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EDITORIAL

Non-parametric distance-based classification techniques and their applications

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Pattern Recognition is a key scientific field of longstanding tradition, with origins in the early years of computer science. Today, Pattern Recognition has reached a level of maturity that allows us to build highly sophisticated systems, which perform very different tasks. Nevertheless, its evolution has opened up a number of new problems, ranging from specific algorithms to system integration, which remain elusive and assure a long life for this research field.

The field is progressing rapidly, and an air of excitement among researchers is being created by the increasing scope of applications to which Pattern Recognition is relevant, and by the many technical advances that have been made in recent years. One reason Pattern Recognition is such a rapidly developing field lies in the fact that modern societies have entered the "data era." An unprecedented investment is being made in the collection of data, with archives being formed on an enormous scale. Biological data are being acquired using increasingly fast machines to scan genomes, hyperspectral satellite imagery is being stored on a massive scale, and web documents are appearing at an explosive rate in internet, and so on. The development of effective ways for extracting useful information from these data stores is an overall challenge to computer science as a discipline. This goal drives much of present pattern recognition and machine learning research.

This Special Issue aims to provide a platform for Pattern Recognition researchers to present their newly developed techniques and applications in the area of non-parametric Pattern Recognition. From a practical point of view, non-parametric classification is one of the most relevant classification approaches for real world problems. From a theoretical point of view, it is still a very active area of research in spite of the fact of being a classical topic of the field.

Areas of interest for this special journal issue included, but were not limited to the following topics: distance based classification in metric and non metric spaces, feature selection and extraction, prototype selection, editing and condensing, non supervised distance-based classification, and applications.

We received 45 manuscripts. Fifteen manuscripts were finally selected for this Special Issue after being reviewed by at least three external reviewers. The accepted papers can be broadly thought of as being representative of the breadth of concerns in areas like discriminant analysis, advanced nearest neighbour classification, online learning, dissimilarity-based classification, and covering a wide range of application domains.

The paper "Distance-based Discriminant Analysis Method and its Applications" by Kosinov and Pun presents a new approach for finding discriminative linear transformations from inter-observation distances. The proposed method is suitable for both binary and multiple category problems and allows for a kernel-based extension that overcomes the linearity assumption of the initial formulation.

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The paper "On Kernel Difference-Weighted k-Nearest Neighbor Classification" by Zuo, Zhang and Wang proposes a kernel difference-weighted k-nearest neighbour method. The proposed solution defines the weighted KNN rule as a constrained optimization problem, and describes an efficient solution to compute the weights of different nearest neighbours. Later, the solution is extended to its kernel version.

In the paper "Online nonparametric discriminant analysis for incremental subspace learning and recognition" by Raducanu and Vitrià, a novel approach for online subspace learning based on an incremental version of the Nonparametric Discriminant Analysis (NDA) is presented. Using this method, new samples can be added asynchronously to the system, at different time stamps, as soon as they become available.

The paper "On the *k*-NN Performance in a Challenging Scenario of Imbalance and Overlapping" by García, Mollineda and Sánchez introduces an extensive analysis of the behaviour of the k-NN rule when learning from imbalanced and overlapped data.). As a result, a number of useful conclusions for classifier design are inferred.

Ndong Nguéma and Saint-Pierre present in their paper "Model-Based Classification with Dissimilarities: a Maximum Likelihood Approach" a novel supervised classification analysis from an observed dissimilarity table. The work concentrates on developing model-based classifiers for dissimilarity, which take into account the measurement error w.r.t. Euclidean distance.

The paper "A Sparse Bayesian Approach for Joint Feature Selection and Classifier Learning" by Lapedriza, Seguí, Masip and Vitrià presents a new method for joint feature selection and classifier learning using a sparse Bayesian approach. These tasks are performed by optimizing a global loss function that includes a term associated with the empirical loss and another one representing a feature selection and regularization constraint on the parameters. The method is fully developed for a well-known non-parametrical classification method, the Relevance Vector Machine (RVM).

The paper "Feature Selection, Mutual Information, and the Classification of High-Dimensional Patterns" by Bonev, Escolano and Cazorla propose a novel feature selection filter for supervised learning, which relies on the efficient estimation of the mutual information between a high dimensional set of features and the classes with the aid of the entropic-graphs approximation of Renyi entropy, and the subsequent approximation of the Shannon one.

In the paper "Converting Non-parametric Distance-Based Classification to Anytime Algorithms" by Xi, Ueno, Keogh and Lee a new method to convert the nearest neighbour classifier into an anytime algorithm that can produce an instant classification with an accuracy that is dependent on the learning time is proposed. The method is applied to a range of different problems in order to show its performance.

