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# Pattern Recognition Applications and Methods

7th International Conference, ICPRAM 2018
Funchal, Madeira, Portugal, January 16–18, 2018
Revised Selected Papers

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# Preface

The present book includes the extended and revised versions of a set of selected papers from the 7th International Conference on Pattern Recognition Applications and Methods (ICPRAM 2018), held in Funchal, Madeira, Portugal, during January 16–18, 2018.

The ICPRAM series of conferences aims at becoming an important point of contact for researchers, engineers, and practitioners in the areas of pattern recognition, whose scope is continuously expanding. Both theoretical and application perspectives are jointly taken into account, aiming at an effective synergy with increasingly advanced implementations. The conference especially welcomes interdisciplinary research. The core of its program is intended to include theoretical studies yielding new insights in pattern recognition methods, as well as experimental validation and concrete application of pattern recognition techniques to real-world problems.

In this framework, ICPRAM 2018 received 102 submissions from 33 countries. The authors of the best conference papers were invited to contribute to this book by submitting the revised and extended versions of their conference papers. Candidate papers were selected by the ICPRAM 2018 chairs who based their choice on a number of criteria. These criteria included the scores and comments provided by the Program Committee reviewers, the assessment of the presentations by the session chairs, as well as the global view by program chairs of all the papers presented at ICPRAM 2018. The extensions were requested to have at least 30% innovative material including, e.g., further theoretical in-depth analysis and/or new experiments. The new papers underwent a two-round reviewing process, at the end of which the ten papers in this book were accepted.

We hope that this book will contribute to the understanding of relevant trends of current research in pattern recognition application and methods. Similarly to the conference organization, the ten papers in this book have been divided into the two main tracks: Applications and Methods. The seven papers dealing with methods are presented first, since they have a more general scope, and each of them may offer inspiration for different applications. Then the three papers presenting a wide variety of applications follow.

In "TIMIT and NTIMIT Phone Recognition Using Convolutional Neural Networks" by Cornelius Glackin, Julie Wall, Gérard Chollet, Nazim Dugan, and Nigel Cannings, an application of convolutional neural networks is presented for phone recognition. Both the TIMIT and NTIMIT speech corpora are employed and their phonetic transcriptions are used to label spectrogram segments in the training phase of the convolutional neural network. Phonetic rescoring is then performed to map each phone set to the smaller standard set.

In "Interactive Design Support for Architecture Projects During Early Phases Based on Recurrent Neural Networks" by Johannes Bayer, Syed Saqib Bukhari, and Andreas Dengel, the production of an architectural project is treated as an iterative design

algorithm, in which high-level ideas and requirements are transformed into a specific building description. This process is usually carried out in a manual and labor-intensive manner, while in this paper a semi-automatic approach is presented to assist the developer by proposing suggestions for solving individual design steps automatically.

The paper "An Efficient Hashing Algorithm for NN Problem in HD Spaces" by Faraj Alhwarin, Alexander Ferrein, and Ingrid Scholl proposes a new hashing method to efficiently cope with nearest neighbor (NN) search in high-dimensional search spaces. In these spaces, the complexity grows exponentially with dimension and the data tends to show strong correlations between dimensions. The developed approach entails splitting the search space into subspaces based on a number of jointly independent and uniformly distributed circular random variables (CRVs), which are computed from the data points.

In "Stochastic Analysis of Time-Difference and Doppler Estimates for Audio Signals" by Gabrielle Flood, Anders Heyden, and Karl Aström, the pairwise comparison of sound and radio signals is considered to estimate the distance between two units that send and receive signals. Some methods are robust to noise and reverberation, but give limited precision, while sub-sample refinements are more sensitive to noise, but give higher precision when they are initialized close to the real translation. In this paper, stochastic models are presented that explain the precision limits of such sub-sample time-difference estimates.

