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Ana Fred · Maria De Marsico  
Gabriella Sanniti di Baja (Eds.)

# Pattern Recognition Applications and Methods

5th International Conference, ICPRAM 2016  
Rome, Italy, February 24–26, 2016  
Revised Selected Papers

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# Preface

The present book includes extended and revised versions of a set of selected papers from the 5th International conference on Pattern Recognition Applications and Methods (ICPRAM 2016), held in Rome, Italy, during February 24–26, 2016. The purpose of the conference is to represent a major point of contact between researchers working along different research lines in the areas of pattern recognition, both from theoretical and application perspectives.

The papers represent the 10% most interesting and relevant part of those received for the conference. They were selected by the event chairs and their selection is based on a number of criteria that include the classifications and comments provided by the Program Committee members, the session chairs' assessment of presentation, and also the program chairs' global view of all papers included in the technical program. The authors of selected papers were then invited to submit a revised and extended version of their papers having a sufficient amount of innovative material, with respect to discussion of the proposed approaches, presentation of theoretical as well as operational details, and experiments.

We hope that the papers selected to be included in this book contribute to the understanding of relevant trends of current research on pattern recognition, especially in the areas covered by this book.

A first subdivision of the papers presented in this book is of course between papers related to methods and theoretical approaches, and those related to specific applications. The value of the former relies in providing support for possible implementation and improvement of applications and further field advancement. The latter are robust, reliable, and flexible in the measure they rely on solid methodological bases.

The first paper dealing with methods is “Experimental Evaluation of Graph Classification with Hadamard Code Graph Kernels” by Tetsuya Kataoka and Akihiro Inokuchi. Kernel methods are used to efficiently classify into the same class those graphs that have similar structures. The authors propose a novel graph kernel that can be used in this kind of operation that is based on the Hadamard code. The paper presents the Hadamard code kernel (HCK) and shortened HCK (SHCK), a version of HCK that compresses vertex labels in graphs. The performance and practicality of the proposed method are demonstrated in experiments that compare the computation time, scalability, and classification accuracy of HCK and SHCK with those of other approaches.

The paper “Document Clustering Games in Static and Dynamic Scenarios” by Rocco Tripodi and Marcello Pelillo proposes a game theoretic model for document clustering. Each document is represented as a player and each cluster as a strategy. The players receive a reward interacting with other players, according to the quality of the adopted strategy. Even in this case, the geometry of the data is modeled by a weighted graph that encodes the pairwise similarity among documents. Weights condition the

chosen strategies. The system was evaluated using 13 document datasets with different settings.

In their paper “Criteria for Mixture-Model Clustering with Side-Information,” Edith Grall-Maës and Duc Tung Dao consider mixture models using side-information, and use them for cluster analysis. Side-information gives the constraint that some data in a group originate from the same source. In this work the authors adapt three usual criteria, which are the Bayesian information criterion (BIC), the Akaike information criterion (AIC), and the entropy criterion (NEC), so that they can take into consideration the side-information.

The paper “Near-Boolean Optimization — A Continuous Approach to Set Packing and Partitioning” by Giovanni Rossi proposes to exploit near-Boolean functions to address the packing problem. Given a family of feasible subsets of the ground set, the packing problem is to find a largest subfamily of pairwise disjoint family members. The problem is first translated into a continuous version, with the objective function taking values on peculiar collections of points in a unit hypercube. Feasible solutions for the original combinatorial optimization problem are included in extremizers, and this allows for a gradient-based local search.

The book then presents the paper “Approximate Inference in Related Multi-output Gaussian Process Regression” by Ankit Chiplunkar, Emmanuel Rachelson, Michele Colombo, and Joseph Morlier. A relevant issue raised with Gaussian process regression is efficient inference when scaling up to large datasets. In this paper, the authors use approximate inference techniques upon multi-output kernels enforcing relationships between outputs. A multi-output kernel is a covariance function over correlated outputs. The main contribution of the paper is the application and validation of the proposed methodology on a dataset of real aircraft flight tests, achieved by also imposing knowledge of aircraft physics into the model.

Papers dealing with specific applications often start from considering specific new kinds of sensors. This is the case of the paper “An Online Data Validation Algorithm for Electronic Nose” by Mina Mirshahi, Vahid Partovi Nia, and Luc Adjéngue. An electronic nose is one of the lesser known achievements in pattern recognition applications. An e-nose is a device that is trained to analyze the chemical components of an odor. It consists of an array of gas sensors for chemical detection, and a mechanism for pattern recognition to return the odor concentration. The latter defines the identifiability and perceivability of an odor. Specific impairment of the e-nose, and further environmental factors, e.g., wind, humidity, temperature, may introduce noise into the measurements, and affect recognition results. The paper proposes an online algorithm to evaluate the validity of sensor measurements during the sampling before using the data for pattern recognition phase.

