MUSCLE
International Workshop on
Computational Intelligence for Multimedia
Understanding

December 13 - 15, 2011

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PROGRAM

Tuesday, 13th

08.30  Registration

09.15  E. Çetin, O. Salvetti, E. Salerno  
Opening Session

09.30  S. Siltanen (invited lecture)  
Augmented Reality beyond the hype - what is it good for?

10.30  Coffee Break

Session 1, Chairperson: R. Dahyot

11.00  P. Perner  
Learning Ontology for Visual Tasks

11.30  M. Martinelli, O. Salvetti, S. Colantonio  
Ontology and Algorithms Integration for Image Analysis

12.00  J. Mateos, A.K. Katsaggelos, R. Molina, P. Ruiz Matarán  
A Bayesian Active Learning Framework for a Two-Class Classification Problem

12.30  Lunch

Session 2, Chairperson: E. Kuruoglu

14.15  K. Kayabol, J. Zerubia, V.A. Krylov  
Unsupervised Classifi cation of SAR Images using Hierarchical Agglomeration and EM

14.45  D. Szolgay, T. Szirányi  
Adaptive Cartoon/Texture Decomposition with Orthogonality Based Optimization

15.15  R. Dahyot, D. Kim  
Bayesian Shape from Silhouettes

15.45  Coffee Break

16.15  B. Sankur (invited lecture)  
Emotions and Gestures from Face Images

17.15  End of works first day
**Wednesday, 14th**

*Session 3, Chairperson: E. Salerno*

09.15  
F. Coelho, C. Ribeiro  
*Pivot-based Indexes for Fast Retrieval in Large-scale Photo Collections*

09.45  
L. Kovács  
*Shape retrieval and recognition on mobile devices*

10.15  
F. Keskin, A.E. Çetin  
*Directionally Selective Fractional Wavelet Transform Using a 2-D Non-Separable Unbalanced Lifting Structure*

10.45  
Coffee Break

*Session 4, Chairperson: S. Siltanen*

11.15  
J. Han, P. de Zeeuw, E. Pauwels  
*Visible and Infrared Image Registration Employing Line-based Geometric Analysis*

11.45  
P. Vácha, M. Haindl  
*Texture Recognition using Robust Markovian Features*

12.15  
N. Malandrakis, S. Narayanan, E. Iosif, A. Potamianos  
*EmotiWord: Affective Lexicon Creation with Application to Interaction and Multimedia Data*

12.45  
Lunch

*Session 5, Chairperson: E. Çetin*

14.15  
X. Giró-i-Nieto, F. Marqués, E. Carcel, M. Martos  
*Rich Internet Application for Semi-Automatic Annotation of Semantic Shots on Keyframes*

14.45  
E. Martienne, P. Gros, V. Claveau  
*Labeling TV stream segments with Conditional Random Fields*

15.15  
J. Gallego, M. Solano, M. Pardás  
*Foreground objects segmentation for moving camera scenarios based on SCGMM*

15.45  
Coffee Break

16.00  
*Excursion to Lucca & Social Dinner*
Thursday, 15th

Session 6, Chairperson: F. Martinelli

09.15  M. Haindl  
*A Plausible Texture Enlargement and Editing Compound Markovian Model*

09.45  M. Haindl, M. Havlíček  
*Bidirectional Texture Function Simultaneous Autoregressive Model*

10.15  D. Moroni, O. Salvetti, M. Magrini, G. Pieri  
*Real Time Image Analysis for Infomobility*

10.45  Coffee Break

Session 7, Chairperson: A. Tonazzini

11.15  S. Szalai, Z. Vidnyanszky, T. Szirániy  
*Tracking the saliency features in images based on human observation statistics*

11.45  J. Filip, M. Haindl, P. Vácha  
*Analysis of Human Gaze Interactions with Texture and Shape*

12.30  Lunch

14.00  MUSCLE PLENARY MEETING

16.00  End of workshop
Abstracts
Learning Ontology for Visual Tasks

Petra Perner

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The definition of ontology for visual tasks is often very tricky since humans are usually not good at expressing visual knowledge. There is a gap between showing and naming. The knowledge in expressing visual experience is often not taught. A methodology how to acquire and express visual knowledge is needed. This methodology should become a standard for visual tasks independent of the technical or medical discipline. We describe in this paper the problems with visual knowledge acquisition and discuss techniques for visual knowledge acquisition. For visual classification tasks such as technical defect classification or medical object classification, we propose a tool based on the repertory grid method and image processing methods that can help a human learn the vocabulary and the relationship between the objects. This knowledge will form the ontology for a visual inspection task.
Ontology and Algorithms Integration
for Image Analysis