The paper "Street2Fashion2Shop: Enabling Visual Search in Fashion E-commerce Using Studio Images," by Julia Lasserre, Christian Bracher and Roland Vollgraf, deals with visual search, in particular as regards the street-to-shop task of matching fashion items, displayed in everyday images, with similar articles. Street2Fashion2Shop is a pipeline architecture that stacks Studio2Fashion, a segmentation model responsible for eliminating the background in a street image, with Fashion2Shop, an improved model matching the remaining foreground image with "title images." The latter are front views of fashion articles on a white background. Both segmentation and product matching rely on deep convolutional neural networks. The pipeline allows for circumventing the lack of quality annotated wild data by leveraging specific data sets at all steps.

In the paper "Earth Mover's Distance Between Rooted Labeled Unordered Trees Formulated from Complete Subtrees" by Taiga Kawaguchi, Takuya Yoshino and Kouichi Hirata, earth mover's distances (EMDs) are introduced for rooted labeled trees formulated from complete subtrees. The EMDs are shown to be metrics and are computed in O(n3{\}log n) time, where n is the maximum number of nodes in two given trees.

The paper "CNN-Based Deep Spatial Pyramid Match Kernel for Classification of Varying Size Images" by Shikha Gupta, Manjush Mangal, Akshay Mathew, Dileep Aroor Dinesh, Arnav Bhavsar, and Veena Thenkanidiyoor addresses the issues of handling varying size images in convolutional neural networks (CNNs). Two approaches are considered. The first approach explores deep spatial pyramid match kernel (DSPMK) to compute a matching score between two varying size sets of activation maps. In the second approach, spatial pyramid pooling (SPP) layer in CNN architectures is used to remove the fixed-length constraint, and to allow the original varying size image as input to train and fine-tune the CNN for different datasets.

In “Detection and Classification of Faulty Weft Threads Using Both Feature-Based and Deep Convolutional Machine Learning Methods” by Marcin Kopaczka, Marco Saggiomo, Moritz Güttler, Kevin Kielholz, and Dorit Merhof, a novel computer vision approach is presented to automatically detect faulty weft threads on air-jet weaving machines. The system consists of a camera array for image acquisition and a classification pipeline, where different image processing and machine learning methods are used to precisely localize and classify defects.

Video activity recognition using support vector machines (SVMs) is treated in “Video Activity Recognition Using Sequence Kernel-Based Support Vector Machines” by Sony S. Allappa, Veena Thenkanidiyoor, and Dileep Aroor Dinesh. Videos include sequences of sub-activities, where sub-activities correspond to video segments. Segments are encoded by means of feature vectors and each video is represented as sequences of feature vectors. GMM-based encoding schemes and bag-of-visual-word vector representation are considered to encode video segments. Building the SVM-based activity recognizer requires suitable kernels matching the sequences of feature vectors. To this purpose, time flexible kernel, segment level pyramid match kernel, segment level probability sequence kernel, and segment level Fisher kernel are employed.

In “Visual Cryptography for Detecting Hidden Targets by Small-Scale Robots” by Danilo Avola, Luigi Cinque, Gian Luca Foresti and Daniele Pannone, a vision-based system is presented to find encrypted targets in unknown environments by using small-scale robots and visual cryptography. The robots acquire the scene by a standard RGB camera and use a visual cryptography-based technique to encrypt the data. Encrypted data are subsequently sent to a server that will decrypt and analyze it for searching target objects or tactic positions. The experiments have been performed by using two robots, i.e., a small-scale rover in indoor environments and a small-scale unmanned aerial vehicle (UAV) in outdoor environments, to show the effectiveness of the proposed system.

We would like to close this preface by thanking all the authors for their contributions and also the reviewers, who helped to ensure the quality of this publication. Pattern recognition is a continuously evolving and multifaceted discipline, and it is hard to account for all possible applications, but we hope that the papers in this book can provide a significant sample or present research to encourage new achievements.

January 2018

Maria De Marsico
Gabriella Sanniti di Baja
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