shown that L2-norm
the parameter space introduces a reasonable metric in the actual space of modelled diffeomorphisms. A new parametrization of 3D deformation fields, using potentials and Helmholtz decomposition is also presented. The representation can be considered a natural parametrization for both elastic and fluid image registration due to the decoupling of the parameters. The determinant gradient field is shown to be the first-order small-deformation approximation to the determinant of the Jacobian matrix.

Spline approximations of functions and in particular image registration warp fields are discussed. It is shown how spline bases may be learned from the optimization process, i.e. image registration optimization, and how this may contribute with a reasonable prior, or regularization in the method. A new formula, based on the multivariate divided difference, for explicit calculation of the simplex splines is presented. The formula additionally admits easy calculation of derivatives, both spatial, and with respect to the position of the knots. It is demonstrated that conditions may be set on the knot movements, which ensures that the splines form a partition of unity, even if the knots are not Delaunay. A subdivision scheme is also presented, which requires no recalculation of the configurations of the splines. The use of the splines for image registration is demonstrated, and the inherent smoothing or averaging cost, of selecting warp parameterizations at a specific kernel resolution, has been analyzed. A refinement measure has been derived, which is shown to be efficient for guiding the local mesh layout. With the combination of the refinement measure and the local flexibility of the multivariate B-splines, the warp field is automatically refined in areas where it results in the minimization of the registration cost function.

### Computer Vision for Timber Harvesting

The goal of this thesis is to investigate computer vision methods for timber harvesting operations. The background for developing computer vision for timber harvesting is to document origin of timber and to collect qualitative and quantitative parameters concerning the timber for efficient harvest planning. The investigations in this thesis is done as initial work on a planning and logistic system for timber harvesting called logTracker. In this thesis we have focused on three methods for the logTracker project, which includes image segmentation, image classification, and image retrieval. Segmentation is to partition an image based on image characteristics and in our study we have focused on image texture. Our segmentation method is inspired by iterative function systems and contractive maps, which makes the basis for both our texture characterization and our method for obtaining the image segments. The purpose of image segmentation is to make the basis for more advanced computer vision methods like object recognition and classification. Our second method concerns image classification and we present a method where we classify small timber samples to tree species based on Active Appearance Models and texture characteristics. The last method is image retrieval based on the so called "bag of visual words" procedure. An image is characterized as a distribution of local image descriptors, which is the basis for effective image search. These methods are described and discussed in relation to the logTracker project and ideas for further development of the system is provided. Building a complete logTracker system is a very demanding task and the conclusion is that it is important to focus on the elements that can bring most value to timber harvest planning. Besides contributing to the development of the logTracker system the described methods have a general applicability making them useful for many other computer vision problems.
Modeling the Biological Diversity of Pig Carcasses
This thesis applies methods from medical image analysis for modeling the biological diversity of pig carcasses. The Danish meat industry is very focused on improving product quality and productivity by optimizing the use of the carcasses and increasing productivity in the abattoirs. In order to achieve these goals there is a need for more detailed information about pig carcasses in relation to measures of quality. Non-invasive imaging such as X-ray Computed Tomography (CT) can provide this very detailed information discerning the major tissue types. Medical image analysis provides the tools for extracting and modeling meaningful information from the vast amount of information available from non-invasive imaging data. The lean meat percentage (LMP) is a common standard for measuring the quality of pig carcasses. Measuring the LMP using CT and using this as a reference for calibration of online equipment is investigated, without the need for a calibration against a less accurate manual dissection. The rest of the contributions regard the construction and use of point distribution models (PDM). PDM's are able to capture the shape variation of a population of shapes, in this case a 3D surface of a specific bone structure in the ham. These models can assist developers of robotic tools by enabling population based testing before actual construction of the tools. Sparse models are compared to the standard PCA based model and a method for fitting PDM's to sparse data is proposed. The former provides more spatially localized modes of variation that are easier interpretable and the latter enables the use of PDM's without the need for full point correspondence of new data. There is great potential in applying CT as non-invasive modality in the meat industry, e.g. in population based studies, for shape modeling and for analyzing carcass composition. In the future online CT applications can be used to make decisions on the use of each specific carcass by obtaining improved quality measures.

An Efficient Data-driven Tissue Deformation Model
In this paper we present an efficient data-driven tissue deformation model. The work originates in process automation within the pig meat processing industry. In the development of tools for automating accurate cuts, knowledge on tissue deformation is of great value. The model is built from empirical data; 10 pig carcasses are subjected to deformation from a controlled source imitating the cutting tool. The tissue deformation is quantified by means of steel markers inserted into the carcass as a three-dimensional bone structure in the ham. These models can assist developers of robotic tools by enabling population based testing before actual construction of the tools. Sparse models are compared to the standard PCA based model and a method for fitting PDM's to sparse data is proposed. The former provides more spatially localized modes of variation that are easier interpretable and the latter enables the use of PDM's without the need for full point correspondence of new data. There is great potential in applying CT as non-invasive modality in the meat industry, e.g. in population based studies, for shape modeling and for analyzing carcass composition. In the future online CT applications can be used to make decisions on the use of each specific carcass by obtaining improved quality measures.
principal modes, and the results are compared to manual measurements of carcass composition. We find an association between the first principal mode and the lateral movement. Furthermore, there is a link between this and the ratio of meat-fat quantity - a potentially very useful finding since existing tools for carcass grading and sorting measure equivalent quantities.

Efficient Incorporation of Markov Random Fields in Change Detection

Many change detection algorithms work by calculating the probability of change on a pixel-wise basis. This is a disadvantage since one is usually looking for regions of change, and such information is not used in pixel-wise classification - per definition. This issue becomes apparent in the face of noise, implying that the pixel-wise classifier is also noisy. There is thus a need for incorporating local homogeneity constraints into such a change detection framework. For this modelling task Markov Random Fields are suitable. Markov Random Fields have, however, previously been plagued by lack of efficient optimization methods or numerical solvers. We here address the issue of efficient incorporation of local homogeneity constraints into change detection algorithms. We do this by exploiting recent advances in graph based algorithms for Markov Random Fields. This is combined with an IR-MAD change detector, and demonstrated on
real data with good results.

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State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling, Geodesy, National Space Institute
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**GazeTrain: A case study of an action oriented gaze-controlled game**

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**Image analysis and multivariate statistics in production of aquaculture feed**

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Quantification and validation of soft tissue deformation

We present a model for soft tissue deformation derived empirically from 10 pig carcasses. The carcasses are subjected to deformation from a known single source of pressure located at the skin surface, and the deformation is quantified by means of steel markers injected into the tissue. The steel markers are easy to distinguish from the surrounding soft tissue in 3D computed tomography images. By tracking corresponding markers using methods from point-based registration, we are able to accurately quantify the magnitude and propagation of the induced deformation. The deformation is parameterised by radial basis functions with compact support. The parameterisation yields an absolute error with mean 0.20 mm, median 0.13 mm and standard deviation 0.21 mm (not cross validated). We use the parameterisation to form a statistical deformation model applying principal component analysis on the estimated deformation parameters. The model is successfully validated using leave-one-out cross validation by subject, achieving a sufficient level of precision using only the first two principal modes; mean 1.22 mm, median 1.11 mm and standard deviation 0.67 mm.
Shape and Texture Based Classification of Fish Species

In this paper we conduct a case study of fish species classification based on shape and texture. We consider three fish species: cod, haddock, and whiting. We derive shape and texture features from an appearance model of a set of training data. The fish in the training images were manual outlined, and a few features including the eye and backbone contour were also annotated. From these annotations an optimal MDL curve correspondence and a subsequent image registration were derived. We have analyzed a series of shape and texture and combined shape and texture modes of variation for their ability to discriminate between the fish types, as well as conducted a preliminary classification. In a linear discriminant analysis based on the two best combined modes of variation we obtain a resubstitution rate of 76%.
Similarity-based Fisherfaces

In this article, a face recognition algorithm aimed at mimicking the human ability to differentiate people is proposed. For each individual, we first compute a projection line that maximizes his or her dissimilarity to all other people in the user database. Facial identity is thus encoded in the dissimilarity pattern composed by all the projection coefficients of an individual against all other enrolled user identities. Facial recognition is achieved by calculating the dissimilarity pattern of an unknown individual with that of each enrolled user. As the proposed algorithm is composed of different one-dimensional projection lines, it easily allows adding or removing users by simply adding or removing the corresponding projection lines in the system. Ideally, to minimize the influence of these additions/removals, the user group should be representative enough of the general population. Experiments on three widely used databases (XM2VTS, AR and Equinox) show consistently good results. The proposed algorithm achieves Equal Error Rate (EER) and Half-Total Error Rate (HTER) values in the ranges of 0.41-1.67% and 0.1-1.95%, respectively. Our approach yields results comparable to the top two winners in recent contests reported in the literature. (C) 2009 Elsevier B.V. All rights reserved.
Simulation of the K-function in the analysis of spatial clustering for non-randomly distributed locations - Exemplified by bovine virus diarrhoea virus (BVDV) infection in Denmark

The K-function is often used to detect spatial clustering in spatial point processes, e.g. clustering of infected herds. Clustering is identified by testing the observed K-function for complete spatial randomness modelled, e.g. by a homogeneous Poisson process. The approach provides information about spatial clustering as well as the scale of distances of clustering. However, there are several problems related to applying the K-function, e.g. estimation of the size of the study area and the assumption about modelling spatial random distribution of the events by, e.g. a homogeneous Poisson process. The objective of the present study was to develop a null hypothesis version of the K-function that overcomes the assumption about a specific underlying spatial distribution characterising complete spatial randomness. Furthermore, the objective was to develop an approach that does not include the estimation of the size of the study area. The paper presents a simulation procedure to derive the null hypothesis version of the K-function. The null hypothesis
version of the K-function is simulated by random sampling of N+ locations from the distribution of N observed locations (infected (N+) and non-infected (N-N+)). The differences between the empirical and the estimated null-hypothesis version of the K-function are plotted together with the 95% simulation envelopes versus the distance, h. In this way we test if the spatial distribution of the infected herds differs from the spatial distribution of the herd locations in general. The approach also overcomes edge effects and problems with complex shapes of the study region. An application to bovine virus diarrhoea virus (BVDV) infection in Denmark is described.

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Temporal reflectance changes in vegetables

Quality control in the food industry is often performed by measuring various chemical compounds of the food involved. We propose an imaging concept for acquiring high quality multispectral images to evaluate changes of carrots and celeriac over a period of 14 days. Properties originating in the surface chemistry of vegetables may be captured in an integrating sphere illumination which enables the creation of detailed surface chemistry maps with a good combination of spectral and spatial resolutions. Prior to multispectral image recording, the vegetables were prefried and frozen at -30°C for four months. During the 14 days of image recording, the vegetables were kept at +5°C in refrigeration. In this period, surface changes and thereby reflectance properties were very subtle. To describe this small variation we employed advanced statistical techniques to search a large featurespace of variables extracted from the chemistry maps. The resulting components showed a change in both the carrot and celeriac samples. We were able to deduct from the resulting components that oxidation caused the changes over time.

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Virtual dissection of pig carcasses
This paper proposes the use of computed tomography (CT) as a reference method for estimating the lean meat percentage (LMP) of pig carcasses. The current reference is manual dissection which has a limited accuracy due to variability between butchers. A contextual Bayesian classification scheme is applied to classify volume elements of full body CT-scans of pig carcasses into three tissue types. A linear model describes the relation between voxels and the full weight of the half carcass, which can be determined more accurately than that of the lean meat content. Two hundred and ninety-nine half pig carcasses were weighed and CT-scanned. The explained variance of the model was $R^2 = 0.9994$ with a root-mean-squared error of prediction of 83.6 g. Applying this method as a reference will ensure a more robust calibration of sensors for measuring the LMP, which is less prone to variation induced by manual intervention.
Analysis of Craniofacial Images using Computational Atlases and Deformation Fields

The topic of this thesis is automatic analysis of craniofacial images. The methods proposed and applied contribute to the scientific knowledge about different craniofacial anomalies, in addition to providing tools for detailed and robust analysis of craniofacial images for clinical and research purposes. The basis for most of the applications is non-rigid image registration. This approach brings one image into the coordinate system of another resulting in a deformation field describing the anatomical correspondence between the two images. A computational atlas representing the average anatomy of a group may be constructed and brought into correspondence with a set of images of interest. Having established such a correspondence, various analyses may be carried out. This thesis discusses two types of such analyses, i.e. statistical deformation models and novel approaches for the quantification of asymmetry. The analyses are applied to the study of three different craniofacial anomalies. The craniofacial applications include studies of Crouzon syndrome (in mice), unicoronal synostosis plagiocephaly and deformational plagiocephaly. Using the proposed methods, the thesis reveals novel findings about the craniofacial morphology and asymmetry of Crouzon mice. Moreover, a method to plan and evaluate treatment of children with deformational plagiocephaly, based on asymmetry assessment, is established. Finally, asymmetry in children with unicoronal synostosis is automatically assessed, confirming previous results based on manual reference points and providing a higher level of detail.

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Estimation of shape model parameters for 3D surfaces
Statistical shape models are widely used as a compact way of representing shape variation. Fitting a shape model to unseen data enables characterizing the data in terms of the model parameters. In this paper a Gauss-Newton optimization scheme is proposed to estimate shape model parameters of 3D surfaces using distance maps, which enables the
estimation of model parameters without the requirement of point correspondence. For applications with acquisition limitations such as speed and cost, this formulation enables the fitting of a statistical shape model to arbitrarily sampled data. The method is applied to a database of 3D surfaces from a section of the porcine pelvic bone extracted from 33 CT scans. A leave-one-out validation shows that the parameters of the first 3 modes of the shape model can be predicted with a mean difference within [-0.01,0.02] from the true mean, with a standard deviation less than 0.34.

Independent histogram pursuit for segmentation of skin lesions

In this paper, an unsupervised algorithm, called the Independent Histogram Pursuit (HIP), for segmenting dermatological lesions is proposed. The algorithm estimates a set of linear combinations of image bands that enhance different structures embedded in the image. In particular, the first estimated combination enhances the contrast of the lesion to facilitate its segmentation. Given an N-band image, this first combination corresponds to a line in N dimensions, such that the separation between the two main modes of the histogram obtained by projecting the pixels onto this line, is maximized. The remaining combinations are estimated in a similar way under the constraint of being orthogonal to those already computed. The performance of the algorithm is tested on five different dermatological datasets. The results obtained on these datasets; indicate the robustness of the algorithm and its suitability to deal with different types of dermatological lesions. The boundary detection precision using k-means segmentation was close to 97%. The proposed algorithm can be easily combined with the majority of classification algorithms.
Sparse Discriminant Analysis

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**Organisations:** Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling, Stanford University  
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**Original language:** English
A method for comparison of growth media in objective identification of Penicillium based on multi-spectral imaging

We consider the problems of using excessive growth media for identification and performing objective identification of fungi at the species level. We propose a method for choosing the subset of growth media, which provides the best discrimination between several fungal species. Furthermore, we propose the use of multi-spectral imaging as a means of objective identification. Three species of the fungal genus Penicillium are subject to classification. To obtain an objective classification we use multi-spectral images. Previously, RGB images have proven useful for the purpose. We use multi-spectral bands as they provide additional information about the chemistry of the fungal colonies. In this study three media [Czapek yeast extract agar (CYA), oatmeal agar (OAT), and yeast extract sucrose agar (YES)] have been compared on their ability to discriminate between the three species. We propose a statistical method to test which medium or combination of media gives the best discrimination. Statistical tests indicate that YES combined with CYA is the best choice of media in this case. However, for the objective identification one medium is sufficient to discriminate between the species. Statistical tests show that there are significant differences between the species on all individual media, and that these differences are largest on YES. The objective identification has been performed solely by means of digital image analysis. The features obtained from the image analysis merely correspond to macro-morphological features. The species have been classified using only 3–4 of the spectral bands with a 100% correct classification rate using both leave-one-out cross-validation and test set validation.
A Method for Evaluating Treatment in Infants with Deformational Plagiocephaly

Deformational Plagiocephaly (DP) is a term describing head asymmetry and deformation commonly seen in infants. DP affects the back of the head and, to a lesser extent, the forehead. The deformity is thought to result from protracted external pressure to the skull in one position. Treatment is non-surgical and involves parental education on infant repositioning to avoid pressure on the attented side, and, in many cases, orthotic molding helmet therapy. The purpose of this work was to develop a method for assessment of helmet therapy employing a statistical analysis of change in head asymmetry.

The clinical population consisted of 37 infants for whom 3D surface scans of the head had been obtained both before and after their helmet treatment. Detailed point correspondence between all head surfaces was established by tps-transforming a symmetric template to each of the head surfaces. This also ensured full left-right point correspondence. Asymmetry was quantified by the ratio of distances between sides, measured from a midpoint between the ears to corresponding surface points on opposite sides of the midsagittal plane. The method was able to quantify and localize the asymmetry, which occurred predominantly in the back and/or the front of the head. Change in asymmetry was determined by computing the difference between measurement before and after the therapy. The results revealed that the head asymmetry was, in most cases, corrected in the posterior and/or anterior regions. The values of asymmetry change were statistically analyzed using Principal Components Analysis. The model localized the two major improvements to the posterior and anterior regions of the head, respectively, where also the main head asymmetries had been detected (and clinically observed). Results deem this method suitable for treatment evaluation. In addition, results establish helmet
therapy as an effective treatment for improving head asymmetry in infants with DP.