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Analyzing an image means extracting a number of relevant features for describing, meaningfully and concisely, image content. Usually, the selection of the features to be extracted depends on the image based task that has to be performed. This problem dependency has caused the flourish of number and number features in the literature, with a substantial disorganization of their introduction and definition. The idea behind the work reported in this paper is to make a step towards the systematization of the image feature domain by defining an ontological model, in which features and other concepts relevant to feature definition and computation are formally defined and catalogued. To this end, the Image Feature Ontology has been defined and is herein described. Such an ontology has the peculiarity of cataloguing features, modelling the image analysis domain and being integrated with a library of image processing algorithms, thus supplying functionalities for supporting feature selection and computation.
A Bayesian Active Learning Framework for a Two-Class Classification Problem

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In this paper we present an active learning procedure for the two-class supervised classification problem. The utilized methodology exploits the Bayesian modeling and inference paradigm to tackle the problem of kernel-based data classification. This Bayesian methodology is appropriate for both finite and infinite dimensional feature spaces. Parameters are estimated, using the kernel trick, following the evidence Bayesian approach from the marginal distribution of the observations. The proposed active learning procedure uses a criterion based on the entropy of the posterior distribution of the adaptive parameters to select the sample to be included in the training set. A synthetic dataset as well as a real remote sensing classification problem are used to validate the followed approach.
Unsupervised Classification of SAR Images using Hierarchical Agglomeration and EM

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We implement an unsupervised classification algorithm for high resolution Synthetic Aperture Radar (SAR) images. The foundation of algorithm is based on Classification Expectation-Maximization (CEM). To get rid of two drawbacks of EM type algorithms, namely the initialization and the model order selection, we combine the CEM algorithm with the hierarchical agglomeration strategy and a model order selection criterion called Classification Likelihood in Mixture (CLM). We exploit amplitude and texture statistics in a single Finite Mixture Model (FMM), and a Multinomial Logistic (MnL) latent class label model for a mixture density to obtain spatially smooth class segments. We test our algorithm on TerraSAR-X data.
Adaptive Cartoon/Texture Decomposition with Orthogonality Based Optimization

Dániel Szolgay$^1$ and Tamás Sziráni$^2$

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The present paper addresses the cartoon/texture discrimination task, offering theoretically clear solutions for the main issues of adaptivity, structure enhancement and the quality criterion of the goal function. After a total variation based preprocessing, an anisotropic diffusion with an orthogonality based parameter estimation and stopping condition is applied. The quality criterion is defined by the assumption that theoretically the cartoon and the texture components of an image should be orthogonal to each other. Through visual and numerical evaluation the presented method was compared to similar algorithms from the state-of-the-art to prove its superiority.
Bayesian Shape from Silhouettes

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This paper extends the likelihood kernel density estimate of the visual hull proposed by Kim et al [2010] by introducing a prior. Inference of the shape is then performed using a meanshift algorithm over a posterior kernel density function that is refined iteratively using both a multiresolution framework (to avoid local maxima) and using KNN for selecting the best reconstruction basis at each iteration. This approach allows us to recover concave areas of the shape that are usually lost when estimating the visual hull.
Pivot-based Indexes for Fast Retrieval in Large-scale Photo Collections

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Pivot-based indexing schemes can be used to accelerate visual retrieval in collections with a large number of photos. In our system, images are represented by the Joint Composite Descriptor as signatures combining color, texture and spatial information, with indexing performed by the M-Index and PP-Index. The paper presents an evaluation of these indexing methods on two large photo collections, MIRFlickr-25k and SAPO-Labs. Experiments revealed that, with the same number of pivots and prefix size, the M-Index has lower storage and processing requirements than the PP-Index, while providing results faster and with better precision. Randomly choosing pivots in the M-Index and the PP-Index provides the best precision scores, and using a diversity-based algorithm substantially reduces storage requirements while increasing build and search times.
Shape retrieval and recognition on mobile devices

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This paper presents a proof-of-concept shape/contour-based visual recognition and retrieval approach with the main goal of lightweight implementation on mobile devices locally, not relying on network connection or server side processing. In such circumstances the focus needs to be on effectiveness and simplicity, while still preserving high level of functionality (i.e. good recognition). Application areas involve offline object recognition and template matching (e.g. for authorization and blind aid applications), and various object categorizations either in pre-processing or in full local processing.
Directionally Selective Fractional Wavelet Transform

Using a 2-D Non-Separable Unbalanced Lifting Structure

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In this paper, we extend the recently introduced concept of fractional wavelet transform to obtain directional subbands of an image. Fractional wavelet decomposition is based on two-channel unbalanced lifting structures whereby it is possible to decompose a given discrete-time signal $x[n]$ sampled with period $T$ into two sub-signals $x_1[n]$ and $x_2[n]$ whose average sampling periods are $pT$ and $qT$, respectively. Fractions $p$ and $q$ are rational numbers satisfying the condition: $1/p + 1/q = 1$. Filters used in the lifting structure are designed using the Lagrange interpolation formula. 2-d separable and non-separable extensions of the proposed fractional wavelet transform are developed. Using a non-separable unbalanced lifting structure, directional subimages for five different directions are obtained.
Visible and Infrared Image Registration Employing