One of the tasks included in image understanding is duplicate or near-duplicate retrieval. Among the local feature detectors and descriptors used for this task, the paper “Near-Duplicate Retrieval: A Benchmark Study of Modified SIFT Descriptors” by Afra’a Ahmad Alyosef and Andreas Nürnberger especially focuses on SIFT descriptors. The authors evaluate the accuracy and performance of variations of SIFT descriptors (reduced SIFT versions, RC-SIFT-64D, the original SIFT-128D) and SURF-64D, both using benchmarks of various sizes, and using one particular benchmark but extracting varying amounts of descriptors. Moreover, they also provide

results of a comparative performance analysis using benchmarks generated by combining several image affine transformations.

Activity recognition is gaining a relevant role of its own in many application fields. The paper “Activity Recognition for Elderly Care by Evaluating Proximity to Objects and Human Skeleton Data” by Julia Richter, Christian Wiede, Enes Dayangac, Ahsan Shahenshah, and Gangolf Hirtz deals with remote control of activities of daily living (ADLs) of elderly for ambient-assisted living (AAL). The paper presents an algorithm that detects activities related to personal hygiene. The approach is based on the evaluation of pose information and a person’s proximity to objects belonging to the typical equipment of bathrooms, such as sink, toilet, and shower. Moreover, a skeleton-based algorithm recognizes actions using a supervised learning model.

The paper “Real-Time Swimmer Tracking on Sparse Camera Array” by Paavo Nevalainen, M. Hashem Haghbayan, Antti Kauhanen, Jonne Pohjankukka, Mikko-Jussi Laakso, and Jukka Heikkonen deals with the analysis of swimming patterns from data captured from multiple cameras. This task is very important in a video-based athletics performance analysis. The presented real-time algorithm allows one to perform the planar projection of the image, fading the background to protect the intimacy of other swimmers, framing the swimmer at a specific swimming lane, and eliminating the redundant video stream from idle cameras. The generated video stream can be further analyzed. The geometric video transform accommodates a sparse camera array and enables geometric observations of swimmer silhouettes. The methodology allows for unknown camera positions and can be installed in many types of public swimming pools.

Recognition can also support higher-level tasks. In the paper “Fundamentals of Nonparametric Bayesian Line Detection” by Anne C. van Rossum, Hai Xiang Lin, Johan Dubbeldam, and H. Jaap van den Herik, Bayes approach is explored to solve the problem of line detection. In fact, line detection is a fundamental problem in the world of computer vision and a component step of higher-level recognition/detection activities.

The paper by Humberto Sossa and Hermilo Sánchez, “Computing the Number of Bubbles and Tunnels of a 3-D Binary Object,” presents specific techniques to achieve separately the two results that can be used in a further analysis step.

An unusual application is presented in the paper “Raindrop Detection on a Windshield Based on Edge Ratio” by Junki Ishizuka and Kazunori Onoguchi. The method exploits data from an in-vehicle single camera. The rationale for this application is that raindrops on a windshield cause various types of bad influence for video-based automobile applications, such as pedestrian detection, lane detection and so on. For this reason, it is important to understand the state of the raindrop on a windshield for a driving safety support system or an automatic driving vehicle.

Last but not least, the paper “Comparative Analysis of PRID Algorithms Based on Results Ambiguity Evaluation” by V. Renò, A. Cardellicchio, T. Politi, C. Guaragnella, and T. D’Orazio deals with one of the faster-developing areas of pattern recognition that is most quickly developing at present, namely, biometric recognition. The re-identification of a subject among different cameras (Person Re-Identification or PRID) is a task that implicitly defines ambiguities, e.g., raising when images of two individuals dressed in a similar manner or with a comparable body shape are analyzed

by a computer vision system. The authors propose an approach to find, exploit, and classify ambiguities among the results of PRID algorithms.

To conclude, we would like to thank all the authors for their contributions, and also the reviewers who helped ensure the quality of this publication. Finally, thanks are also due to the INSTICC staff that supported both the conference and the preparation of this book.

February 2016

Ana Fred  
Maria De Marsico  
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