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Organisations: Department of Informatics and Mathematical Modeling, Computer Science and Engineering, Image Analysis and Computer Graphics
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**A Point-Wise Quantification of Asymmetry Using Deformation Fields: Application to the Study of the Crouzon Mouse Model**

This paper introduces a novel approach to quantify asymmetry in each point of a surface. The measure is based on analysing displacement vectors resulting from nonrigid image registration. A symmetric atlas, generated from control subjects is registered to a given subject image. A comparison of the resulting displacement vectors on the left and right side of the symmetry plane, gives a point-wise measure of asymmetry. The asymmetry measure was applied to the study of Crouzon syndrome using Micro CT scans of genetically modified mice. Crouzon syndrome is characterised by the premature fusion of cranial sutures, which gives rise to a highly asymmetric growth. Quantification and localisation of this asymmetry is of high value with respect to surgery planning and treatment evaluation. Using the proposed method, asymmetry was calculated in each point of the surface of Crouzon mice and wild-type mice (controls). Asymmetry appeared in similar regions for the two groups but the Crouzon mice were found significantly more asymmetric. The localisation ability of the method was in good agreement with ratings from a clinical expert. Validating the quantification ability is a less trivial task due to the lack of a gold standard. Nevertheless, a comparison with a different, but less accurate measure of asymmetry revealed good correlation.

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**Automatic assessment of intrabdominal fat by MRI**
Automatic change detection and quantification of dermatological diseases with an application to psoriasis images

Change monitoring in skin lesion analysis has proven to be a useful adjunct in their assessment. This article presents a comparative study of the available change detection techniques applied to change visualization and quantification in bi-temporal psoriasis images. The chosen methods are evaluated on a time series of psoriasis images and results are compared with dermatologists' scores.
Automatic Detection of Wild-type Mouse Cranial Sutures

In the study of craniofacial malformations, the cranial sutures are often of interest. The premature fusion of sutures occurring in e.g. Crouzon and Apert syndrome can lead to asymmetric head shape, enlarged intracranial pressure and blindness. In large population studies of such syndromes, automatic detection of the cranial sutures becomes important.

We have previously built a craniofacial, wild-type mouse atlas from a set of 10 Micro CT scans using a B-spline-based nonrigid registration method by Rueckert et al. Subsequently, all volumes were registered nonrigidly to the atlas. Using these transformations, any annotation on the atlas can automatically be transformed back to all cases. For this study, two rounds of tracing seven of the cranial sutures, were performed on the atlas by one observer. The average of the two rounds was automatically propagated to all the cases. For validation, the observer traced the sutures on each of the mouse volumes as well. The observer outperforms the automatic approach by approximately 0.1 mm. All mice have similar errors while the suture error plots reveal that suture 1 and 2 are cumbersome, both for the observer and the automatic approach. These sutures can be hard to detect with the eye. We still believe that overall, the errors are not considerable and by qualitatively estimating the accuracy, the automatic sutures are very close to the observer sutures. Our plan is to improve the results by local feature detection methods.

General Information
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Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling, Computer Science and Engineering
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Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 200554
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2007
Computational mouse atlases and their application to automatic assessment of craniofacial dysmorphology caused by the Crouzon mutation Fgfr2

Crouzon syndrome is characterised by premature fusion of sutures and synchondroses. Recently the first mouse model of the syndrome was generated, having the mutation Cys342Tyr in Fgfr2c, equivalent to the most common human Crouzon/Pfeiffer syndrome mutation. In this study, a set of Micro CT scannings of the skulls of wild-type mice and Crouzon mice were analysed with respect to the dysmorphology caused by Crouzon syndrome. A computational craniofacial atlas was built automatically from the set of wild-type mouse Micro CT volumes using (i) affine and (ii) nonrigid image registration. Subsequently, the atlas was deformed to match each subject from the two groups of mice. The accuracy of these registrations was measured by a comparison of manually placed landmarks from two different observers and automatically assessed landmarks. Both of the automatic approaches were within the inter-observer accuracy for normal specimens, and the nonrigid approach was within the inter-observer accuracy for the Crouzon specimens. Four linear measurements, skull length, height and width and inter-orbital distance, were carried out automatically using the two different approaches. Both automatic approaches assessed the skull length, width and height accurately for both groups of mice. The nonrigid approach measured the inter-orbital distance accurately for both groups while the affine approach failed to assess this parameter for both groups. Using the full capability of the nonrigid approach, local displacements obtained when registering the nonrigid wild-type atlas to a nonrigid Crouzon mouse atlas were determined on the surface of the wild-type atlas. This revealed a 0.6 mm bending in the nasal region and a 0.8 mm shortening of the zygoma, which are similar to characteristics previously reported in humans. The most striking finding of this analysis was an angulation of approximately 0.6 mm of the cranial base, which has not been reported in humans. Comparing the two different methodologies, it is concluded that the nonrigid approach is the best way to automatically assess linear skull parameters. Furthermore, the nonrigid approach is essential when it comes to analysing local, nonlinear shape differences.

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Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling, Embedded Systems Engineering
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Volume: 211
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BFI (2016): BFI-level 2
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BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.057 SNIP 1.144 CiteScore 2.32
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 0.98 SNIP 1.229 CiteScore 2.14
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.179 SNIP 1.117 CiteScore 2.56
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.1 SNIP 1.219 CiteScore 2.64
ISI indexed (2012): ISI indexed yes
Craniofacial Statistic Deformation Models of Wild-type mice and Crouzon mice

Crouzon syndrome is characterised by the premature fusion of cranial sutures and synchondroses leading to craniofacial growth disturbances. The gene causing the syndrome was discovered approximately a decade ago and recently the first mouse model of the syndrome was generated. In this study, a set of Micro CT scannings of the heads of wild-type (normal) mice and Crouzon mice were investigated. Statistical deformation models were built to assess the anatomical differences between the groups, as well as the within-group anatomical variation. Following the approach by Rueckert et al. we built an atlas using B-spline-based nonrigid registration and subsequently, the atlas was nonrigidly registered to the cases being modelled. The parameters of these registrations were then used as input to a PCA. Using different sets of registration parameters, different models were constructed to describe (i) the difference between the two groups in anatomical variation and (ii) the within-group variation. These models confirmed many known traits in the wild-type and Crouzon mouse craniofacial anatomy. Moreover, they showed new traits, not reported before.

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Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling, Computer Science and Engineering
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Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 200306
Publication: Research - peer-review › Article in proceedings – Annual report year: 2007
Estimation of independent non-linear deformation modes for analysis of craniofacial malformations in crouzon mice

Crouzon syndrome is a genetic disease resulting in premature fusion of cranial sutures and synchondroses causing craniosynostosis. A decade ago the Crouzon gene was discovered, and recently the first mouse model of the syndrome was generated. In this study, a set of Micro CT scanings of the heads of wild-type (normal) mice and Crouzon mice were investigated. We present for what we believe is the first time, a statistical deformation model based on independent component analysis (ICA). A set of deformation parameters for each mouse was calculated using a B-spline-based nonrigid registration. From the parameters controlling the deformations for each subject, the statistical model was estimated. ICA is demonstrated to provide localized deformation components, many of which give a clear separation between Crouzon and wild-type mice. This is a clear improvement of a previous principal component-based model, which only provided one global deformation component describing the disease. The ICA components allow interpretation of each deformation feature to be carried out independently of other features, and provides a basis for linking the observed craniofacial malformations to the fusing of sutures. ICA revealed an interesting new finding, not previously reported in the literature, namely asymmetries in the head in Crouzon mice. This phenomenon is probably caused by asymmetric closure of craniofacial sutures.

Individual discriminative face recognition models based on subsets of features

The accuracy of data classification methods depends considerably on the data representation and on the selected features. In this work, the elastic net model selection is used to identify meaningful and important features in face recognition. Modelling the characteristics which distinguish one person from another using only subsets of features will both decrease the computational cost and increase the generalization capacity of the face recognition algorithm.
Moreover, identifying which are the features that better discriminate between persons will also provide a deeper understanding of the face recognition problem. The elastic net model is able to select a subset of features with low computational effort compared to other state-of-the-art feature selection methods. Furthermore, the fact that the number of features usually is larger than the number of images in the data base makes feature selection techniques such as forward selection or lasso regression become inadequate. In the experimental section, the performance of the elastic net model is compared with geometrical and color based algorithms widely used in face recognition such as Procrustes nearest neighbor, Eigenfaces, or Fisher-faces. Results show that the elastic net is capable of selecting a set of discriminative features and thereby obtain higher classification rates.

**General information**

State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Clemmensen, L. K. H. (Intern), Gomez, D. D. (Intern), Ersbøll, B. K. (Intern)
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Publication date: 2007
Event:
Main Research Area: Technical/natural sciences
Electronic versions: imm5147.pdf
Source: orbit
Source-ID: 200544
Publication: Research › peer-review › Conference abstract for conference – Annual report year: 2007

**Palatal Surface Area of Maxillary Plaster Casts: A Comparison Between Two-Dimensional and Three-Dimensional Measurements**

Objective: To investigate the relationship between corresponding two-dimensional and three-dimensional measurements on maxillary plaster casts taken from photographs and three-dimensional surface scans, respectively.

Materials and Methods: Corresponding two-dimensional and three-dimensional measurements of selected linear distances, curve lengths, and (surface) areas were carried out on maxillary plaster casts from individuals with unilateral or bilateral cleft lip and palate. The relationship between two-dimensional and three-dimensional measurements was investigated using linear regression.

Results and Conclusions: Error sources in the measurement of three-dimensional palatal segment surface area from a two-dimensional photograph were identified as photographic distortion (2.7%), interobserver error (3.3%), variability in the orientation of the plaster cast (3.2%), and natural shape variation (4.6%). The total error of determining the cleft area/palate surface area ratio was 15%. In population studies, the effect of using two-dimensional measurements is a decrease of discriminating power. In well-calibrated setups, a two-dimensional measurement of the cleft area/palate surface area ratio may be converted to a three-dimensional measurement by use of a multiplication factor of 0.75.

**General information**

State: Published
Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Darvann, T. A. (Intern), Hermann, N. V. (Ekstern), Ersbøll, B. K. (Intern), Kreiborg, S. (Ekstern), Berkowitz, S. (Ekstern)
Precise acquisition and unsupervised segmentation of multi-spectral images

In this work, an integrated imaging system to obtain accurate and reproducible multi-spectral images and a novel multi-spectral image segmentation algorithm are proposed. The system collects up to 20 different spectral bands within a range that vary from 395 nm to 970 nm. The system is designed to acquire geometrically and chromatically corrected images in
homogeneous and diffuse illumination, so images can be compared over time. The proposed segmentation algorithm combines the information provided by all the spectral bands to segment the different regions of interest. Three experiments are conducted to show the ability of the system to acquire highly precise, reproducible and standardized multi-spectral images and to show its applicabilities in different situations.

**General information**
- **State:** Published
- **Organisations:** Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
- **Authors:** Gomez, D. D. (Intern), Clemmensen, L. K. H. (Intern), Ersbøll, B. K. (Intern), Carstensen, J. M. (Intern)
- **Pages:** 183-193
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  - BFI (2015): BFI-level 2
  - Scopus rating (2015): SJR 1.165 SNIP 2.215 CiteScore 3.33
  - BFI (2014): BFI-level 2
  - Scopus rating (2014): SJR 0.834 SNIP 1.985 CiteScore 2.83
  - BFI (2013): BFI-level 2
  - Scopus rating (2013): SJR 1.102 SNIP 2.631 CiteScore 3.39
  - ISI indexed (2013): ISI indexed yes
  - BFI (2012): BFI-level 2
  - Scopus rating (2012): SJR 0.845 SNIP 2.466 CiteScore 2.91
  - ISI indexed (2012): ISI indexed yes
  - BFI (2011): BFI-level 2
  - Scopus rating (2011): SJR 1.352 SNIP 4.421 CiteScore 4.82
  - ISI indexed (2011): ISI indexed yes
  - BFI (2010): BFI-level 2
  - Scopus rating (2010): SJR 1.412 SNIP 3.775
  - Web of Science (2010): Indexed yes
  - BFI (2009): BFI-level 2
  - Scopus rating (2009): SJR 1.45 SNIP 3.427
  - BFI (2008): BFI-level 1
  - Scopus rating (2008): SJR 1.44 SNIP 2.92
  - Scopus rating (2007): SJR 1.846 SNIP 3.101
  - Web of Science (2007): Indexed yes
  - Scopus rating (2006): SJR 1.497 SNIP 3.104
  - Scopus rating (2005): SJR 1.187 SNIP 2.696
  - Scopus rating (2004): SJR 1.322 SNIP 3.527
  - Scopus rating (2003): SJR 2.492 SNIP 3.161
  - Scopus rating (2002): SJR 1.778 SNIP 2.652
  - Scopus rating (2001): SJR 2.279 SNIP 2.935
  - Scopus rating (2000): SJR 0.758 SNIP 1.776
  - Scopus rating (1999): SJR 0.848 SNIP 1.799
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- **Exploratory data analysis, Pattern recognition, Multi-spectral image analysis, Illumination, Image segmentation, Image acquisition**
- **DOIs:**
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Quantifying Biological Variation

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Organisations: Department of Informatics and Mathematical Modeling, Danish Meat Research Institute
Authors: Erbou, S. G. H. (Intern), Vester-Christensen, M. (Intern), Larsen, R. (Intern), Olsen, E. V. (Ekstern), Ersbøll, B. K. (Intern)
Publication date: 2007

Publication information
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3D statistical shape model, Computed tomography, Biological variation, Image analysis
Source: orbit
Source-ID: 207395
Publication: Research - peer-review › Journal article – Annual report year: 2007

Robust Pose Estimation using the SwissRanger SR-3000 Camera

In this paper a robust method is presented to classify and estimate an objects pose from a real time range image and a low dimensional model. The model is made from a range image training set which is reduced dimensionally by a nonlinear manifold learning method named Local Linear Embedding (LLE). New range images are then projected to this model giving the low dimensional coordinates of the object pose in an efficient manner. The range images are acquired by a state of the art SwissRanger SR-3000 camera making the projection process work in real-time.

General information
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Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Gudmundsson, S. A. (Intern), Larsen, R. (Intern), Ersbøll, B. K. (Intern)
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Publisher: Springer
Editors: Ersbøll, B. K., Pedersen, K. S.
ISBN (Print): 978-3-540-73039-2
Main Research Area: Technical/natural sciences
Conference: 15th Scandinavian Conference on Image Analysis (SCIA), Aalborg, Denmark, 01/01/2007
DOIs:
10.1007/978-3-540-73040-8_98
Source: orbit
Source-ID: 208980
Publication: Research - peer-review › Article in proceedings – Annual report year: 2007

Robust Pseudo-Hierarchical Support Vector Clustering

Support vector clustering (SVC) has proven an efficient algorithm for clustering of noisy and high-dimensional data sets, with applications within many fields of research. An inherent problem, however, has been setting the parameters of the SVC algorithm. Using the recent emergence of a method for calculating the entire regularization path of the support vector domain description, we propose a fast method for robust pseudo-hierarchical support vector clustering (HSVC). The method is demonstrated to work well on generated data, as well as for detecting ischemic segments from multidimensional myocardial perfusion magnetic resonance imaging data, giving robust results while drastically reducing the need for parameter estimation.
Sparse Statistical Deformation Model for the Analysis of Craniofacial Malformations in the Crouzon Mouse

Crouzon syndrome is characterised by the premature fusion of cranial sutures. Recently the first genetic Crouzon mouse model was generated. In this study, Micro CT skull scannings of wild-type mice and Crouzon mice were investigated. Using nonrigid registration, a wild-type mouse atlas was built. The atlas was registered to all mice providing parameters controlling the deformations for each subject. Our previous PCA-based statistical deformation model on these parameters revealed only one discriminating mode of variation. Aiming at distributing the discriminating variation over more modes we built a different model using Independent Component Analysis (ICA). Here, we focus on a third method, sparse PCA (SPCA), which aims at approximating the properties of a standard PCA while introducing sparse modes of variation. This approach is compared to a standard PCA and ICA. The results show that the SPCA outperforms both ICA and PCA with respect to the Fisher discriminant.

Surface-to-surface registration using level sets

This paper presents a general approach for surface-to-surface registration (S2SR) with the Euclidean metric using signed distance maps. In addition, the method is symmetric such that the registration of a shape A to a shape B is identical to the registration of the shape B to the shape A. The S2SR problem can be approximated by the image registration (IR) problem of the signed distance maps (SDMs) of the surfaces confined to some narrow band. By shrinking the narrow bands around the zero level sets the solution to the IR problem converges towards the S2SR problem. It is our hypothesis that this approach is more robust and less prone to fall into local minima than ordinary surface-to-surface registration. The IR problem is solved using the inverse compositional algorithm. In this paper, a set of 40 pelvic bones of Duroc pigs are registered to each other w.r.t. the Euclidean transformation with both the S2SR approach and iterative closest point approach, and the results are compared.

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling, Danish Meat Association
Authors: Hansen, M. F. (Intern), Erbou, S. G. (Intern), Vester-Christensen, M. (Intern), Larsen, R. (Intern), Erbsell, B. K. (Intern), Christensen, L. B. (Ekstern)
Texture Enhanced Appearance Models

Statistical region-based registration methods such as the Active Appearance Model (AAM) are used for establishing dense correspondences in images. At low resolution, images correspondences can be recovered reliably in real-time. However, as resolution increases this becomes infeasible due to excessive storage and computational requirements. We propose to reduce the dimensionality of the textural components by selecting a subset of basis functions from a larger dictionary, estimate regression splines and model only the coefficients of the retained basis functions. We demonstrate the use of two types of bases, namely wavelets and wedgelets. The former extends the previous work of Wolstenholme and Taylor where Haar wavelet coefficients subsets were applied. The latter introduces the wedgelet regression tree based on triangulated domains. The wavelet and wedgelet regression splines are functional descriptions of the intensity information and serve to 1) reduce noise and 2) produce a compact textural description. Dimensionality reduction by subsampling in the CDF 9-7 wavelet and wedgelet representations yield better results than 'standard' subsampling in the pixel domain. We show that the bi-orthogonal CDF 9-7 wavelet yields better results than the Haar wavelet. Further, we show that the inherent frequency separation in wavelets allows for cost-free band-pass filtering, e.g. edge-emphasis, and that this edge enhancement provides better results in terms of segmentation accuracy. Wedgelet representation are superior to wavelet representations at high dimensionality-reduction rates. At low reduction rates an edge enhanced wavelet representation provides better segmentation accuracy than the full standard AAM model.