Line-based Geometric Analysis

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We present a new method to register a pair of visible (ViS) and infrared (IR) images. Unlike most of existing systems that align interest points of two images, we align lines derived from edge pixels, because the interest points extracted from both images are not always identical, but most major edges detected from one image do appear in another image. To solve feature matching problem, we emphasize the geometric structure alignment of features (lines), instead of descriptor-based individual feature matching. This is due to the fact that image properties and patch statistics of corresponding features might be quite different, especially when one compares ViS image with long wave IR images (thermal information). However, the spatial layout of features for both images always preserves consistency. The last step of our algorithm is to compute the image transform matrix, given minimum 4 pairs of line correspondence. The comparative evaluation for algorithms demonstrates higher accuracy attained by our method when compared to the state-of-the-art approaches.
Texture Recognition using Robust Markovian Features

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We provide a thorough experimental evaluation of several state-of-the-art textural features on four representative and extensive image databases. Each of the experimental textural databases ALOT, Bonn BTF, UEA Uncalibrated, and KTH-TIPS2 aims at specific part of realistic acquisition conditions of surface materials represented as multispectral textures. The extensive experimental evaluation proves the outstanding reliable and robust performance of efficient Markovian textural features analytically derived from a wide-sense Markov random field causal model. These features systematically outperform leading Gabor, Opponent Gabor, LBP, and LBP-HF alternatives. Moreover, they even allow successful recognition of arbitrary illuminated samples using a single training image per material. Our features are successfully applied also for the recent most advanced textural representation in the form of 7-dimensional Bidirectional Texture Function (BTF).
EmotiWord: Affective Lexicon Creation with Application to Interaction and Multimedia Data

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We present a fully automated algorithm for expanding an affective lexicon with new entries. Continuous valence ratings are estimated for unseen words using the underlying assumption that semantic similarity implies affective similarity. Starting from a set of manually annotated words, a linear affective model is trained using the least mean squares algorithm followed by feature selection. The proposed algorithm performs very well on reproducing the valence ratings of the Affective Norms for English Words (ANEW) and General Inquirer datasets. We then propose three simple linear and non-linear fusion schemes for investigating how lexical valence scores can be combined to produce sentence-level scores. These methods are tested on a sentence rating task of the SemEval 2007 corpus, on the ChIMP politeness and frustration detection dialogue task and on a movie subtitle polarity detection task.
Rich Internet Application for Semi-Automatic Annotation of Semantic Shots on Keyframes

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This paper describes a broadcaster system developed for semi-automatic keyframe-based semantic shot annotation. The tool aims at optimizing the traditional indexation process by substituting manual annotation for automatic annotation and validation. The system is based on supervised learning binary SVM classifiers over a set of MPEG-7 descriptor that are generic for all kind of application contexts. The resulting models are remotely accessed through web services from a graphical user interface that provides the necessary tools to edit and validate the automatic suggestions. The classification engine has been tested on the multiclass problem of semantic shot detection, a type of metadata used by archivists to index new content ingested in the system. The detection performance has been assessed in two different domains: soccer and parliament. The detection engine is complemented by a Rich Internet Application that accesses the classification system via a web service. The graphical user interface provides an intuitive framework for validating and editing the semantic shot labels predicted by the detection engine. The system has been described as complete and easy to use by the professional archivists at a broadcasting company.
Labeling TV stream segments with Conditional Random Fields

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In this paper, we consider the issue of structuring large TV streams. More precisely, we focus on the labeling problem: once segments have been extracted from the stream, the problem is to automatically label them according to their type (e.g., programs vs. commercial breaks). In the literature, several machine learning techniques have been proposed to solve this problem: Inductive Logic Programming, numeric classifiers like SVM or decision trees...