The paper "Classification of dissimilarity data with a new flexible Mahalanobis-like metric" by Manolova and Guérin-Dugué describes a new method for discriminant analysis from dissimilarity data. The approach is inspired by the Gaussian classifier and the decision rules are defined to mimic the behaviour of a linear or a quadratic classifier. The method is compared to state-of-the art techniques such as Support Vector Machines and Nearest Neighbour classifier.

The paper "Prototype reduction using an Artificial Immune Model" by Garain describes a prototype selection method for the Nearest Neighbour classifier that is inspired in an Artificial Immune System. The clonal selection model of immunology has been incorporated to condense the original prototype set and the performance is verified by employing the proposed technique in a practical optical character recognition system as well as for training and testing of a set of benchmark databases available in the public domain. This method improves the classification performance of the Nearest Neighbour classifier and also reduces its storage and computing time requirements.

The paper "Efficient Distance-Based Per-Pixel Texture Classification with Gabor Wavelet Filters" by Melendez, Garcia and Puig describes an efficient solution to the problem of per-pixel classification of textured images with multichannel Gabor wavelet filters. The method is based on an automatic prototype selection for each texture class. Results with Brodatz compositions and outdoor images, and comparisons with alternative classification techniques are presented.

In the paper "Binarized Eigenphases Applied to Limited Memory Face Recognition Systems" by Zaeri, Mokhtarian and Cherri a novel solution for efficient face recognition problem to be used in memory-limited memory devices is described. The new technique applies the principal component analysis to the binarized phase spectrum of the Fourier transform of the covariance matrix constructed from the MPEG-7 Fourier Feature Descriptor vectors of the images. The proposed technique increases the face recognition rate and at the same time achieves substantial savings in the computational time, when compared to other known systems.

The paper "Diversity-Based Combination of Non-parametric Classifiers for EMG Signal Decomposition" by Rasheed, Stashuk and Kamel several non-parametric classification procedures based on a certainty measure and nearest neighbour rule for motor unit potential classification (MUP) during electromyographic (EMG) signal decomposition are explored. A diversity-based classifier

fusion approach is developed and evaluated to achieve improved classification performance. Performance of the developed system was evaluated using real and simulated EMG signals and was compared with the performance of the constituent base classifiers and the performance of the fixed ensemble containing the full set of base classifiers.

The paper "Dissimilarity-based Classification of Chromatographic Profiles" by Sousa, Mendonça and Campilho proposes a non-parametric method for the classification of Thin-Layer Chromatographic images from patterns represented in a dissimilarity space. The methodology comprises various phases, including image processing and analysis steps to extract the chromatographic profiles and a classification phase to discriminate among two groups, one corresponding to normal cases and the other to three pathological classes.

The paper "Fusion of textural statistics using a similarity measure: application to texture recognition and segmentation" by Karoui, Fablet, Boucher, Pieczynski and Augustin describes a novel approach for the selection and fusion of textural features that rely on a similarity measure defined as a weighted sum of the Kullback-Leibler measures between empirical feature statistics. The similarity measure is also used within a Bayesian Markov Random Field (MRF) based framework.

Finally, we would like to thank all authors who have submitted their manuscripts to this Special Issue, and to the external reviewers for their invaluable contributions to the reviewing process. We would also like to thank the Editor-in-Chief, Prof. Sameer Singh, for giving us the great opportunity of organizing this special issue.

Author Biographies

Dr. Jordi Vitrià joined the Computer Science Department of the Universitat Autònoma de Barcelona (UAB) in 1986, becoming associated professor in 1991. In 1990, he received the Ph.D. at the UAB on work in mathematical morphology and image analysis. In 2007, he has joined the Applied Mathematics and Analysis Department at the Universitat de Barcelona (UB). Dr. Vitrià has taught courses on various topics in the area of artificial intelligence and computer vision, including undergraduate and graduate courses. He has been, since 1991, the organizer of several activities related to image analysis, computer vision and artificial intelligence. He has published a number of papers related to pattern recognition and computer vision. His research has focused on the application of machine learning techniques to visual object recognition problems as well as to the development of statistical machine learning techniques.

Dr. Petia Radeva received the Ph.D. degree in development of physics-based models applied to image analysis from the Universitat Autònoma de Barcelona (UAB). She joined as an Associate Professor the Applied Mathematics and Analysis Department, Universitat de Barcelona in 2007. Her present research interest is concentrated on the development of physics-based and statistical approaches for object recognition, medical image analysis, and industrial vision. She is a member of the IEEE.

Filiberto Pla received the Degree and Ph.D. degree in physics from the University of Valencia, Valencia, Spain, in 1989 and 1993, respectively. He is currently a Full Professor in the Departament de Llenguatges i Sistemes Informàtics, Universitat Jaume I, Castellón de la Plana, Spain. His current research interests are colour and spectral image analysis, visual motion analysis, active vision, and pattern recognition techniques applied to image processing. Prof. Pla is a member of the International Association for Pattern Recognition.