General information

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Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling, Coding, Department of Photonics Engineering
Authors: Larsen, R. (Intern), Stegmann, M. B. (Intern), Darkner, S. (Intern), Forchhammer, S. (Intern), Cootes, T. F. (Ekstern), Ersbøll, B. K. (Intern)
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BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.165 SNIP 2.215 CiteScore 3.33
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 0.834 SNIP 1.985 CiteScore 2.83
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.102 SNIP 2.631 CiteScore 3.39
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
A Comparison of FFD-based Nonrigid Registration and AAMs Applied to Myocardial Perfusion MRI

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Authors: Ólafsdóttir, H. (Intern), Stegmann, M. B. (Intern), Ersbøll, B. K. (Intern), Larsson, H. B. (Ekstern)
Publication date: 2006

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Title of host publication: International Symposium on Medical Imaging 2006, San Diego, CA
Publisher: The International Society for Optical Engineering (SPIE)
Main Research Area: Technical/natural sciences

Automatic Assessment of Global Craniofacial Differences between Crouzon mice and Wild-type mice in terms of the Cephalic Index

This paper presents the automatic assessment of differences between Wild-Type mice and Crouzon mice based on high-resolution 3D Micro CT data. One factor used for the diagnosis of Crouzon syndrome in humans is the cephalic index, which is the skull width/length ratio. This index has traditionally been computed by time-consuming manual measurements that prevent large-scale populational studies. In this study, an automatic method to estimate cephalic index for this mouse model of Crouzon syndrome is presented. The method is based on constructing a craniofacial atlas of Wild-type mice and then registering each mouse to the atlas using affine transformations. The skull length and width are then measured on the atlas and propagated to all subjects to obtain automatic measurements of the cephalic index. The registration
accuracy was estimated by RMS landmark errors. Even though the accuracy of landmark matching is limited using only affine transformations, the errors were considered acceptable. The automatic estimation of the cephalic index was in full agreement with the gold standard measurements. Discriminant analysis of the three scaling parameters resulted in a good classification of the mouse groups.

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Main Research Area: Technical/natural sciences
Workshop: 9th MICCAI - Workshop on Biophotonics Imaging for Diagnostics and Treatment, Lyngby, Denmark, 06/10/2006

Building a real-time digital face to map from speech to lip movements and facial expression

General information
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Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Lehn-Schiøler, T. (Intern), Stegmann, M. B. (Intern), Buchhave, L. C. (Intern), Ersbøll, B. K. (Intern)
Publication date: 2006

Host publication information
Title of host publication: 6th French-Danish Workshop on Spatial Statistics and Image Analysis in Biology, Skagen, Denmark
Main Research Area: Technical/natural sciences
Conference: 6th French-Danish Workshop on Spatial Statistics and Image Analysis in Biology, Skagen, Denmark, Richard Petersens Plads, Building 321, DK-2800 Kgs. Lyngby, 01/01/2006

Characterization of pre- and postoperative macular holes from retinal OCT

General information
State: Published
Organisations: Department of Physics, Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Thomadsen, J. (Ekstern), Jørgensen, T. M. (Intern), Christensen, U. (Ekstern), Krøyer, K. (Ekstern), Erbsøll, B. K. (Intern), Larsen, R. (Intern)
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Main Research Area: Technical/natural sciences
Workshop: 9th MICCAI - Workshop on Biophotonics Imaging for Diagnostics and Treatment, Lyngby, Denmark, 06/10/2006
Class Generation for Numerical Wind Atlases

A new optimised clustering method is presented for generating wind classes for mesoscale modelling to produce numerical wind atlases. It is compared with the existing method of dividing the data in 12 to 16 sectors, 3 to 7 wind-speed bins and dividing again according to the stability of the atmosphere. Wind atlases are typically produced using many years of on-site wind observations at many locations. Numerical wind atlases are the result of mesoscale model integrations based on synoptic scale wind climates and can be produced in a number of hours of computation. 40 years of twice daily NCEP/NCAR reanalysis geostrophic wind data (approximately 200 km resolution) are represented in typically around 150 classes, each with a frequency of occurrence. The mean wind-speed and direction in each class is used as input data to force the mesoscale model, which downscales the wind to a 5 km resolution while adapting to the local topography. The purpose of forming classes is to minimise the computational time for the mesoscale model while still representing the synoptic climate features. Only tried briefly in the past, clustering has traits that can be used to improve the existing class generation method by optimising the representation of the data and by automating the procedure more. The Karlsruhe Atmospheric Mesoscale Model (KAMM) is combined with the WA$\tilde{a}$P analysis to produce numerical wind atlases for two sites, Ireland and Egypt. The model results are compared with wind atlases made from measurements at specific sites. The sources are The New Irish Wind Resource Atlas and the Wind Atlas for the Gulf of Suez. The new clustering method has the ability to include wind-speed, direction and thermal stability from different heights for the classification. It is shown that the clustering method is able to produce results at least as accurate as the existing method for both sites. A refined, general clustering procedure is devised which could improve the results for both sites, where the existing method requires two different configurations.
Collecting highly reproducible images to support dermatological medical diagnosis

In this article, an integrated imaging system for acquisition of accurate standardized images is proposed. The system also aims at making highly reproducible images over time, so images taken at different times can be compared. The system is made up of an integrating intensity sphere illumination together with a high resolution 3CCD color camera. The well-defined and diffuse illumination of the optically closed scene enhances the true color and avoids effects from specular reflections, shading and shadows. Two experiments are conducted to show the precision of the system and the suitability of the collected images to track dermatological diseases. Results indicate that the developed equipment is an excellent tool for getting high quality digital images. Furthermore, the images collected with the equipment turn out to be a good source to characterize dermatological images.

General information
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Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Gomez, D. D. (Intern), Carstensen, J. M. (Intern), Ersbøll, B. K. (Intern)
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Main Research Area: Technical/natural sciences

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Web of Science (2016): Indexed yes
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Scopus rating (2015): SJR 1.264 SNIP 1.987 CiteScore 3.36
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 0.787 SNIP 2.172 CiteScore 2.8
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.157 SNIP 3.451 CiteScore 3.92
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.014 SNIP 3.519 CiteScore 3.83
ISI indexed (2012): ISI indexed yes
Coupled Shape Model Segmentation in Pig Carcasses

In this paper we are concerned with multi-object segmentation. For each object we will train a level set function based shape prior from a sample set of outlines. The outlines are aligned in a multi-resolution scheme wrt. an Euclidean similarity transformation in order to maximize the overlap of the interior between all pairs of outlines. Then the outlines are converted to level set functions. A shape model is constructed from the mean level set and the first few principal variations. We combine the prior model with an observation model based on the Chan-Vese functional assuming constant intensity levels inside the outline as well as in a narrow band outside the outline. The maximum a posteriori estimate of the outline is found by gradient descent optimization. In order to segment a group of mutually dependent objects we propose 2 procedures, 1) the objects are found sequentially by conditioning the initialization of the next search from already found objects; 2) all objects are found simultaneously and a repelling force is introduced in order to avoid overlap between outlines in the solution. The methods are applied to segmentation of cross sections of muscles in slices of CT scans of pig backs for quality assessment of bacon slices.

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Authors: Hansen, M. F. (Intern), Larsen, R. (Intern), Ersbøll, B. K. (Intern), Christensen, L. B. (Intern)
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Creating surface chemistry maps using multispectral vision technology

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling, Department of Physics
Publication date: 2006

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Title of host publication: 9th MICCAI - Workshop on Biophotonics Imaging for Diagnostics and Treatment
Publisher: IMM-Technical Report-2006-17
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Workshop: 9th MICCAI - Workshop on Biophotonics Imaging for Diagnostics and Treatment, Lyngby, Denmark, 06/10/2006
redundancy imaging, color image analysis, multiray imaging, LED imaging, multispectral imaging
Source: orbit
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Publication: Research - peer-review › Article in proceedings – Annual report year: 2006

Diagnosis of Connective Tissue Disorders based on Independent Component Analysis of Aortic Shape and Motion from 4D MR Images

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Hansen, M. S. (Intern), Zhao, F. (Ekstern), Zhang, H. (Ekstern), Ersbøll, B. K. (Intern), Wahle, A. (Ekstern), Scholz, T. (Ekstern), Sonka, M. (Ekstern)
Publication date: 2006

Host publication information
Title of host publication: The 1st International Workshop on Computer Vision for Intravascular and Intracardiac Imaging. CVII 2006
Publisher: IEEE
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 191534
Publication: Research - peer-review › Article in proceedings – Annual report year: 2006

MICCAI ’06 - Workshop on Biophotonics Imaging for Diagnostics and Treatment, October 6, 2006 proceedings, 9th MICCAI Conference
Preface: Biophotonics can be defined as the study of the interaction of light with biological material. With the recent advances in biomedical science, our understanding of the mechanisms of human health and disease has extended into the regime of cellular and molecular structure and function. The ability to image, analyze, and manipulate living tissue at this level (and to do so in a minimally- or noninvasive manner) has become essential for continued progress in biomedical research and development. Light is unique in that it can be utilized to perform exactly these functions; and as a consequence biophotonics is widely regarded as the basis for the next generation of clinical tools and biomedical research instruments. With bioimaging the impact and amount of information contained in visual data is going to be huge. For this reason, imaging remains one of the most powerful tools in biomedical research. Contents: 1 Hyperspectral image analysis: Some applications in biotechnology and their prospective solutions / Mark Berman et al., CSIRO, Australia 7 Quantifying composition of human tissues from multispectral images using a model of image formation / Ela Claridge et al., School of Computer Science, The University of Birmingham, UK 15 Multispectral recordings and analysis of psoriasis lesions / Line H. Clemmensen and Bjarne Ersbøll, IMM, DTU, Denmark 19 Creating surface chemistry maps using multispectral vision technology / Jens Michael Carstensen et al., Videometer A/S, Denmark 29 Optical imaging of the embryonic heart for a better understanding of congenital heart defects / Talat Mesud Yelbuz, Dept. of Pediatric Cardiology and Intensive Care Medicine, Hannover Medical School, Hannover, Germany 33 Stereo reconstruction of the epicardium for optical fluorescence imaging / Desmund Chung et al., Department of Medical Biophysics, University of Toronto, Canada 41
Multispectral recordings and analysis of psoriasis lesions

An objective method to evaluate the severity of psoriasis lesions is proposed. In order to obtain objectivity multispectral imaging is used. The multi-spectral images give rise to a large p, small n problem which is solved by use of elastic net model selection. The method is promising for further studies of larger data sets including more patients than the four regarded here.

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Clemmensen, L. K. H. (Intern), Erbsøll, B. K. (Intern)
Pages: 15-18
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Registration and shape modeling of porcine bone structures via CT

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Erbou, S. G. (Intern), Larsen, R. (Intern), Erbsøll, B. K. (Intern)
Towards Describing Crouzon syndrome via a Craniofacial Atlas

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Ólafsdóttir, H. (Intern), Darvann, T. A. (Intern), Oubel, E. (Ekstern), Frangi, A. F. (Ekstern), Hermann, N. V. (Ekstern), Ersbøll, B. K. (Intern), Perlyn, C. A. (Ekstern)
Publication date: 2006

A combined alignment and registration scheme of lesions with psoriasis

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Maletti, G. M. (Intern), Ersbøll, B. K. (Intern), Conradsen, K. (Intern)
Pages: 141-159
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Main Research Area: Technical/natural sciences

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BFI (2016): BFI-level 2
Scopus rating (2016): SJR 1.91 SNIP 2.537 CiteScore 5.37
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 2.069 SNIP 2.573 CiteScore 4.46
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.422 SNIP 3.322 CiteScore 5.47
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 2.332 SNIP 3.491 CiteScore 5.46
A face recognition algorithm based on multiple individual discriminative models

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Fagertun, J. (Intern), Gomez, D. D. (Intern), Ersbøll, B. K. (Intern), Larsen, R. (Intern)
Pages: 69-75
Publication date: 2005

Calcium mobilization stimulates Dictyostelium discoideum shear-flow induced cell motility

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Deformable Models for Eye Tracking

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling, Cognitive Systems
Authors: Vester-Christensen, M. (Intern), Leimberg, D. (Ekstern), Ersbøll, B. K. (Intern), Hansen, L. K. (Intern)
Development of an image based system to objectively score the severity of psoriasis

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Gomez, D. D. (Intern), Ersbøll, B. K. (Intern), Carstensen, J. M. (Intern)
Publication date: 2005

Publication information
Original language: English
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Main Research Area: Technical/natural sciences
Links:
http://www2.imm.dtu.dk/pubdb/p.php?4013
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Publication: Research › Ph.D. thesis – Annual report year: 2005

Estimation of Critical Parameters in Concrete Production Using Multispectral Vision Technology

General information
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Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Hansen, M. E. (Intern), Ersbøll, B. K. (Intern), Carstensen, J. M. (Intern), Nielsen, A. A. (Intern)
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Publication date: 2005

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Volume: 3540
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Source-ID: 185692
Publication: Research › peer-review › Article in proceedings – Annual report year: 2005

Heuristics for speeding up gaze estimation

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

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Title of host publication: Proc. Svenska Symposium i Bildanalys, SSBA 2005, Malmø, Sweden
Segmentation for object-based Video of gaze Communication

General information
State: Published
Organisations: Coding, Department of Photonics Engineering, Department of Informatics and Mathematical Modeling
Authors: Aghito, S. M. (Intern), Ersbøll, B. K. (Intern), Forchhammer, S. (Intern), Stegmann, M. B. (Intern)
Publication date: 2005

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Title of host publication: Proc. HCI International 2005
Place of publication: Las Vegas, Nevada, USA
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Segmentation of object-based video of gaze communication

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Department of Photonics Engineering, Image Analysis and Computer Graphics
Authors: Aghito, S. M. (Ekstern), Stegmann, M. B. (Intern), Forchhammer, S. (Intern), Ersbøll, B. K. (Intern)
Publication date: 2005

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Title of host publication: HCI International, 11th International Conference on Human-Computer Interaction, Las Vegas, USA
Main Research Area: Technical/natural sciences
Conference: HCI International, 11th International Conference on Human-Computer Interaction, Las Vegas, USA, 01/01/2005
Source: orbit
Source-ID: 185658
Publication: Research - peer-review Article in proceedings – Annual report year: 2005

Towards emotion modeling based on gaze dynamics in generic interfaces

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

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Main Research Area: Technical/natural sciences
Links:
Generative Interpretation of Medical Images

This thesis describes, proposes and evaluates methods for automated analysis and quantification of medical images. A common theme is the usage of generative methods, which draw inference from unknown images by synthesising new images having shape, pose and appearance similar to the analysed images. The theoretical framework for fulfilling these goals is based on the class of Active Appearance Models, which has been explored and extended in case studies involving cardiac and brain magnetic resonance images (MRI), and chest radiographs. Topics treated include model truncation, model compression using wavelets, handling of non-Gaussian variation by means of cluster analysis, correction of respiratory noise in cardiac MRI, and the extensions to multi-slice two-dimensional time-series and bi-temporal three-dimensional models. The medical applications include automated estimation of: left ventricular ejection fraction from 4D cardiac cine MRI, myocardial perfusion in bolus passage cardiac perfusion MRI, corpus callosum shape and area in mid-sagittal brain MRI, and finally, lung, heart, clavicle location and cardiothoracic ratio in anterior-posterior chest radiographs.

A library of 7TM receptor C-terminal tails - Interactions with the proposed post-endocytic sorting proteins ERM-binding phosphoprotein 50 (EBP50), N-ethylmaleimide-sensitive factor (NSF), sorting nexin 1 (SNX1), and G protein-coupled receptor-associated sorting protein (GASP)

Adaptor and scaffolding proteins determine the cellular targeting, the spatial, and thereby the functional association of G protein-coupled seven-transmembrane receptors with co-receptors, transducers, and downstream effectors and the adaptors determine post-signaling events such as receptor sequestration through interactions, mainly with the C-terminal intracellular tails of the receptors. A library of tails from 59 representative members of the super family of seven-transmembrane receptors was probed as glutathione S-transferase fusion proteins for interactions with four different adaptor proteins previously proposed to be involved in post-endocytotic sorting of receptors. Of the two proteins suggested to target receptors for recycling to the cell membrane, which is the route believed to be taken by a majority of receptors, ERM (ezrin-radixin-moesin)binding phosphoprotein 50 (EBP50) bound only a single receptor tail, i.e. the beta(2)-adrenergic receptor, whereas N-ethylmaleimide-sensitive factor bound 11 of the tail-fusion proteins. Of the two proteins proposed to target receptors for lysosomal degradation, sorting nexin 1 (SNX1) bound 10 and the C-terminal domain of G protein-coupled receptor-associated sorting protein bound 23 of the 59 tail proteins. Surface plasmon resonance analysis of the binding kinetics of selected hits from the glutathione S-transferase pull-down experiments, i.e. the tails of the virally encoded receptor US28 and the delta-opioid receptor, confirmed the expected nanomolar affinities for interaction with SNX1. Truncations of the NK1 receptor revealed that an extended binding epitope is responsible for the interaction with both SNX1 and G protein-coupled receptor-associated sorting protein as well as with N-ethylmaleimide-sensitive factor. It is concluded that the tail library provides useful information on the general importance of certain adaptor proteins, for example, in this case, ruling out EBP50 as being a broad spectrum-recycling adaptor.
Analysis of time-varying psoriasis lesion image patterns
The multivariate alteration detection transform is applied to pairs of within and between time varying registered psoriasis image patterns. Color band contribution to the variates explaining maximal change is analyzed.