In this paper, we assimilate the problem of labeling segments to the problem of labeling a sequence of data. We propose to use a very effective approach based on another classifier: the Conditional Random Fields (CRF), a tool which has proved useful to handle sequential data in other domains. We report different experiments, conducted on some manually and automatically segmented data, with different label granularities and different features to describe segments. We demonstrate that this approach is more robust than other classification methods, in particular when it uses the neighbouring context of a segment to find its type. Moreover, we highlight that the segmentation and the choice of features to describe segments are two crucial points in the labeling process.
Foreground objects segmentation for moving camera scenarios based on SCGMM

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In this paper we present a new system for segmenting non-rigid objects in moving camera sequences for indoor and outdoor scenarios that achieves a correct object segmentation via global MAP-MRF framework formulation for the foreground and background classification task. Our proposal, suitable for video indexation applications, receives as an input an initial segmentation of the object to segment and it consists of two region-based parametric probabilistic models to model the spatial (x,y) and color (r,g,b) domains of the foreground and background classes. Both classes rival each other in modeling the regions that appear within a dynamic region of interest that includes the foreground object to segment and also, the background regions that surrounds the object. The results presented in the paper show the correctness of the object segmentation, reducing false positive and false negative detections originated by the new background regions that appear near the region of the object.
A Plausible Texture Enlargement and Editing

Compound Markovian Model

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This paper describes high visual quality compound Markov random field texture model capable to realistically model multispectral bidirectional texture function, which is currently the most advanced representation of visual properties of surface materials. The presented compound Markov random field model combines a non-parametric control random field with analytically solvable widesense Markov representation for single regions and thus allows very efficient non-iterative parameters estimation as well as the compound random field synthesis. The compound Markov random field model is utilized for realistic texture compression, enlargement, and powerful automatic texture editing. Edited textures maintain their original layout but adopt anticipated local characteristics from one or several parent target textures.
Bidirectional Texture Function Simultaneous

Autoregressive Model

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The Bidirectional Texture Function (BTF) is the recent most advanced representation of visual properties of surface materials. It specifies their altering appearance due to varying illumination and viewing conditions. Corresponding huge BTF measurements require a mathematical representation allowing simultaneously extremal compression as well as high visual fidelity. We present a novel Markovian BTF model based on a set of underlying simultaneous autoregressive models (SAR). This complex but efficient BTF-SAR model combines several multispectral band limited spatial factors and range map sub-models to produce the required BTF texture space. The BTF-SAR model enables very high BTF space compression ratio, texture enlargement, and reconstruction of missing unmeasured parts of the BTF space.
Real Time Image Analysis for Infomobility

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In our society the abundant number of source of information available from various sensors, is still to be fully exploited for a global improvement in urban living. Among these information a big role is played by images and multimedia data (i.e. coming from CCTV and surveillance videos, traffic cameras, etc.). This along with the wide availability of embedded sensor platforms and low-cost cameras – together with the developments in wireless communication – make it now possible the conception of pervasive intelligent systems based on vision. Such systems may be understood as distributed and collaborative sensor networks, able to produce, aggregate and process images in order to understand the observed scene and communicate the relevant information found about it. In this paper, we investigate the characteristics of image processing algorithms coupled to visual sensor networks. In particular the aim is to define strategies to accomplish the tasks of image processing and analysis over these systems which have a rather strong constraint in the available power for computation and transmission of data. Thus, such embedded platforms, cannot use advanced computer vision and pattern recognition methods that are power consuming, but on the other hand the platform is able to exploit a multi-node strategy that allows to perform a hierarchical processing, in order to decompose a complex task into simpler problems. In order to apply and test the described methods, a solution to a visual sensor network for infomobility is proposed. The experimental setting considered is two-folded: acquisition and integration of different views of parking lots, and acquisition and processing of traffic-flow images, in order to provide a complete description of a parking scenario and its surrounding area.
Tracking the saliency features in images based on human observation statistics

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We address the statistical inference of saliency features in the images based on human eye-tracking measurements. Training videos were recorded by a head-mounted wearable eye-tracker device, where the position of the eye fixation relative to the recorded image was annotated. From the same video records, artificial saliency points (SIFT) were measured by computer vision algorithms which were clustered to describe the images with a manageable amount of descriptors. The measured human eye-tracking (fixation pattern) and the estimated saliency points are fused in a statistical model, where the eye-tracking supports us with transition probabilities among the possible image feature points. This HVS-based statistical model results in the estimation of possible tracking paths and region of interest areas of the human vision. The proposed method may help in image saliency analysis, better compression of region of interest areas and in the development of more efficient human-computer-interaction devices.
Analysis of Human Gaze Interactions with Texture and Shape

Jiří Filip, Pavel Vácha, and Michal Haindl

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Understanding of human perception of textured materials is one of the most difficult tasks of computer vision. In this paper we designed a strictly controlled psychophysical experiment with stimuli featuring different combinations of shape, illumination directions and surface texture. Appearance of five tested materials was represented by measured view and illumination dependent Bidirectional Texture Functions. Twelve subjects participated in visual search task - to find which of four identical three dimensional objects had its texture modified. We investigated the effect of shape, texture and illumination direction on subjects attention. We are not looking at low level salience, as the task is to make a high level quality judgment. Our results revealed several interesting aspects of human perception of different textured materials and, surface shapes.
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