Bayesian grid matching
A method for locating distorted grid structures in images is presented. The method is based on the theories of template matching and Bayesian image restoration. The grid is modeled as a deformable template. Prior knowledge of the grid is described through a Markov random field (MRF) model which represents the spatial coordinates of the grid nodes. Knowledge of how grid nodes are depicted in the observed image is described through the observation model. The prior consists of a node prior and an arc (edge) prior, both modeled as Gaussian MRFs. The node prior models variations in the positions of grid nodes and the arc prior models variations in row and column spacing across the grid. Grid matching is done by placing an initial rough grid over the image and applying an ensemble annealing scheme to maximize the posterior distribution of the grid. The method can be applied to noisy images with missing grid nodes and grid-node artifacts and the method accommodates a wide range of grid distortions including: large-scale warping, varying row/column spacing, as well as nonrigid random fluctuations of the grid nodes. The methodology is demonstrated in two case studies concerning (1) localization of DNA signals in hybridization filters and (2) localization of knit units in textile samples.
A CART extension using Quadratic Decision Borders

General information
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Organisations: Department of Informatics and Mathematical Modeling
Authors: Hartelius, K. (Intern)
Pages: 777-783
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Analysis of irregularly distributed points

The present thesis is on the analysis of irregularly distributed points. The main part of the thesis is concerned with interpolating and restoring of irregularly distributed points. The least squares methods of kriging and Kalman filtering and the Bayesian restoration method of iterated conditional modes are applied to this problem. The Kalman filter is described as a powerful tool for modelling two-dimensional data. Motivated by the development of the reduced update Kalman filter we propose a reduced update Kalman smoother which offers considerable computational savings. Kriging is described as a robust estimator which may be applied straightforwardly to a wide range of point patterns and processes when the correlation structure is known. We give a qualitative and quantitative comparison of kriging, Kalman filter and iterated conditional modes. The Kalman filter have shown to provide a powerful modelling of autocorrelated noise structures. The Kalman filter have shown to be superior to ordinary kriging in precision and computational speed. Simple kriging has same statistical properties as the Kalman filter, but the usage of simple kriging may lead to ill-conditioned matrices when applied to highly irregularly distributed points. Adaptive Kalman filter schemes are investigated. A new parallel Kalman filter algorithm based on windowing technique gives good results in a case study on the Igallico satellite scene and represents an interesting contextuel classifier. Extended Kalman filtering on the other hand seems to be well suited for interpolation in gradually changing environments. Bayesian restoration is applied to a point matching problem, which consists of matching a grid to an image of (irregularly) distributed point observations. We present an extension to an existing grid model, which is based on a combined line- and point-process. A pseudolikelihood estimator for the parameters is introduced, which is defined in terms of the semivariance structure. The developed models have been applied to a case study on hybridisation analysis, which comprise matching a grid to an arrayed set of DNA-clones spotted onto a hybridisation filter. The line process has proven to perform a satisfactory modelling of shifted fields (subgrids) in the hybridisation grid, and a two-staged hierarchical grid matching scheme which was designed to firstly locate the overall positions of "node-blocks" in the grid and secondly locate the individual positions of grid nodes has proven to work.
Lecture notes on Two Dimensional Kalman Filtering: Course in Statistic Image Analysis E96

Performance of food inspection methods: Esprit Project 21023 (CATIE)

Progress Report on EC Funded Project BRE2-CT201

Projects:

Purity-analysis of SEED
Application of herbicides is currently reduced substantially in the conventional seed-production. In organic farms a production of grass and clover are being developed, to meet the needs for ecologically produced seed in the year 2000. These changed methods of cultivation will, no doubt, increase the amount of unwanted seeds in the raw material and thereby increase the need for surveillance and new development of the cleaning process. To meet the increasing demands of the cleaning process the development of a prototype for a vision-based purity-analysis machine have started. The machine aims at a usage in the field of processes control of the cleaning process plus the purity control. The project will, in the development face, focus on one of the most difficult and thereby also one of the most vision-relevant problems, that is to differ between seeds of meadow grass and 1 year old meadow grass.

Department of Informatics and Mathematical Modeling
Period: 01/09/1999 → 31/08/2001
Number of participants: 3
Project ID: 3147
Project participant:
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Hartelius, Karsten (Intern)
Project Manager, organisational:
Carstensen, Jens Michael (Intern)

Financing sources
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Name of research programme: Udkendt
Amount: 300,600.00 Danish Kroner
Project

Project-no.: 1223.Center for IT-Research (CIT)
Department of Informatics and Mathematical Modeling
Colours and texture inspection equipment ESPRIT Project 21023 - CATIE
The objective is to provide cost-effective colour and texture-based automatic inspection and sorting solutions for industry. Three application areas are considered: Hot steel strip, wood slabs, and food. Novel solutions for low delay image analysis, a few tens of milliseconds from imaging to decision, will be developed and used in real-time on-line inspection demonstrators in each application. The inspection system platform will be the same and exploit an off-the-shelf component-based parallel architecture designed to support hypothesis-and-verification oriented inspection strategies. The platform will cope with the high volumes of data associated with colour and texture inspection. The basic technology of high-performance personal computers will be used. Because of the vibrations of hot strip and the nature of motion of food particles to be sorted high-speed prism-based colour-line-scan cameras will be developed to capture the RGB values of each pixel at the same time. Due to the required high line scan rates, stable illuminators with feature-enhancing radiation patterns will be designed, and an online colour camera calibration technique will be developed to make the colour measurements independent of longer term changes in illumination.

Department of Informatics and Mathematical Modeling
Spectra-Physics VisionTech Oy
ELEXSO Sortiertechnik GmbH
Juncker's Industrier A/S
STN Atlas Elektronik GmbH
T.V.I. - Temet Vision Industry Oy
Fraunhofer Gesellschaft
University of Oulu

VTT - Technical Research Centre of Finland
Period: 01/01/1996 → 31/05/1999
Number of participants: 3
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Hartelius, Karsten (Intern)
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Analysis of irregularly distributed data
Administration
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