General information
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Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Maletti, G. M. (Intern), Ersbøll, B. K. (Intern), Nielsen, A. A. (Intern), Gomez, D. D. (Intern)
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Source: orbit
Source-ID: 154639
Publication: Research - peer-review › Article in proceedings – Annual report year: 2004

An image based system to automatically and objectively score the degree of redness and scaling in psoriatic lesions.
In this work, a combined statistical and image analysis method to automatically evaluate the severity of scaling in psoriasis lesions is proposed. The method separates the different regions of the disease in the image and scores the degree of scaling based on the properties of these areas. The proposed method provides a solution to one of the present problems in dermatology: the lack of suitable methods to assess the lesion and to evaluate the changes during the treatment. An experiment over a collection of psoriasis images is conducted to test the performance of the method. Results show that the obtained scores are highly correlated with scores made by doctors. This and the fact that the obtained measures are continuous indicate the proposed method is a suitable tool to evaluate the lesion and to track the evolution of dermatological diseases.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Gomez, D. D. (Intern), Ersbøll, B. K. (Intern), Carstensen, J. M. (Intern)
Publication date: 2004

Host publication information
Title of host publication: Proceedings of the 13. Danish conference in pattern recognition and image analysis
Main Research Area: Technical/natural sciences
Electronic versions:
imm3583.pdf
Links:
Source: orbit
Source-ID: 154618
Automatic scoring of the severity of psoriasis scaling

In this work, a combined statistical and image analysis method to automatically evaluate the severity of scaling in psoriasis lesions is proposed. The method separates the different regions of the disease in the image and scores the degree of scaling based on the properties of these areas. The proposed method provides a solution to the lack of suitable methods to assess the lesion and to evaluate changes during the treatment. An experiment over a collection of psoriasis images is conducted to test the performance of the method. Results show that the obtained scores are highly correlated with scores made by doctors. This and the fact that the obtained measures are continuous indicate the proposed method is a suitable tool to evaluate the lesion and to track the evolution of dermatological diseases.

Multi-set multi-temporal canonical analysis of psoriasis images

Nowadays, the medical tracking of dermatological diseases is imprecise, mainly due to the lack of suitable objective methods to evaluate the lesion. The severity of the disease is currently scored by doctors merely by means of visual examination. In this work, multi-set canonical correlation analysis over registered images is proposed to track the evolution of the disease automatically. This method transforms the original images into sets of variables that exhibit decreasing degree of similarity, based on correlation measures. Due to this property, these new variables are more suitable to detect where changes occur. An experiment with 5 different time series collected from psoriasis patients during 4 different sessions is conducted. The analysis of the obtained results points out some patterns that can be used both to interpret and summarize the evolution of the lesion and to achieve a better image registration.
Precise Multi-Spectral Dermatological Imaging

In this work, an integrated imaging system to obtain accurate and reproducible multi-spectral dermatological images is proposed. The system is made up of an integrating sphere, light emitting diodes and a generic monochromatic camera. The system can collect up to 10 different spectral bands. These spectral bands vary from ultraviolet to near infrared. The well-defined and diffuse illumination of the optically closed scene aims to avoid shadows and specular reflections. Furthermore, the system has been developed to guarantee the reproducibility of the collected images. This allows for comparative studies of time series of images. Two experiments are conducted to show the ability of the system to acquire highly precise and standardized multi-spectral images. The first experiment aims to show the capacity of the system to collect reproducible images. The second experiment demonstrates that the multi-spectral images provide more information than the classical tri-chromatic images and that this information is enough to segment lesions easily. These two facts together indicate the suitability of the system to collect images and to summarize and track the evolution of dermatological diseases.

S.H.A.R.P: A smart Hierarchical Algorithm to Register Psoriasis

In this work, an automatic algorithm for registering psoriasis images is proposed. The algorithm, made up of two stages, takes advantages of the behavior of the disease. In the first stage, the diseased area is segmented in the image. The second stage uses this information to align the image based on the two first statistical moments of the area. The algorithm is compared with other existing methods. One of these methods was developed specifically to register psoriasis images. Results show the suitability of the proposed algorithm from the point of view of accuracy, parameter dependency and speed.
Structure in Biocrystallograms: A Computer Vision Pilot Study
This paper reports our work on various aspects image processing and statistical analysis based on local texture and crystal object structure of biocrystallogram images. We built a modular test engine that executes objects of image data and analysis schemes, proposed a series of image processing and statistical analysis methods and have implemented a Gabor filter bank, a principal component analysis function capable of operating on high-dimensional data sets, and have our results summarized in a set of tests using multivariate statistics (MANOVA testing for grouping- or factor- effect by use of Wilk’s , and group similarity measures based on Mahalanobis’ distances between group centres). Finally we discuss issues of marginal interest to the central scope of the present study such as image registration errors in order to explain result deviations encountered, and the types of analysis tasks performed the requiring Laboratory's in order to devise appropriate statistical tests for the operational statistical analysis not implemented at present in the Laboratory's organization. In this project, structure has been approached as localization, orientation and size. In this study, the mentioned approach to structure took preference over the approach as de ned by a tree-shaped object located in the image by segmentation allocated a set of values for each "limb" and deploying graph theory to analyze the objects. Although the ultimate results of this pilot leave room for improvement, both of the image processing (filtering, segmentation, etc.) and classification, we do show that the methodologies presented have a promising potential for implementation in a future operational information management system run at the Laboratory.

Wedgelet Enhanced Appearance Models
Statistical region-based segmentation methods such as the Active Appearance Model (AAM) are used for establishing dense correspondences in images based on learning the variation in shape and pixel intensities in a training set. For low resolution 2D images correspondences can be recovered reliably in real-time. However, as resolution increases this becomes infeasible due to excessive storage and computational requirements. In this paper we propose to reduce the textural components by modelling the coefficients of a wedgelet based regression tree instead of the original pixel intensities. The wedgelet regression trees employed are based on triangular domains and estimated using cross validation. The wedgelet regression trees are functional descriptions of the intensity information and serve to 1) reduce noise and 2) produce a compact textural description. The wedgelet enhanced appearance model is applied to a case study of human faces. Compression rates of the texture information of 1:40 is obtained without sacrificing segmentation accuracy noticeably, even at compression rates of 1:150 fair segmentation is achieved.
Wrist stability after experimental traumatic triangular fibrocartilage complex lesions

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Munk, B. (Ekstern), Jensen, S. L. (Ekstern), Olsen, B. S. (Ekstern), Kroener, K. (Ekstern), Ersbøll, B. K. (Intern)
Pages: 43-49
Publication date: 2004

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Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 1.026 SNIP 1.202 CiteScore 1.38
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.277 SNIP 1.412 CiteScore 1.49
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.265 SNIP 1.411 CiteScore 1.53
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.277 SNIP 1.438 CiteScore 1.56
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.125 SNIP 1.557 CiteScore 1.63
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.137 SNIP 1.395 CiteScore 1.48
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.161 SNIP 1.425
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.18 SNIP 1.361
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.131 SNIP 1.497
Scopus rating (2007): SJR 0.956 SNIP 1.237
Scopus rating (2006): SJR 1.125 SNIP 1.762
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A combined alignment and registration scheme of psoriasis lesion images

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Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Maletti, G. M. (Intern), Ersbøll, B. K. (Intern)
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Publication: Research - peer-review › Report – Annual report year: 2003

A hierarchical classification scheme of psoriasis images

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Maletti, G. M. (Intern), Ersbøll, B. K. (Intern)
Publication date: 2003

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Electronic versions:
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Source-ID: 58704
Publication: Research - peer-review › Report – Annual report year: 2003

Antibacterial drug use for treatment of mastitis in Danish dairy cows

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Ersbøll, B. K. (Intern), Bruun, J. (Ekstern), Madsen, J. F. (Ekstern), Ersbøll, A. K. (Intern)
Number of pages: 3
Publication date: 2003
Building an Image-Based System to automatically Score psoriasis

Nowadays the medical tracking of dermatological diseases is imprecise. The main reason is the lack of suitable objective methods to evaluate the lesion. The severity of the disease is scored by doctors just through their visual examination. In this work, a system to take accurate images of dermatological lesions has been developed. Mathematical methods can be applied to these images to obtain values that summarize the lesion and help to track its evolution. The system is composed of two elements. A precise image acquisition equipment and a statistical procedure to extract the lesions from the images. The system is tested on patients with the dermatological disease psoriasis. Temporal series of images are taken for each patient and the lesions are automatically extracted. Results indicate that to the images obtained are a good source for obtaining derived variables to track the lesion.

Change detection in registered psoriasis lesion image patterns

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Maletti, G. M. (Intern), Ersbøll, B. K. (Intern)
Number of pages: 22
Publication date: 2003
Diagnostic decision rule for support in clinical assessment of the need for surgical intervention in horses with acute abdominal pain

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Thøefner, M. B. (Ekstern), Ersbøll, B. K. (Intern), Jansson, N. (Ekstern), Hesselholt, M. (Ekstern)
Pages: 20-29
Publication date: 2003
Main Research Area: Technical/natural sciences

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Ratings:
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BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.384 SNIP 0.439 CiteScore 0.84
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.485 SNIP 0.55 CiteScore 0.88
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.51 SNIP 0.622 CiteScore 1.11
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.53 SNIP 0.734 CiteScore 1.14
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.524 SNIP 0.833 CiteScore 1.24
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.645 SNIP 0.85 CiteScore 1.33
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.744 SNIP 0.776
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.704 SNIP 0.857
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.564 SNIP 0.778
Scopus rating (2007): SJR 0.507 SNIP 0.613
Scopus rating (2006): SJR 0.538 SNIP 0.744
Scopus rating (2005): SJR 0.749 SNIP 0.854
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.762 SNIP 1.099
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.654 SNIP 0.952
Web of Science (2003): Indexed yes
Epidemiological Studies Based on Small Sample Sizes – A Statistician's Point of View

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Ersbøll, A. K. (Intern), Ersbøll, B. K. (Intern)
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Volume: 44
Issue number: 1
ISSN (Print): 0065-1699
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Web of Science (2017): Indexed Yes
Web of Science (2012): Indexed yes
Web of Science (2011): Indexed yes
Web of Science (2010): Indexed yes
Web of Science (2006): Indexed yes
Web of Science (2005): Indexed yes
Web of Science (2004): Indexed yes
Web of Science (2003): Indexed yes
Web of Science (2002): Indexed yes
Web of Science (2001): Indexed yes
Web of Science (2000): Indexed yes
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DOIs:
10.1186/1751-0147-44-S1-S127
Source: orbit
Source-ID: 58435
Publication: Research - peer-review › Journal article – Annual report year: 2003

FAME - A Flexible Appearance Modelling Environment
Combined modelling of pixel intensities and shape has proven to be a very robust and widely applicable approach to interpret images. As such the Active Appearance Model (AAM) framework has been applied to a wide variety of problems within medical image analysis. This paper summarises AAM applications within medicine and describes a public domain implementation, namely the Flexible Appearance Modelling Environment (FAME). We give guidelines for the use of this research platform, and show that the optimisation techniques used renders it applicable to interactive medical applications. To increase performance and make models generalise better, we apply parallel analysis to obtain automatic and objective model truncation. Further, two different AAM training methods are compared along with a reference case study carried out on cross-sectional short-axis cardiac magnetic resonance images and face images. Source code and annotated data sets needed to reproduce the results are put in the public domain for further investigation.
Illumination correction from psoriasis image data

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Maletti, G. M. (Intern), Ersbøll, B. K. (Intern)
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Title of host publication: 13th Scandinavian Conference on Image Analysis, Gothenburg, Sweden : Lecture Notes in Computer Sciences
Main Research Area: Technical/natural sciences
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Illumination correction in psoriasis lesions images

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Maletti, G. M. (Intern), Ersbøll, B. K. (Intern)
Publication date: 2003

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Electronic versions:
imm2389.pdf
Links:
Source: orbit
Source-ID: 58705
Publication: Research - peer-review › Report – Annual report year: 2003

Principal component analysis of psoriasis lesions images
A set of RGB images of psoriasis lesions is used. By visual examination of these images, there seem to be no common pattern that could be used to find and align the lesions within and between sessions. It is expected that the principal components of the original images could be useful during future lesion segmentation and alignment purposes.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Maletti, G. M. (Intern), Ersbøll, B. K. (Intern)
Texture alteration detection in bitemporal images of lesions with psoriasis

The objective of this work is to explore the feasibility of quantifying textural change between pairs of segmented patterns without registering them. The Multi-variate Alteration Detection (M.A.D.) Transform is applied to a texture model constructed with the data of segmented psoriasis lesions images. The texture model is Haralick’s co-occurrence matrix, which is computed and normalized for each single band with the equalized data of a given lesion. The contribution of each single color band to the textural change is analyzed.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Maletti, G. M. (Intern), Ersbøll, B. K. (Intern)
Uncovering multivariate structure between milk productions variables and udder health variables using canonical correlations

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Ersbøll, B. K. (Intern), Bruun, J. (Ekstern)
Number of pages: 3
Publication date: 2003

Host publication information
Title of host publication: The International Society for Veterinary Epidemiology and Economics, Viña del Mar, Chile, 17.-21. November
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 58514
Publication: Research - peer-review › Article in proceedings – Annual report year: 2003

Exploratory Analysis of Multivariate Data (Unsupervised Image Segmentation and Data Driven Linear and Nonlinear Decomposition)
This work describes different methods that are useful in the analysis of multivariate single and multiset data. The thesis covers selected aspects of relevant data analysis techniques in this context. Methods dedicated to handling data of a spatial nature are of primary interest with focus on data driven exploratory methods for i) clustering, and for both ii) linear and iii) nonlinear decompositioning. New extensions are presented in all three fields.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, DTU Data Analysis, Image Analysis and Computer Graphics
Authors: Hilger, K. B. (Intern), Ersbøll, B. K. (Intern), Nielsen, A. A. (Intern)
Publication date: Mar 2002

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Electronic versions: imm123.pdf
Source: orbit
Source-ID: 57998
Publication: Research › Ph.D. thesis – Annual report year: 2002

A Contextual Classifier That Only Requires One Prototype Pixel for Each Class
A three-stage scheme for the classification of multispectral images is proposed. In each stage, the statistics of each class present in the image are estimated. The user is required to provide only one prototype pixel for each class to be seeded into a homogeneous region. The algorithm starts by generating optimum initial training sets, one for each class, maximizing the redundancy in the data sets. These sets are the realizations of the maximal discs centered on the prototype pixels for which it is true that all the elements belong to the same class as the center one. Afterwards, a region-growing algorithm increases the sample size, providing more statistically valid samples of the classes. Final classification of each pixel is done by comparison of the statistical behavior of the neighborhood of each pixel with the statistical behavior of the classes. A critical sample size obtained from a model constructed with experimental data is used in this
stage. The algorithm was tested with the Kappa coefficient κ on synthetic images and compared with K-means (κ≈0.41) and a similar scheme that uses spectral means (κ≈0.75) instead of histograms (κ≈0.90). The results are shown on a dermatological image with a malignant melanoma.

**General information**

State: Published
Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Maletti, G. M. (Intern), Ersbøll, B. K. (Intern), Conradsen, K. (Intern)
Pages: 700-706
Publication date: 2002
Main Research Area: Technical/natural sciences

**Publication information**

Journal: IEEE Transactions on Nuclear Science
Volume: 49
Issue number: 3
ISSN (Print): 0018-9499
Ratings:
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.567 SNIP 1.048 CiteScore 1.43
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.663 SNIP 1.367 CiteScore 1.48
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.596 SNIP 1.367 CiteScore 1.48
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.866 SNIP 1.489 CiteScore 1.67
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.764 SNIP 1.299 CiteScore 1.67
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.619 SNIP 1.458 CiteScore 1.72
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.006 SNIP 1.549
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.762 SNIP 1.534
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.776 SNIP 1.441
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.728 SNIP 1.893
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.539 SNIP 1.251
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.692 SNIP 1.482
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.621 SNIP 2.169
Scopus rating (2003): SJR 0.395 SNIP 1.76
Scopus rating (2002): SJR 0.667 SNIP 1.227
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.479 SNIP 0.969
Scopus rating (2000): SJR 0.57 SNIP 1.086
Scopus rating (1999): SJR 0.536 SNIP 0.91
Building and Testing a Statistical Shape Model of the Human Ear Canal

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling, Oticon A/S
Authors: Paulsen, R. R. (Intern), Larsen, R. (Intern), Laugesen, S. (Intern), Nielsen, C. (Ekstern), Ersbøll, B. K. (Intern)
Publication date: 2002

Host publication information
Title of host publication: Medical Image Computing and Computer-Assisted Intervention - MICCAI 2002, 5th Int. Conference, Tokyo, Japan
Publisher: Springer
Main Research Area: Technical/natural sciences
Electronic versions:
imm860.pdf
Links:
Source: orbit
Source-ID: 58217
Publication: Research - peer-review › Article in proceedings – Annual report year: 2002

Deteccion de polipos en colonografias virtuales

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Navarro, E. B. (Ekstern), Larsen, R. (Intern), Ersbøll, B. K. (Intern), Arnesen, R. (Ekstern)
Publication date: 2002

Host publication information
Title of host publication: CASEIB'02 – XX Congreso Anual de la Sociedad Espanola de la Ingenieria Biomedica, 27-29 November
Publisher: Instituto de investigacion en Ingenieria de Aragon
Main Research Area: Technical/natural sciences
Electronic versions:
imm1242.pdf
Links:
Source: orbit
Source-ID: 58245
Publication: Research › Article in proceedings – Annual report year: 2002

Estimacion de la direccion a la corteza cerebral a partir de imagines de resonancias magneticas

General information
Iterative extended mean shift algorithm

L1 Generalized Procrustes 2D Shape Alignment

L1 Generalized Procrustes 2D Shape Alignment

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Sebastian, J. M. (Ekstern), Larsen, R. (Intern), Ersbøll, B. K. (Intern), Pakkenberg, B. (Ekstern), Gundersen, H. J. G. (Ekstern), Frangi, A. (Ekstern)
Publication date: 2002

Host publication information
Title of host publication: CASEIB'02 - XX Congreso Anual de la Sociedad Espanola de Ingenieria Biomedica, 27-29 November, Zaragoza
Publisher: Instituto de Investigacion en ingenieria de Aragon
Main Research Area: Technical/natural sciences
Electronic versions:
imm1241.pdf
Links:
Source: orbit
Source-ID: 58252
Publication: Research › Article in proceedings – Annual report year: 2002

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Maletti, G. M. (Intern), Ersbøll, B. K. (Intern), Conradsen, K. (Intern)
Pages: 793-796
Publication date: 2002

Host publication information
Title of host publication: 4th International Conference on Computer Vision, Pattern Recognition & Image Processing - CVPRIP
Main Research Area: Technical/natural sciences
Links:
Source: orbit
Source-ID: 58190
Publication: Research - peer-review › Article in proceedings – Annual report year: 2002

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Larsen, R. (Intern), Eiriksson, H. (Ekstern), Ersbøll, B. K. (ed.) (Intern)
Publication date: 2002

Host publication information
Title of host publication: Eleventh International Workshop on Matrices and Statistics, Lyngby, Denmark:August 29–31
Publisher: Informatics and Mathematical Modelling, Technical University of Denmark, DTU
Main Research Area: Technical/natural sciences
Links:
Mean shift detection using active learning in dermatological images

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Maletti, G. M. (Intern), Ersbøll, B. K. (Intern), Conradsen, K. (Intern)
Pages: 1790-1797
Publication date: 2002

Host publication information
Title of host publication: Proc. SPIE, vol. 4684, Medical Imaging
Main Research Area: Technical/natural sciences
Links:

Statistical Analysis of Pseudomonas aeruginosa Biofilm Development: Impact of Mutations in Genes Involved in Twitching Motility, Cell-to-Cell Signaling, and Stationary-Phase Sigma Factor Expression

Four strains of Pseudomonas aeruginosa (wild type, DeltapiHIJK mutant, lasI mutant, and rpoS mutant) were genetically tagged with the green fluorescent protein, and the development of flow chamber-grown biofilms by each of them was investigated by confocal laser scanning microscopy. The structural developments of the biofilms were quantified by the computer program COMSTAT (A. Heydorn, A. T. Nielsen, M. Hentzer, C. Sternberg, M. Givskov, B. K. Ersboll, and S. Molin, Microbiology 146:2395-2407, 2000). Two structural key variables, average thickness and roughness, formed the basis for an analysis of variance model comprising the four P. aeruginosa strains, five time points (55, 98, 146, 242, and 314 h), and three independent rounds of biofilm experiments. The results showed that the wild type, the DeltapiHIJK mutant, and the rpoS mutant display conspicuously different types of temporal biofilm development, whereas the lasI mutant was indistinguishable from the wild type at all time points. The wild type and the lasI mutant formed uniform, densely packed biofilms. The rpoS mutant formed densely packed biofilms that were significantly thicker than those of the wild type, whereas the DeltapiHIJK mutant formed distinct microcolonies that were regularly spaced and almost uniform in size. The results are discussed in relation to the current model of P. aeruginosa biofilm development.

General information
State: Published
Organisations: Department of Systems Biology, Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Pages: 2008-2017
Publication date: 2002
Main Research Area: Technical/natural sciences

Publication information
Journal: Applied and environmental microbiology
Volume: 68
Issue number: 4
ISSN (Print): 0099-2240
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4.08
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.891 SNIP 1.308 CiteScore 4.14
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Testing for Gender Related Size and Shape Differences of the Human Ear canal using Statistical methods

This work deals with the analysis of the shape of the human ear canal. It is described how a dense surface point distribution model of the human ear canal is built based on a training set of laser scanned ear impressions and a sparse set of anatomical landmarks placed by an expert. The dense surface models are built by using the anatomical landmarks to warp a template mesh onto all shapes in the training set. Testing the gender related differences is done by initially reducing the dimensionality using principal component analysis of the vertices of the warped meshes. The number of components to retain is chosen using Horn's parallel analysis. Finally a multivariate analysis of variance is performed on
A contextual classifier that only requires one prototype pixel for each class

A three-stage scheme for classification of multi-spectral images is proposed. In each stage, statistics of each class present in the image are estimated. The user is required to provide only one prototype pixel for each class to be seeded into a homogeneous region. The algorithm starts by generating optimum initial training sets, one for each class, maximizing the redundancy in the data sets. These sets are the realizations of the maximal discs centered on the prototype pixels for which it is true that all the elements belong to the same class as the center one. Afterwards, a region growing algorithm increases the sample size providing more statistically valid samples of the classes. Final classification of each pixel is done by comparison of the statistical behavior of the neighborhood of each pixel with the statistical behavior of the classes. A critical sample size obtained from a model constructed with experimental data is used in this stage. The algorithm was tested with the Kappa coefficient $k$ on synthetical images and compared with K-means ($k\approx0.41$) and a similar scheme that uses spectral means ($k\approx0.75$) instead of histograms ($k\approx0.90$). Results are shown on a dermatological image with a malignant melanoma.

A filter for local estimation of cluster centers

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Host publication information
Title of host publication: 2nd International Workshop on Computer Assisted Fundus Image Analysis (CAFIA)
Main Research Area: Technical/natural sciences
Conference: 2nd International Workshop on Computer Assisted Fundus Image Analysis (CAFIA), Copenhagen, Denmark, 01/01/2001
Links:
Source: orbit
Source-ID: 57912
Publication: Research - peer-review › Article in proceedings – Annual report year: 2001

Analysis of directional data for Rockwool A/S

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Ersbøll, B. K. (Intern), Conradsen, K. (Intern)
Publication date: 2001

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Links:
Source: orbit
Source-ID: 58015
Publication: Research › Report – Annual report year: 2001

An initial training set generation scheme

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Maletti, G. M. (Intern), Ersbøll, B. K. (Intern), Conradsen, K. (Intern), Lira, J. (Ekstern)
Publication date: 2001

Host publication information
Title of host publication: Proceedings of the 12th Scandinavian Conference on Image Analysis (SCIA),Proceedings. Bergen June 11-14
Main Research Area: Technical/natural sciences
Links:
Source: orbit
Source-ID: 57856
Publication: Research - peer-review › Article in proceedings – Annual report year: 2001

Biopersistence of synthetic mineral fibers as a predictor of chronic inhalation toxicity in rats

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Bernstein, D. M. (Ekstern), Sintes, J. M. R. (Ekstern), Ersbøll, B. K. (Intern), Kunert, J. (Ekstern)
Pages: 823-849
Publication date: 2001
Main Research Area: Technical/natural sciences

Publication information
Journal: Inhalation Toxicology
Volume: 13
Issue number: 10
ISSN (Print): 0895-8378
Ratings:
Biopersistence of synthetic mineral fibers as a predictor of chronic intraperitoneal injection tumor response in rats

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Bernstein, D. M. (Ekstern), Sintess, J. M. R. (Ekstern), Ersbøll, B. K. (Intern), Kunert, J. (Ekstern)
Pages: 851-876
Publication date: 2001
Main Research Area: Technical/natural sciences

Publication information
Journal: Inhalation Toxicology
Volume: 13
Issue number: 10
ISSN (Print): 0895-8378
Ratings:
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
Extending and applying active appearance models for automated, high precision segmentation in different image modalities

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Stegmann, M. B. (Intern), Fisker, R. (Intern), Ersbøll, B. K. (Intern), Austvoll, I. (ed.) (Ekstern)
Pages: 90-97
Publication date: 2001

Host publication information
Title of host publication: Proc. 12th Scandinavian Conference on Image Analysis - SCIA 2001, Bergen, Norway
Publisher: NOBIM
Main Research Area: Technical/natural sciences
Electronic versions: imm118.pdf
Source: orbit
Source-ID: 57752
Publication: Research - peer-review › Journal article – Annual report year: 2001
Protein spot correspondence in two-dimensional electrophoresis gels

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Pedersen, L. (Intern), Ersbøll, B. K. (Intern)
Pages: 118-125
Publication date: 2001

Host publication information
Title of host publication: Scandinavian Conference on Image Analysis
Main Research Area: Technical/natural sciences
Links:
Source: orbit
Source-ID: 57870
Publication: Research - peer-review › Article in proceedings – Annual report year: 2001

Special issue selected papers from Statistical Methods for Image Processing

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Åström, K. (Ekstern), Ersbøll, B. K. (Intern)
Publication date: 2001
Main Research Area: Technical/natural sciences

Publication information
Journal: Pattern Recognition Letters
Volume: 22
Issue number: 11
ISSN (Print): 0167-8655
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 0.82 SNIP 1.669 CiteScore 2.9
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 0.976 SNIP 2.105 CiteScore 2.87
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 0.797 SNIP 2.211 CiteScore 2.72
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 0.838 SNIP 2.616 CiteScore 2.86
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 0.719 SNIP 2.4 CiteScore 2.57
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 0.738 SNIP 2.009 CiteScore 2.56
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 0.832 SNIP 1.998
Web of Science (2010): Indexed yes
Special issue selected papers, pattern recognition letters

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Åström, K. (Ekstern), Ersbøll, B. K. (Intern)
Publication date: 2001

Host publication information
Title of host publication: Statistical Methods for Image Processing
Main Research Area: Technical/natural sciences
Links:
Source: orbit
Source-ID: 57893
Publication: Research - peer-review › Article in proceedings – Annual report year: 2001

Experimental reproducibility in flow-chamber biofilms

General information
State: Published
Organisations: Department of Systems Biology, Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Pages: 2409-2415
Publication date: 2000
Main Research Area: Technical/natural sciences

Publication information
Journal: Microbiology-Uk
Volume: 146
Issue number: 10
ISSN (Print): 0026-2617
Ratings:
BFI (2017): BFI-level 1
Kvalitetssikring af astmapatienters lægemiddelbehandling

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Søndergaard, B. (Ekstern), Thorleifsson, S. (Ekstern), Herborg, H. (Ekstern), Frøkjær, B. (Ekstern), Hepler, C. D. (Ekstern), Ersbøll, B. K. (Intern)
Publication date: 2000
Main Research Area: Technical/natural sciences

Publication information
Journal: Ugeskrift for Læger
ISSN (Print): 0041-5782
Ratings:
BFI (2017): BFI-level 1
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.11 SNIP 0.041 CiteScore 0.02
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.124 SNIP 0.077 CiteScore 0.03
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.129 SNIP 0.116 CiteScore 0.05
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.14 SNIP 0.122 CiteScore 0.06
ISI indexed (2013): ISI indexed no
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.146 SNIP 0.15 CiteScore 0.08
ISI indexed (2012): ISI indexed no
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.143 SNIP 0.157 CiteScore 0.1
Long-wave UVA offers partial protection against UVB-induced

Ultraviolet-B (UVB, 280–320 nm) interferes with the generation of cell-mediated immunity to contact allergens applied epicutaneously on the irradiated site. To investigate whether pretreatment with UVA-1 (340–400 nm) protects against the UVB-induced immune suppression we sensitized human volunteers with diphenylcyclopropenone (DPCP) on normal buttock skin (n=12), on UVB-irradiated buttock skin (n=21), on buttock skin pretreated with UVA-1 (n=12), and on buttock skin pretreated with UVA-1 and thereafter irradiated with UVB (n=22). Sensitization on UVB-irradiated skin reduced the immunization rate to DPCP compared with sensitization on non-irradiated skin (p

Quantification of biofilm structures by the novel computer program COMSTAT

General information
State: Published
Organisations: Department of Microbiology, Department of Systems Biology, Center for Biomedical Microbiology, Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Quantitative measurement of changes in retinal vessel diameter in ocular fundus images

The change in diameter of retinal vessels as a function of increasing distance to the optic disc is believed to be indicative of the risk level of various vascular diseases such as generalised arteriosclerosis and Diabetes Mellitus. In particular, focal arteriolar narrowing (FAN) is considered related to arteriosclerosis. The aim of this work is to develop methods to provide quantitative information about the FAN status of retinal arteriolar vessel segments. We propose a method to measure the vessel diameter and changes herein along the vessel. The width or diameter measurement is based on intensity profiles orthogonal to a smoothed trace in the vessel found by Dijkstra’s shortest path algorithm. The vessel diameter is calculated from the intensity profiles using two different methods to estimate profile widths. We propose a “normalised accumulated gradient” (NAG) and the coefficient of variance (CV) to estimate the FAN in a vessel segment. The NAG is designed to detect increases in the vessel diameter as the distance to the papilla increases. The performance of the methods developed is compared to the evaluation by a skilled ophthalmologist. The methods are seen to perform well. (C) 2000 Elsevier Science B.V. All rights reserved.
Image analysis, Vessel diameter measurement, Fundus images, Focal arteriolar narrowing

DOIs:
10.1016/S0167-8655(00)00084-2

Source: orbit
Source-ID: 176428
Publication: Research - peer-review › Conference article – Annual report year: 2000
Surface-bounded growth modeling applied to human mandibles

From a set of longitudinal three-dimensional scans of the same anatomical structure, the authors have accurately modeled the temporal shape and size changes using a linear shape model. On a total of 31 computed tomography scans of the mandible from six patients, 14,851 semilandmarks are found automatically using shape features and a new algorithm called geometry-constrained diffusion. The semilandmarks are mapped into Procrustes space. Principal component analysis extracts a one-dimensional subspace, which is used to construct a linear growth model. The worst case mean modeling error in a cross validation study is 3.7 mm.

Publication Information

Journal: IEEE Transactions on Medical Imaging
Volume: 19
Issue number: 11
ISSN (Print): 0278-0062
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 1.522 SNIP 2.369 CiteScore 4.83
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.765 SNIP 2.68 CiteScore 4.9
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.407 SNIP 2.756 CiteScore 4.66
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.916 SNIP 3.2 CiteScore 5.55
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.545 SNIP 2.794 CiteScore 4.94
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.332 SNIP 2.583 CiteScore 4.59
Estimation of Dense Image Flow Fields in Fluids

The estimation of flow fields from time sequences of satellite imagery has a number of important applications. For visualisation of cloud or sea ice movements in sequences of crude temporal sampling a satisfactory non-blurred temporal interpolation can be performed only when the flow field or an estimate thereof is known. Estimated flow fields in weather satellite imagery might also be used on an operational basis as inputs to short-term weather prediction. In this article we describe a method for the estimation of dense flow fields. Local measurements of motion are obtained by analysis of the local energy distribution, which is sampled using a set of 3-D spatio-temporal filters. The estimated local energy distribution also allows us to compute a confidence measure of the estimated local normal flow. The algorithm furthermore utilises Markovian random fields in order to integrate the local estimates of normal flows into a dense flow field using measures of spatial smoothness. To obtain smoothness we will constrain first order derivatives of the flow field. The performance of the algorithm is illustrated by the estimation of the flow fields corresponding to a sequence of Meteosat thermal images. The estimated flow fields are used in a temporal interpolation scheme.
Feasibility study for the "Viswood" project

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, RISØ
Authors: Ersbøll, B. K. (Intern), Jørgensen, T. M. (Ekstern)
Number of pages: 30
Publication date: 1998

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Fusion of SPOT XS and ortoPhoto Data using a Markov Random Field Model

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Conradsen, K. (Intern), Ersbøll, B. K. (Intern), Larsen, R. (Intern), Nielsen, A. A. (Intern), Nielsen, T. H. (Ekstern)
Pages: 25-30
Publication date: 1998

Host publication information
Title of host publication: Fusion of Earth Data: Merging of Point Measurements, Raster Maps and Remotely Sensed Images
Main Research Area: Technical/natural sciences
Conference: Fusion of Earth Data: Merging of Point Measurements, Raster Maps and Remotely Sensed Images, 01/01/1998
Source: orbit
Source-ID: 200444
Publication date: 1998

Application of Image Processing: Techniques and Geostatistical Methods to the Aerial Gamma-Ray Spectrometric and Aeromagnetic Survey Data of Wadi Al Miah - Wadi Ash Shalul, Central Eastern Desert, Egypt as an Aid to Geological Mapping and Mineral Exploration

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Nuclear Materials Authority
Authors: Ersbøll, B. K. (Intern), Mahmoud, S. M. (Ekstern), Nielsen, A. A. (Intern)
Number of pages: 49
Publication date: 1997

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 168678
Publication date: 1997


General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Ersbøll, B. K. (Intern)
Pages: 2759-2760
Publication date: 1997
Main Research Area: Technical/natural sciences

Publication information
Journal: Statistics in Medicine
Volume: 16
ISSN (Print): 0277-6715
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 1.94 SJR 2.022 SNIP 1.419
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 2.006 SNIP 1.184 CiteScore 1.64
BFI (2014): BFI-level 2
On Fusion of High (Spatial) Resolution Greyscale Imagery with Low (Spatial) Resolution Color Imagery

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Ersbøll, B. K. (Intern), Nielsen, T. (Ekstern), Conradsen, K. (Intern)
Publication date: 1997

Host publication information
Title of host publication: Proceedings of the Third International Airborne Remote Sensing Conference and Exhibition
Main Research Area: Technical/natural sciences
Conference: Third International Airborne Remote Sensing Conf. and Exhibition, Copenhagen, 01/01/1997
Source: orbit
Source-ID: 168673
Publication: Research - peer-review › Article in proceedings – Annual report year: 1997

On modelling corridors between areas of remnant vegetation

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Ersbøll, B. K. (Intern), Lambeck, R. (Ekstern)
Number of pages: 7
Publication date: 1997

Host publication information
On modelling corridors between areas of remnant vegetation

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Ersbøll, B. K. (Intern), Lambeck, R. (Ekstern)
Publication date: 1997

Host publication information
Title of host publication: Proceedings of the 17th EARSeL Symposium
Place of publication: Netherlands
Publisher: Balkema Publishers, A.A. / Taylor & Francis The Netherlands
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 200057
Publication: Research - peer-review › Article in proceedings – Annual report year: 1997

On spatio-temporal Kriging

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Ersbøll, A. K. (Intern), Ersbøll, B. K. (Intern)
Pages: 617-622
Publication date: 1997

Host publication information
Title of host publication: Proceedings of the Third Annual Conference of the International Ass. for math. Geology. Vera Pawlowsky Glahn (ed.)
Place of publication: Barcelona, Spain
Publisher: CIMNE
Main Research Area: Technical/natural sciences
Conference: Third Annual Conference of the International Ass. for Math. Geology, Barcelona, 01/01/1997
Source: orbit
Source-ID: 168674
Publication: Research - peer-review › Article in proceedings – Annual report year: 1997

Spatial analysis of multivariate, (lr-)regularly sampled data: Geochemistry of the eastern Erzgebirge

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Nielsen, A. A. (Intern), Ersbøll, B. K. (Intern), Pälchen, W. (Ekstern), Baafi, E. (ed.) (Ekstern), Scofield, N. (ed.) (Ekstern)
Pages: 1173-1184
Publication date: 1997

Host publication information
Title of host publication: Proceedings of the 5th International Geostatistics Congress. Wollongong, 22-27 September 1996
Publisher: Kluwer Academic Publishers
Main Research Area: Technical/natural sciences
Temporal interpolation in Meteosat images
The geostationary weather satellite Meteosat supplies us with a visual and an infrared image of the earth every 30 minutes. However, due to transmission errors some images may be missing. European TV weather reports are often supported by such infrared image sequences. The cloud movements in such animated films are perceived as being jerky due to the low temporal sampling rate in general and missing images in particular. In order to perform a satisfactory temporal interpolation we estimate and use the optical flow corresponding to every image in the sequence. The estimation of the optical flow is based on images sequences where the clouds are segmented from the land/water that might also be visible in the images. Because the pixel values measured correspond directly to temperature and because clouds (normally) are colder than land/water we use an estimated land temperature map to perform a threshold between clouds and land/water. The temperature maps are estimated using observations from the image sequence itself at cloud free pixels and ground temperature measurements from a series of meteorological observation stations in Europe. The temporal interpolation of the images is based on a path of each pixel determined by the estimated optical flow. The performance of the algorithm is illustrated by the interpolation of a sequence of Meteosat infrared images.

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Larsen, R. (Intern), Hansen, J. D. (Intern), Ersbøll, B. K. (Intern), Conradsen, K. (Intern)
Publication date: 1997

A note on the Wool style Project (CWT80)

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Ersbøll, B. K. (Intern)
Publication date: 1996

A Simple Contextual Classifier

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Ersbøll, B. K. (Intern)
Publication date: 1996

Host publication information
Title of host publication: Proceeding of the 8th Australasian Remote Sensing Conference
Place of publication: Canberra
Main Research Area: Technical/natural sciences
Conference: 8th Australasian Remote Sensing Conference, Canberra, Australia, 01/01/1996
Source: orbit
On Automatic Production of a Bushfire Mask from AVHRR Data

**General information**
- **State**: Published
- **Organisations**: Department of Informatics and Mathematical Modeling
- **Authors**: Ersbøll, B. K. (Intern)
- **Publication date**: 1996

**Publication information**
- **Original language**: English
- **Main Research Area**: Technical/natural sciences
- **Source**: orbit
- **Source-ID**: 165398
- **Publication**: Research - peer-review › Report – Annual report year: 1996

On Fusion of High (spatial) resolution greyscale imagery with low (spatial) resolution colour imagery

**General information**
- **State**: Published
- **Organisations**: Department of Informatics and Mathematical Modeling
- **Authors**: Ersbøll, B. K. (Intern)
- **Publication date**: 1996

**Publication information**
- **Original language**: English
- **Main Research Area**: Technical/natural sciences
- **Source**: orbit
- **Source-ID**: 165399
- **Publication**: Research - peer-review › Report – Annual report year: 1996

On Modelling Corridors Between Areas of Remnant Vegetation

**General information**
- **State**: Published
- **Organisations**: Department of Informatics and Mathematical Modeling
- **Authors**: Ersbøll, B. K. (Intern)
- **Publication date**: 1996

**Publication information**
- **Original language**: English
- **Main Research Area**: Technical/natural sciences
- **Source**: orbit
- **Source-ID**: 165396
- **Publication**: Research - peer-review › Report – Annual report year: 1996

Spatial Analysis of Multivariate, (Ir-)regularly Sampled Data: Geochemistry from the Eastern Erzgebirge: E.Y. Baafi and N.A. Schofield (Eds.)

**General information**
- **State**: Published
- **Organisations**: Department of Informatics and Mathematical Modeling
- **Authors**: Nielsen, A. A. (Intern), Ersbøll, B. K. (Intern), Palchen, W. (Ekstern), Rank, G. (Ekstern)
- **Publication date**: 1996

**Host publication information**
- **Title of host publication**: Geostatistics Wollongong '96: Quantitative Geology and Geostatistics
- **Place of publication**: Wollongong
- **Publisher**: Kluwer Academic Publishers
- **Main Research Area**: Technical/natural sciences
- **Conference**: Geostatistics Wollongong '96: Quantitative Geology and Geostatistics, Wollongong, 01/01/1996
Use of a Two-step Bayesian Classifier to avoid Singularity and to Aid Interpretation

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Ersbøll, B. K. (Intern)
Publication date: 1996

Host publication information
Title of host publication: Proceedings fo the Interface conference at SISC
Main Research Area: Technical/natural sciences
Conference: Interface conference at SISC, 01/01/1996
Source: orbit
Source-ID: 165402
Publication: Research - peer-review › Article in proceedings – Annual report year: 1996

A simple contextual classifier

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Ersbøll, B. K. (Intern)
Number of pages: 8
Publication date: 1995

Host publication information
Title of host publication: Proc. of The 8th Australasian Conference on Remote Sensing, Canberra, 25-29 March 1995
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 200059
Publication: Research - peer-review › Article in proceedings – Annual report year: 1995

Differentiation between geogenic and anthropogenic influences on soils in a mining processing area - some alternatives

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Palchen, W. (Ekstern), Rank, G. (Ekstern), Kluge, A. (Ekstern), Nielsen, A. A. (Intern), Ersbøll, B. K. (Intern)
Number of pages: 1
Publication date: 1995

Host publication information
Title of host publication: Biometrics 95, 25-27 September 1995
Publisher: International Biometric Society Australasian Region
Main Research Area: Technical/natural sciences
Conference: Biometrics 95, 25-27 September 1995, 01/01/1995
Source: orbit
Source-ID: 200312
Publication: Research - peer-review › Article in proceedings – Annual report year: 1995

Estimation of Dense Image Flow Fields in Fluids
The estimation of flow fields from time sequences of satellite imagery has a number of important applications. For visualization of cloud or sea ice movements in sequences of crude temporal sampling a satisfactory non blurred temporal interpolation can be performed only when the flow field or an estimate there-of is known. Estimated flow fields in weather satellite imagery might also be used on an operational basis as inputs to short-term weather prediction. In this article we describe a method for the estimation of dense flow fields. Local measurements of motion are obtained by analysis of the local energy distribution, which is sampled using a set of 3-D spatio-temporal filters. The estimated local energy distribution also allows us to compute a certainty measure of the estimated local flow. The algorithm furthermore utilizes Markovian random fields in order to incorporate smoothness across the field. To obtain smoothness we will constrain first
as well as second order derivatives of the flow field. The performance of the algorithm is illustrated by the estimation of the flow fields corresponding to a sequence of Meteosat thermal images. The estimated flow fields are used in a temporal interpolation scheme.

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Larsen, R. (Intern), Conradsen, K. (Intern), Ersbøll, B. K. (Intern)
Number of pages: 19
Publication date: 1995

Publication information
Publisher: Department of Mathematical Modelling, Technical University of Denmark
Original language: English
Main Research Area: Technical/natural sciences
Markov random fields, optical flow, local orientation
Electronic versions:
imm1136.pdf
Source: orbit
Source-ID: 200959
Publication: Research - peer-review › Report – Annual report year: 1995

Progress Report on EC Funded Project BRE2-CT201

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Conradsen, K. (Intern), Nielsen, A. A. (Intern), Ersbøll, B. K. (Intern), Larsen, R. (Intern), Hartelius, K. (Intern), Carstensen, J. M. (Intern)
Publication date: 1994

Publication information
Publisher: Informatics and Mathematical Modelling (IMM), Technical University of Denmark
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 200896
Publication: Research - peer-review › Report – Annual report year: 1994

A new approach to differentiation between geogenic and anthropogenic influences on soils in a mining processing area

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Pälchen, W. (Ekstern), Rank, G. (Ekstern), Kluge, A. (Ekstern), Ersbøll, B. K. (Intern)
Number of pages: 14
Publication date: 1993

Host publication information
Title of host publication: GUESS'1 Nordic Symposium on Variability in Polluted Soil and Groundwater, Ås, Norway
Main Research Area: Technical/natural sciences
Conference: GUESS’1 Nordic Symposium on Variability in Polluted Soil and Groundwater, Ås, Norway, 01/01/1993
Source: orbit
Source-ID: 200350
Publication: Research - peer-review › Article in proceedings – Annual report year: 1993


General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Conradsen, K. (Intern), Nielsen, A. A. (Intern), Windfeld, K. (Ekstern), Ersbøll, B. K. (Intern), Larsen, R. (Intern), Hartelius, K. (Intern), Olsen, C. K. (Ekstern)
A randomized, double blind, placebo controlled, dose-response study of the analgesic effect of lornoxicam after surgical removal of mandibular third molars

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Nørholt, S. E. (Ekstern), Sindet-Pedersen, S. (Ekstern), Bugge, C. (Ekstern), Branebjerg, P. E. (Ekstern), Ersbøll, B. K. (Intern), Bastian, H. L. (Ekstern)
Pages: 606-614
Publication date: 1993
Main Research Area: Technical/natural sciences

Publication information
Journal: The Journal of Clinical Pharmacology
Volume: 35
Issue number: 6
ISSN (Print): 0091-2700
Ratings:
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 1.007 SNIP 0.995 CiteScore 2.67
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.957 SNIP 1.016 CiteScore 2.43
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.976 SNIP 1.025 CiteScore 2.43
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.045 SNIP 0.982 CiteScore 2.65
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.1 SNIP 1.075 CiteScore 2.83
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.167 SNIP 1.118 CiteScore 3.24
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.417 SNIP 1.103
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.222 SNIP 1.13
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.066 SNIP 1.072
Scopus rating (2007): SJR 0.838 SNIP 1.025
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.109 SNIP 1.231
Scopus rating (2005): SJR 0.981 SNIP 1.116
Scopus rating (2004): SJR 0.704 SNIP 0.875
Scopus rating (2003): SJR 0.703 SNIP 0.819
Scopus rating (2002): SJR 0.65 SNIP 0.825
Aspects of analysis of multivariate, spatial data: Geochemistry from the Eastern Erzgebirge

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Nielsen, A. A. (Intern), Ersbøll, B. K. (Intern), Pålchen, W. (Ekstern), Rank, G. (Ekstern)
Number of pages: 14
Publication date: 1993

Host publication information
Title of host publication: GUESS'1 Nordic Symposium on Variability in Polluted Soil and Groundwater, Ås, Norway
Main Research Area: Technical/natural sciences
Conference: GUESS'1 Nordic Symposium on Variability in Polluted Soil and Groundwater, Ås, Norway, 01/01/1993
Source: orbit
Source-ID: 200264
Publication: Research - peer-review › Article in proceedings – Annual report year: 1993


General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Conradsen, K. (Intern), Nielsen, A. A. (Intern), Ersbøll, B. K. (Intern), Larsen, R. (Intern), Hartelius, K. (Intern)
Publication date: 1993

Publication information
Publisher: IMSOR, DTU
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 200897
Publication: Research - peer-review › Report – Annual report year: 1993

Three different criteria for the design of two-dimensional zero phase FIR digital filters
An error criterion for the design of FIR filters is proposed. Filters with relatively many free filter coefficients are designed using the Chebyshev, the weighted-least-squares (WLS), and a new partitioned minimax error criterion, and the performance of the filters is compared. A general and fast technique for the WLS design is also presented.

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Gislason, E. (Ekstern), Johansen, M. (Ekstern), Conradsen, K. (Intern), Ersbøll, B. K. (Intern), Jacobsen, S. K. (Intern)
Pages: 3070-3074
Publication date: 1993
Main Research Area: Technical/natural sciences

Publication information
Journal: I E E E Transactions on Signal Processing
Volume: 41
Issue number: 10
ISSN (Print): 1053-587X
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 1.591 SNIP 2.587 CiteScore 5.54
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.756 SNIP 2.783 CiteScore 4.65
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.867 SNIP 2.925 CiteScore 4.72
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 2.504 SNIP 3.349 CiteScore 5.04
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 2.404 SNIP 3.552 CiteScore 4.81
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.957 SNIP 3.005 CiteScore 4.06
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.201 SNIP 2.925
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 2.034 SNIP 2.929
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.912 SNIP 2.751
Scopus rating (2007): SJR 1.939 SNIP 3.031
Scopus rating (2006): SJR 2.033 SNIP 3.36
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 2.399 SNIP 3.964
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 2.165 SNIP 3.661
Scopus rating (2003): SJR 1.635 SNIP 2.339
Scopus rating (2002): SJR 1.545 SNIP 1.876
Scopus rating (2001): SJR 1.21 SNIP 1.716
Scopus rating (2000): SJR 1.125 SNIP 2.623
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 0.564 SNIP 1.521
Original language: English
Electronic versions:
Gislason.pdf
DOIs:
10.1109/78.277812

Bibliographical note
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advertising or promotional purposes or for creating new collective works for resale or redistribution to servers or lists, or to
reuse any copyrighted component of this work in other works must be obtained from the IEEE
Source: orbit
Source-ID: 199585
Publication: Research - peer-review › Journal article – Annual report year: 1993

Automated grading of wood-slabs. The development of a prototype system
This paper proposes a method for automatically grading small beechwood slabs. The method involves two classification
steps: the first step detects defects based on local visual texture; the second step utilizes the relative distribution of defects
to perform a final grading assessment. At a major Danish plant for manufacture of parquet boards, the quality grading
(visual quality) has always been done manually. As it is expected to be both expensive and difficult to recruit sufficient
numbers of personnel to do this type of job in the future, it is of great interest to automate the function as much as
possible. A vast range of types of defects has to be considered when the grading is done. This and the fact that wood is a 'natural' material means it is not easily described using ordinary vision systems. The proposed method assumes a 3-D feature space which depends on local texture-based measures of 'lightness', 'speckle' and 'dark deviation'. These measures are calculated for each pixel in an image of a slab. The feature space is separated into 12 decision regions corresponding to 12 'defect types'; these 'defects' are labeled as clear wood, wavy grain, split, black knots, ingrown bark, etc. Based on the relative distribution of these detected defects on the surface of a given slab, the slab is further classified into 5 quality grades: prime, standard, flamy, extra flamy and rejects. As a result of this project, a prototype for the computer vision grading system has been built and is being tested on-site.

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Ersbøll, B. K. (Intern), Conradsen, K. (Intern)
Pages: 219-236
Publication date: 1992
Main Research Area: Technical/natural sciences

Publication information
Journal: Industrial metrology
Volume: 2
Issue number: 3-4
ISSN (Print): 0921-5956
Original language: English
Source: orbit
Source-ID: 199563
Publication: Research - peer-review › Journal article – Annual report year: 1992

Automatic screening of plain film mammography
General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Fredfeld, K. E. (Ekstern), Christensen, E. (Ekstern), Conradsen, K. (Intern), Ersbøll, B. K. (Intern), Stedstrup, S. (Ekstern)
Pages: 135-139
Publication date: 1992
Main Research Area: Technical/natural sciences

Publication information
Journal: Seminars in Ultrasound, C T and M R I
Volume: 13
Issue number: 2
ISSN (Print): 0887-2171
Ratings:
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.476 SNIP 0.889 CiteScore 1.26
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.598 SNIP 1.106 CiteScore 1.84
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.611 SNIP 1.185 CiteScore 1.66
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.584 SNIP 1.055 CiteScore 1.81
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.674 SNIP 0.85 CiteScore 1.28
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.533 SNIP 0.877 CiteScore 1.16
ISI indexed (2011): ISI indexed yes
Automated Grading of Wood-slabs: The Development of a Prototype System

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Ersbøll, B. K. (Intern), Conradsen, K. (Intern)
Publication date: 1991

Publication information
Publisher: IMSOR, DTU
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 200904
Publication: Research - peer-review » Report – Annual report year: 1991

Data dependent orthogonal transformations of multichannel image data. IMSOR

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Conradsen, K. (Intern), Ersbøll, B. K. (Intern)
Pages: 34
Publication date: 1991
Main Research Area: Technical/natural sciences

Publication information
Journal: PAMI
Original language: English
Source: orbit
Source-ID: 199550
Publication: Research - peer-review » Journal article – Annual report year: 1991

Discriminant analysis of an integrated data base applied in uranium exploration

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Conradsen, K. (Intern), Ersbøll, B. K. (Intern)
Pages: 377-386
Integration of multi-source data in mineral exploration

This paper describes several multivariate statistical analysis applications of geochemical, geophysical, and spectral variables in mineral exploration. Mahalanobis' distance is described in some detail and based on four multisource variables this measure is applied to produce a map that gives an expression of the statistical proximity of each point in the map to a mineralized area. The four multisource variables chosen from a much larger set of variables have all been subject to extensive data processing: the geochemical variable is the noise MAF (minimum/maximum autocorrelation factor) of eleven kriging interpolated stream sediment variables; the geophysical variables are kriged aeromagnetic data iteratively moving average corrected to minimize the flight line striping and kriged Bouguer gravity anomaly data corrected for a quadratic trend; and the spectral variable is the density of automatically generated linear features based on Landsat TM data. The results indicate among other things a not previously recognized subsurface continuation of an already mapped lineament.
Noise removal in multichannel image data by a parametric maximum noise fraction estimator
Some approaches to noise removal in multispectral imagery are presented. The primary contribution of the present work is the establishment of several ways of estimating the noise covariance matrix from image data and a comparison of the noise separation performances. A case study with Landsat MSS data demonstrates that the principal components are not sorted correctly in terms of visual image quality, whereas the minimum/maximum autocorrelation factors and the maximum noise fractions (MAFs) are. A case study with Landsat TM data shows an ordering which is consistent with the spatial wavelength in the components. The case studies indicate that a better noise separation is attained when using more complex noise models than the simple model implied by MAF analysis. (L.M.)

Some results on analysis of mammograms

On the Design of Two-dimensional Zero Phase FIR Digital Filters
Test Bed for Experimental Computer Vision. VIPWOB-memo 9003

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Christensen, H. I. (Ekstern), Melsen, P. (Ekstern), Ersbøll, B. K. (Intern), Carstensen, J. M. (Intern), Kjærulff, M. (Ekstern), Nielsen, M. (Ekstern)
Publication date: 1990

Variable selection in non-linear discriminant analysis. IMSOR, DTH

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Conradsen, K. (Intern), Ersbøll, B. K. (Intern)
Publication date: 1990
Main Research Area: Technical/natural sciences

VIPWOB-konceptet anvendt på IMSOR

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Ersbøll, B. K. (Intern), Carstensen, J. M. (Intern)
Pages: 7-25
Publication date: 1990

Host publication information
Title of host publication: Kompendium for visiondag på AUC
Main Research Area: Technical/natural sciences
Conference: Visiondag på AUC, 01/01/1990
Source: orbit
Source-ID: 200445
Publication: Research › Article in proceedings – Annual report year: 1990

Opbygning af et vision-system til industriel kvalitetskontrol. Kompendium.

General information
Transformations and classifications of remotely sensed data. Theory and geological cases

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Ersbøll, B. K. (Intern)
Number of pages: 297
Publication date: 1989

Publication information
Original language: English
Series: IMSOR-PHD-1989-54
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 200780
Publication: Research › Ph.D. thesis – Annual report year: 1989

Determination of material properties by means of the GOP 300

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Conradsen, K. (Intern), Ersbøll, B. K. (Intern)
Pages: 73-88
Publication date: 1988
Main Research Area: Technical/natural sciences

Publication information
Journal: Materialenyt
Original language: English
Source: orbit
Source-ID: 199552
Publication: Research - peer-review › Journal article – Annual report year: 1988

Robotvision. Robotteknik: Anvendelser og udvikling

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Conradsen, K. (Intern), Ersbøll, B. K. (Intern)
Publication date: 1989

Host publication information
Title of host publication: Seminar, Institut for styreteknik
Main Research Area: Technical/natural sciences
Conference: Seminar, Institut for styreteknik, 01/01/1989
Source: orbit
Source-ID: 200029
Publication: Research - peer-review › Article in proceedings – Annual report year: 1989

State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Conradsen, K. (Intern), Ersbøll, B. K. (Intern)
Pages: 42-74
Publication date: 1989

Host publication information
Title of host publication: Visiondage på IMSOR
Main Research Area: Technical/natural sciences
Conference: Visiondage på IMSOR, 01/01/1989
Source: orbit
Source-ID: 200062
Publication: Research - peer-review › Article in proceedings – Annual report year: 1989
Textural features useful in classification of digital images

Automated analysis of linear features based on satellite imagery compared with geological setting

Automated identification of linear features in digital imagery

Billeder omsat i tal
Comparison of visual and automated lineament analysis on Landsat MSS image from south Greenland

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Conradsen, K. (Intern), Ersbøll, B. K. (Intern), Pedersen, J. L. (Ekstern)
Pages: 205-211
Publication date: 1986

Remote sensing used in mineral exploration in Greenland. Commission on thematic mapping from satellite imagery

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Thyrgs, T. (Ekstern), Conradsen, K. (Intern), Ersbøll, B. K. (Intern)
Pages: 5
Publication date: 1986
Main Research Area: Technical/natural sciences

Statistical methods and remote sensing techniques applied in analysis of combined geodata

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Conradsen, K. (Intern), Nielsen, A. A. (Intern), Ersbøll, B. K. (Intern), Pedersen, J. L. (Ekstern)
Pages: 245-272
Publication date: 1986

The use of additional variables in classification of image data
The use of remote sensing in mapping of oxidized zones and lineaments in Greenland

A comparison of min/max autocorrelation factor analysis and ordinary factor analysis

Analysis of Satellite imagery combined with geophysical and geochemical measurements
Simultaneous analysis of imagery of different origin

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Conradsen, K. (Intern), Ersbøll, B. K. (Intern), Thyrgst, T. (Ekstern)
Pages: 187-188
Publication date: 1985

Host publication information
Title of host publication: 45th session of the ISI, Amsterdam
Main Research Area: Technical/natural sciences
Conference: 45th session of the ISI, Amsterdam, 01/01/1985
Source: orbit
Source-ID: 200036
Publication: Research - peer-review › Article in proceedings – Annual report year: 1985

A dynamic test method for the thermal performance of small houses

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Authors: Nielsen, A. A. (Intern), Ersbøll, B. K. (Intern)
Number of pages: 31
Publication date: 1984

Host publication information
Title of host publication: ACEEE conference, Santa Cruz, California
Main Research Area: Technical/natural sciences
Conference: ACEEE conference, Santa Cruz, California, 01/01/1984
Source: orbit
Source-ID: 200272
Publication: Research - peer-review › Article in proceedings – Annual report year: 1984

Prediction of high tides in the Baltic Sea, IMSOR research

General information
State: Published
Organisations: Mathematical Statistics, Department of Informatics and Mathematical Modeling, Image Analysis and Computer Graphics
Authors: Spliid, H. (Intern), Ersbøll, B. K. (Intern)
Number of pages: 30
Publication date: 1984

Host publication information
Title of host publication: ACEEE Conference Santa Cruz, California
Main Research Area: Technical/natural sciences
Conference: ACEEE Conference Santa Cruz, California, 01/01/1984
Source: orbit
Source-ID: 200388
Publication: Research - peer-review › Article in proceedings – Annual report year: 1984

Tidsrøkkeanalyse af vandstande fra Østersøen omkring Lolland-Falster

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling, Mathematical Statistics
Authors: Ersbøll, B. K. (Intern), Spliid, H. (Intern)
Pages: 369-405
Publication date: 1984
Projects:

Big Data Analysis on Food Supply Chain Data

Department of Applied Mathematics and Computer Science
Period: 01/08/2017 → 31/07/2020
Number of participants: 3
Phd Student: Svendsen, Kira Dynnes (Intern)
Supervisor: Hansen, Lars Kai (Intern)
Main Supervisor: Ersbøll, Bjarne Kjær (Intern)

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

Big Data Analytics with special emphasis on Food Supply Chain Data

Department of Applied Mathematics and Computer Science
Period: 15/03/2017 → 14/03/2020
Number of participants: 3
Phd Student: Vermue, Laurent (Intern)
Supervisor: Hansen, Lars Kai (Intern)
Main Supervisor: Ersbøll, Bjarne Kjær (Intern)

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

Big Data Analytics with special emphasis on Food Supply Chain Data (2/2)

Department of Applied Mathematics and Computer Science
Period: 01/01/2017 → 31/12/2019
Number of participants: 3
Phd Student: Jørgensen, Philip Johan Havemann (Intern)
Supervisor: Hansen, Lars Kai (Intern)
Main Supervisor: Ersbøll, Bjarne Kjær (Intern)

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

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

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

Machine Learning as a Service

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

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

Visualization, Analysis and Modelling of On-street Parking Data

Master project
Department of Applied Mathematics and Computer Science
Statistics and Data Analysis
EasyPark
Period: 01/04/2016 → 28/09/2016
Number of participants: 3
Project participant: Notarangelo, Rosaria (Ekstern)
Supervisor: Thyregod, Camilla (Intern)
Main Supervisor: Ersbøll, Bjarne Kjær (Intern)

Automated NIR management

Department of Applied Mathematics and Computer Science
Period: 15/11/2015 → 17/08/2019
Number of participants: 5
Phd Student: Larsen, Jacob Søgaard (Intern)
Supervisor: Larsen, Anders (Ekstern)
Skov, Thomas Hjort (Intern)
Stockmarr, Anders (Intern)
Main Supervisor:
Ersbøll, Bjarne Kjær (Intern)

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

Impact Assessment of University Research
Department of Management Engineering
Period: 01/09/2015 → 31/08/2018
Number of participants: 3
Phd Student:
Woltmann, Sabrina (Intern)
Supervisor:
Ersbøll, Bjarne Kjær (Intern)
Main Supervisor:
Alkærsig, Lars (Intern)

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

Methods and tools for the statistical data analysis for large datasets collected from bio-based manufacturing processes
Department of Applied Mathematics and Computer Science
Period: 01/06/2015 → 31/05/2018
Number of participants: 4
Phd Student:
Spooner, Max Peter (Intern)
Supervisor:
Clemmensen, Line Katrine Harder (Intern)
Ersbøll, Bjarne Kjær (Intern)
Main Supervisor:
Kulahci, Murat (Intern)

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

Intelligent Quality Assessment of Railway Switches and Crossings
This project aims at significantly improving the safety, reliability and operational lifetime of the 3500 switches and crossings (S&Cs) in the Danish railway network. The project is a close cooperation between the Technical University of Denmark (DTU), the Danish rail infrastructure provider Rail Net Danmark and four affiliated European partners with significant expertise within this field. An inter-disciplinary scientific effort is employed to obtain enhanced rail transport reliability and regularity simultaneously with significant savings in S&Cs maintenance costs. The project results will make maintenance based on intelligent fault prediction tools, instead of the presently used regular planned inspections, and it will provide sophisticated tools to prevent hidden faults from developing to failure in the future. In a novel approach, the project will install state-of the-art sensor technology in selected S&Cs and correlate dynamic parameters during train passage with static geometry data from conventional measurement vehicles. Monitoring of the dynamic responses will provide diagnosis of patterns that indicate when components or ballast begin to deviate from fully functional conditions. Modelling of dynamics will identify root causes to signs of degradation. Damage assessment of components identified by anomalous readings will be done by metallurgical examinations. Data and results will be processed by a holistic model that can produce Maintenance Performance Indicators (MPI) for the S&C condition. The correlation of sensor data to measuring vehicle data will allow existing data to be used reliably as input for the MPI model. It is expected that this project will enable optimisation of maintenance procedures, by which appropriate maintenance can be predicted in advance, thus avoiding unscheduled repairs and delays in the railway traffic.
Department of Electrical Engineering
Automation and Control
Department of Wind Energy
Materials science and characterization
Department of Mechanical Engineering
Solid Mechanics
Department of Applied Mathematics and Computer Science
Statistics and Data Analysis
Banedanmark
Period: 01/03/2015 → 28/02/2019
Number of participants: 9
Acronym: INTELLISWITCH
Project participant:
Galeazzi, Roberto (Intern)
Blanke, Mogens (Intern)
Hansen, Søren (Intern)
Santos, Ilmar (Intern)
Danielsen, Hilmar Kjartansson (Intern)
Tejada, Alejandro de Miguel (Intern)
Ersbøll, Bjarne Kjær (Intern)
Kulahci, Murat (Intern)
Project Manager, academic:
Juul Jensen, Dorte (Intern)

Financing sources
Source: Public research council
Name of research programme: Innovationsfonden
Web address: http://innovationsfonden.dk/da
Amount: 12,700,000.00 Danish Kroner
Year of approval: 2014
Project

Intelligent Quality Assessment of Railway Switches and Crossings (INTELLISWITCH)
Department of Electrical Engineering
Department of Mechanical Engineering
Department of Applied Mathematics and Computer Science
Statistics and Data Analysis
Department of Wind Energy
Materials science and characterization
Banedanmark
Period: 01/03/2015 → 31/12/2019
Number of participants: 3
Project participant:
Thyregod, Camilla (Intern)
Ersbøll, Bjarne Kjær (Intern)
Project Manager, organisational:
Juul Jensen, Dorte (Intern)

Financing sources
Source: Public research council
Name of research programme: Innovation Fund Denmark
Amount: 12.70 Danish Kroner
**COMPUTE Software Group**

Many researchers create tools that could be very valuable to a broader audience. Using them, however, is often impeded by the required expertise and/or effort. This project aims at providing services to all of DTU Compute to help them make their tools and available to the world.

Our goal is to reach out to science and industry to promote the use of the tools and datasets we have created, and thus advance scientific progress at large and its economic dissemination. On a smaller scale, the individual stakeholders each will benefit in turn:

Compute will benefit from increased visibility and newly established contacts and created collaboration opportunities,

The sections will benefit by having more insight into the activities of other sections,

Individual researchers can benefit by more citations and higher visibility.

**Department of Applied Mathematics and Computer Science**

**Software Engineering**

**Embedded Systems Engineering**

**Statistics and Data Analysis**

**Period:** 01/01/2015 → 31/12/2015

**Number of participants:** 4

**Acronym:** CSG

**Project participant:**

Störrle, Harald (Intern)
Madsen, Jan (Intern)
Ersbøll, Bjarne Kjær (Intern)
Kristensen, Kristian (Intern)

**Project**

**Smart Innovation: Parking Guidance**

Department of Applied Mathematics and Computer Science

**Statistics and Data Analysis**

**EasyPark**

**DTU Scion**

**Period:** 01/01/2015 → 31/10/2016

**Number of participants:** 2

**Project participant:**

Thyregod, Camilla (Intern)
Ersbøll, Bjarne Kjær (Intern)

**Project**

**Statistical modelling of space-time processes with**

Department of Applied Mathematics and Computer Science

**Phd Student:**

Lenzi, Amanda (Intern)

**Supervisor:**

Clemmensen, Line Katrine Harder (Intern)
Pinson, Pierre (Intern)

**Main Supervisor:**

Ersbøll, Bjarne Kjær (Intern)

**Examiner:**

Stockmarr, Anders (Intern)
Girard, Robin (Ekstern)
Thorarinsdottir, Thordis L. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Science Without Borders, Brasi

Relations

Publications:
Statistical modelling of space-time processes with application to wind power.
Project: PhD

Image Analysis for X-ray Imaging of Food

Department of Applied Mathematics and Computer Science
Period: 01/06/2012 → 30/09/2016
Number of participants: 6
Phd Student:
Einarsdottir, Hildur (Intern)
Supervisor:
Larsen, Rasmus (Intern)
Main Supervisor:
Ersbøll, Bjarne Kjær (Intern)
Examiner:
Paulsen, Rasmus Reinhold (Intern)
Andersen, Kristinn (Ekstern)
Heyden, Anders (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut, samfinansiering

Relations

Publications:
Image Analysis for X-ray Imaging of Food
Project: PhD

Monitoring Animal Wellbeing

Department of Applied Mathematics and Computer Science
Period: 15/12/2011 → 31/03/2016
Number of participants: 7
Phd Student:
Gronskyte, Ruta (Intern)
Supervisor:
Clemmensen, Line Katrine Harder (Intern)
Hvid, Marchen Sonja (Ekstern)
Main Supervisor:
Kulahci, Murat (Intern)
Examiner:
Ersbøll, Bjarne Kjær (Intern)
Bergquist, Bjarne (Ekstern)
Christensen, Lars Bager (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut, samfinansiering

Relations

Publications:
Monitoring Animal Well-being
Project: PhD
Multivariate Analysis Techniques for Optimal Vision System Design

Department of Applied Mathematics and Computer Science

Period: 01/06/2011 → 21/09/2015

Number of participants: 6

Phd Student:
Sharifzadeh, Sara (Intern)

Supervisor:
Ersbøll, Bjarne Kjær (Intern)

Main Supervisor:
Clemmensen, Line Katrine Harder (Intern)

Examiner:
Conradsen, Knut (Intern)
Ames, Brendan P. W. (Ekstern)
van den Berg, Frans W.J. (Intern)

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

Control & Surveillance of Automated Production Steps (a part of the inSPIRe Food)

Summary of project: Automation of many manual operations in the food industry is difficult, because the criteria for process control are often based on tacit knowledge of the operator. Our hypothesis is that a route to optimal automation of such operations is to register how the trained process operator makes decisions from observations of the process and combining this knowledge with predictive modelling of input/output of the process units.

Department of Applied Mathematics and Computer Science

Statistics and Data Analysis

National Food Institute

Research Group for Food Production Engineering

Image Analysis & Computer Graphics

Period: 01/01/2011 → 31/12/2016

Number of participants: 5

Project participant:
Larsen, Rasmus (Intern)
Ersbøll, Bjarne Kjær (Intern)
Frosch, Stina (Intern)
Clemmensen, Line Katrine Harder (Intern)
Larsen, Anders Boesen Lindbo (Intern)

Financing sources
Source: Public research council
Name of research programme: Danish Council for Strategic Research and the Danish Council for Technology (now The Danish Innovation Foundation)
Amount: 5,218,000.00 Danish Kroner

Multivariate Analysis Techniques for Optimal Vision Design

Department of Informatics and Mathematical Modeling

Period: 01/10/2010 → 10/01/2011

Number of participants: 3

Phd Student:
Mazzaretto, Andrea (Intern)

Supervisor:
Clemmensen, Line Katrine Harder (Intern)
Main Supervisor:
Ersbøll, Bjarne Kjær (Intern)

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

Short range modelling of Culicoides dispersal
National Veterinary Institute
Period: 01/02/2010 → 29/05/2013
Number of participants: 6
Phd Student:
Kirkeby, Carsten Thure (Intern)
Supervisor:
Bedker, Rene (Intern)
Stockmarr, Anders (Intern)
Main Supervisor:
Lind, Peter (Intern)
Examiner:
Ersbøll, Bjarne Kjær (Intern)
Chirico, Jan C. F. (Ekstern)

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

Quantitative assessment of course evaluation
Department of Informatics and Mathematical Modeling
Period: 01/01/2010 → 20/03/2014
Number of participants: 5
Phd Student:
Sliusarenko, Tamara (Intern)
Main Supervisor:
Ersbøll, Bjarne Kjær (Intern)
Examiner:
Conradsen, Knut (Intern)
Adawi, Tom W (Ekstern)
Malmi, Lauri T. E. (Ekstern)

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

Development and Application of Image Analysis and Multivariate Statistics in Industrial Aquaculture Feed Production
Department of Informatics and Mathematical Modeling
Period: 01/09/2009 → 22/11/2012
Number of participants: 6
Phd Student:
Ljungqvist, Martin Georg (Intern)
Supervisor:
Frosch, Stina (Intern)
Main Supervisor:
Ersbøll, Bjarne Kjær (Intern)
Examiner:
Conradsen, Knut (Intern)
Applying image analysis as a new tool for understanding the processes behind dermal tissue damage and regeneration

National Food Institute
Period: 01/08/2009 → 18/12/2013
Number of participants: 6
Phd Student:
Schmidt, Jacob Günther (Intern)
Supervisor:
Ersbøll, Bjarne Kjær (Intern)
Main Supervisor:
Nielsen, Michael Engelbrecht (Intern)
Examiner:
Madsen, Charlotte Bernhard (Intern)
Hammerschmidt, Matthias (Ekstern)
Lindenstrøm, Thomas (Ekstern)

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

Towards the Interactive ESS-Food Catalogue

Department of Informatics and Mathematical Modeling
Period: 01/05/2009 → 24/08/2012
Number of participants: 7
Phd Student:
Laursen, Lasse Farnung (Intern)
Supervisor:
Bærentzen, Jakob Andreas (Intern)
Christensen, Lars Bager (Intern)
Main Supervisor:
Ersbøll, Bjarne Kjær (Intern)
Examiner:
Carstensen, Jens Michael (Intern)
Madsen, Claus Brøndsgaard (Ekstern)
Sramek, Milos (Ekstern)

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

Cranio-facial growth modelling

Department of Informatics and Mathematical Modeling
Period: 01/12/2008 → 24/05/2013
Number of participants: 9
Phd Student:
Thorup, Signe Strann (Intern)
Supervisor:
Darvann, Tron Andre (Intern)
Hermann, Nuno (Ekstern)
Kreiborg, Sven (Ekstern)
Paulsen, Rasmus Reinhold (Intern)
Main Supervisor:
Larsen, Rasmus (Intern)
Examiner:
Ersbøll, Bjarne Kjær (Intern)
Rueckert, Daniel (Ekstern)
Østergaard, Lasse Riis (Ekstern)

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

Statistical Analysis of stochastic fluorescence data in biology and biophysics
Department of Micro- and Nanotechnology
Period: 01/10/2008 → 24/11/2010
Number of participants: 5
Phd Student:
Mortensen, Kim (Intern)
Main Supervisor:
Flyvbjerg, Henrik (Intern)
Examiner:
Ersbøll, Bjarne Kjær (Intern)
Frey, Erwin (Ekstern)
Gaub, Hermann E. (Ekstern)

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

New vision technology for multidimensional quality monitoring of food processes
Department of Informatics and Mathematical Modeling
Period: 01/05/2008 → 31/08/2011
Number of participants: 6
Phd Student:
Dissing, Bjørn Skovlund (Intern)
Supervisor:
Adler-Nissen, Jens (Intern)
Main Supervisor:
Ersbøll, Bjarne Kjær (Intern)
Examiner:
Jørgensen, Bo Munk (Intern)
Christensen, Lars Bager (Intern)
Parkkinen, Jussi (Ekstern)

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

Online CT-scanning af slættesvin
Department of Informatics and Mathematical Modeling
Period: 01/05/2008 → 28/09/2011
Number of participants: 7
Phd Student:
Mosbech, Thomas Hammershaimb (Intern)
Supervisor:
Christensen, Lars Bager (Intern)
Larsen, Rasmus (Intern)
Main Supervisor:
Ersbøll, Bjarne Kjær (Intern)
Examiner:
Conradsen, Knut (Intern)
Brandt, Sami (Ekstern)
Bünger, Lutz (Ekstern)

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

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**Advanced Methods for Biological Shape Analysis**
Department of Informatics and Mathematical Modeling
Number of participants: 6
Phd Student:
Hansen, Michael Sass (Intern)
Supervisor:
Ersbøll, Bjarne Kjær (Intern)
Main Supervisor:
Larsen, Rasmus (Intern)
Examiner:
Paulsen, Rasmus Reinhold (Intern)
Rueckert, Daniel (Ekstern)
Van Leemput, Koen (Intern)

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

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**Data-analyse i sparse, høj-dimensionale rum**
Department of Informatics and Mathematical Modeling
Period: 01/04/2006 → 31/03/2010
Number of participants: 5
Phd Student:
Clemmensen, Line Katrine Harder (Intern)
Main Supervisor:
Ersbøll, Bjarne Kjær (Intern)
Examiner:
Larsen, Rasmus Reinhold (Intern)
Bigun, Josef (Ekstern)
Bro, Rasmus (Intern)

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

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**Multimodal Neuroaktivitetsanalyse**
Department of Informatics and Mathematical Modeling
Godkendelse og sporing af tømmerstokke ved 3D-billedbehandling

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

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

Modellering af biologisk diversitet hos grise

Department of Informatics and Mathematical Modeling
Period: 01/02/2005 → 02/02/2009
Number of participants: 6
Phd Student:
Erbou, Søren Gylling Hemmingsen (Intern)
Supervisor:
Christensen, Lars Bager (Intern)
Main Supervisor:
Ersbøll, Bjarne Kjær (Intern)
Examiner:
Aanæs, Henrik (Intern)
Darvann, Tron Andre (Intern)
Vangen, Odd (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU, Samfinansiering
Project: PhD
Modeling the Effects of Drugs Targeted to Tumor Vasculature using MRI

Department of Informatics and Mathematical Modeling
Period: 01/11/2004 → 05/11/2008
Number of participants: 7
Phd Student:
Holm, David Alberg (Intern)
Supervisor:
Rowland, Ian (Ekstern)
Sidaros, Karam (Intern)
Main Supervisor:
Larsen, Rasmus (Intern)
Examiner:
Ersbøll, Bjarne Kjær (Intern)
Larsson, Elna-Marie (Ekstern)
Maxwell, Ross James (Ekstern)

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

Dynamical Shape analysis

Department of Informatics and Mathematical Modeling
Period: 01/03/2004 → 30/04/2008
Number of participants: 6
Phd Student:
Ólafsdóttir, Hildur (Intern)
Supervisor:
Larsen, Rasmus (Intern)
Main Supervisor:
Ersbøll, Bjarne Kjær (Intern)
Examiner:
Carstensen, Jens Michael (Intern)
Rueckert, Daniel (Ekstern)
Vannier, Michael W. (Ekstern)

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

Modeling of Animale Object Contours, Surfaces, Regions

Department of Informatics and Mathematical Modeling
Period: 01/09/2003 → 31/12/2005
Number of participants: 3
Phd Student:
Dubienskiy, Alexsandr (Intern)
Supervisor:
Ersbøll, Bjarne Kjær (Intern)
Main Supervisor:
Larsen, Rasmus (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådssfinansiering
Project: PhD
System design for vision based dermatological measurement

Department of Informatics and Mathematical Modeling
Period: 01/03/2002 → 12/07/2005
Number of participants: 6
Phd Student: Gomez, David Delgado (Intern)
Supervisor: Ersbøll, Bjarne Kjær (Intern)
Main Supervisor: Carstensen, Jens Michael (Intern)
Examiner: Larsen, Rasmus Werner (Intern)
Johansen, Peter (Ekstern)
Thodberg, Hans Henrik (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Programbevilling
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)
Larsen, Jan (Intern)
Main Supervisor: Carstensen, Jens Michael (Intern)

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

Statistical Image Segmentation in 3D and 4D

Department of Informatics and Mathematical Modeling
Period: 01/01/2001 → 04/06/2004
Number of participants: 6
Phd Student: Stegmann, Mikkel Bille (Intern)
Supervisor: Larsen, Rasmus (Intern)
Larsson, Henrik B.W. (Ekstern)
Main Supervisor: Ersbøll, Bjarne Kjær (Intern)
Examiner: Hansen, Lars Kai (Intern)
Sonka, Milan (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD
FACE- Facial Analysis, Coding and Estimation
Department of Photonics Engineering
Period: 01/12/2000 → 01/01/2003
Number of participants: 3
Phd Student:
Lading, Brian (Intern)
Supervisor:
Ersbøll, Bjarne Kjær (Intern)
Main Supervisor:
Larsen, Rasmus (Intern)

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

3D/4D image analysis
Department of Informatics and Mathematical Modeling
Period: 01/07/2000 → 11/12/2003
Number of participants: 5
Phd Student:
Aanæs, Henrik (Intern)
Main Supervisor:
Larsen, Rasmus (Intern)
Examiner:
Ersbøll, Bjarne Kjær (Intern)
Pollefeys, Marc (Ekstern)
Zhu, Song-Chun (Ekstern)

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

Novelty detection in video and image signals
Department of Informatics and Mathematical Modeling
Period: 01/02/2000 → 26/09/2003
Number of participants: 6
Phd Student:
Maletti, Gabriela Mariel (Intern)
Supervisor:
Conradsen, Knut (Intern)
Main Supervisor:
Ersbøll, Bjarne Kjær (Intern)
Examiner:
Larsen, Rasmus Werner (Intern)
Johansen, Peter (Ekstern)
Sonka, Milan (Ekstern)

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

3D Shape Analysis of The Craniofacial Anomaly in Children With Cleft Lip and Palate
This project develops methods for extraction and analysis of the shape and size of the human skull in infancy and adolescence, and is carried out at the joint 3D-Laboratory (3D-Lab) of Copenhagen University Hospital, School of Dentistry, University of Copenhagen and Informatics and Mathematical Modelling, Technical University of Denmark. The
methods are applied to three-projection x-ray images, plaster casts of palatal impressions and three-dimensional scans of children with cleft lip and palate. Reliable and detailed (semi-) automatic 3D point-to-point correspondence across a population of shapes is achieved using deformable models. Statistical methods are applied in order to analyze the shape and size variation within groups of children, as well as in order to discern between different types of treatment and study temporal evolution.

Department of Informatics and Mathematical Modeling

School of Dentistry
Period: 01/01/2000 → 31/12/2003
Number of participants: 4
Project participant:
Ersbøll, Bjarne Kjær (Intern)
Darvann, Tron (Ekstern)
Project Manager, organisational:
Larsen, Rasmus (Intern)
Kreiborg, Sven (Ekstern)

Intelligent, Interactive Templates and their Application to 3D Medical Modelling

Department of Informatics and Mathematical Modeling
Number of participants: 7
Phd Student:
Darvann, Tron Andre (Intern)
Supervisor:
Conradsen, Knut (Intern)
Kreiborg, Sven (Ekstern)
Main Supervisor:
Ersbøll, Bjarne Kjær (Intern)
Examiner:
Carstensen, Jens Michael (Intern)
Cootes, Timothy Francis (Ekstern)
Mars, Michael (Ekstern)

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

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 lead 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 scientist from DTU and several departments from different hospitals and university clinics.

Department of Informatics and Mathematical Modeling
Period: 01/07/1999 → 30/06/2003
Number of participants: 9
Project participant:
Madsen, Kaj (Intern)
Hansen, Per Christian (Intern)
Hansen, Lars Kai (Intern)
Ersbøll, Bjarne Kjær (Intern)
Carstensen, Jens Michael (Intern)
Larsen, Jan (Intern)
Modelling of the geoid and the north Atlantic Sea level

Department of Informatics and Mathematical Modeling
Period: 01/10/1998 → 27/03/2002
Number of participants: 6
Phd Student:
Hilger, Klaus Baggesen (Intern)
Supervisor:
Nielsen, Allan Aasbjerg (Intern)
Main Supervisor:
Ersbøll, Bjarne Kjær (Intern)
Examiner:
Madsen, Henrik (Ekstern)
Switzer, Paul (Ekstern)
Windfeld, Kristian (Ekstern)

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

The GEOid and Sea level Of the North Atlantic Region (GEOSONAR). Project no.: 1217, Ph.D-student Klaus Baggesen Hilger
Project no.: 1217 Financed by: "GEOSONAR"

Department of Informatics and Mathematical Modeling
Period: 01/10/1998 → 01/10/2001
Number of participants: 2
Project participant:
Hilger, Klaus Baggesen (Intern)
Project Manager, organisational:
Ersbøll, Bjarne Kjær (Intern)

Analysis of two-dimensional electrophoresis images. Project no.: 1276, Ph.D-student Lars Pedersen
Project no.: 1276 Financed by: "CPA", The Center for Proteom Analysis.

Department of Informatics and Mathematical Modeling
Number of participants: 2
Project participant:
Pedersen, Lars (Intern)
Project Manager, organisational:
Ersbøll, Bjarne Kjær (Intern)

Analysis of two-dimensional electrophoresis images

Department of Informatics and Mathematical Modeling
Period: 01/09/1998 → 14/06/2002
Number of participants: 7
Phd Student:
Pedersen, Lars (Intern)
Supervisor:
Conradsen, Knut (Intern)
Fey, Stephen John (Ekstern)
Main Supervisor:
Ersbøll, Bjarne Kjær (Intern)
Examiner:
Larsen, Rasmus Werner (Intern)
Glasbøy, Christopher Andrew (Ekstern)
Johansen, Peter (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Anden Forskningsrådsfinan.-SU
Project: PhD

Forbedring af Videobilledsekvenser
Udvikling af soft- og hardware applikationer til forbedring af videobilleder (sekvenser), med særlig henblik på overførsel til film.
Department of Informatics and Mathematical Modeling
Hokus Bogus Aps.
Context Vision AB
Period: 23/06/1998 → …
Number of participants: 1
Project Manager, organisational:
Ersbøll, Bjarne Kjær (Intern)

Analysis and Extensions of the n-Tuple Classifier with Implications for Ensembles
Department of Management Engineering
Period: 01/05/1998 → 09/08/2001
Number of participants: 6
Phd Student:
Linneberg, Christian (Intern)
Supervisor:
Ersbøll, Bjarne Kjær (Intern)
Main Supervisor:
Høskuldsson, Agnar (Intern)
Examiner:
Mayoh, Brian (Ekstern)
Dobrzeniecki, Andy B. (Intern)
Lucas, Simon (Ekstern)

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

Object measurement. Project no.: 1215, Ph.D-student Claus Gramkow.
Project no.: 1215 Financed by: ATV
Department of Informatics and Mathematical Modeling
Period: 01/01/1997 → 31/12/1999
Number of participants: 2
Project participant:
Gramkow, Claus (Intern)
Project Manager, organisational:
Ersbøll, Bjarne Kjær (Intern)
Does pigmentation protect against ultraviolet B induced immunosuppression?

Department of Informatics and Mathematical Modeling

Amtsygehuset i Gentofte
Estimation and quantification of digitised craniofacial X-rays

Department of Informatics and Mathematical Modeling

University of Copenhagen
Period: 01/01/1996 → …
Number of participants: 2
Project participant:
Skov, Lone (Ekstern)
Project Manager, organisational:
Ersbøll, Bjarne Kjær (Intern)
Project

Quality Improvement of Drug Therapy for Asthma Patients - Evaluation of a Co-operative Danish Programme

Drug therapy is an essential in managing asthma. In spite of increased possibilities in asthma management (eg. peak-flow meters and patient diaries) and the existence of improved anti-asthmatic drugs, the morbidity and mortality of asthma have not improved in Denmark. The purpose of this Therapeutic Outcomes Monitoring project is to establish therapeutic outcomes monitoring as a continuous quality improvement activity for the medication use process among asthma patients in primary health care. To evaluate the experiment in pharmacy practice we use a combined evaluation strategy which is composed of (i) a controlled effect study, (ii) a process- and participant evaluation, (iii) a health economical analysis, and (iv) a qualitative interview study.

Department of Informatics and Mathematical Modeling

Danish College of Pharmacy Practice
Period: 01/01/1996 → 31/12/1999
Number of participants: 3
Project participant:
Rootzén, Helle (Intern)
Herborg, Hanne (Ekstern)
Project Manager, organisational:
Ersbøll, Bjarne Kjær (Intern)
Project