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Editorial

Pattern recognition in interdisciplinary perception and intelligence

1. Introduction

This special issue came to our mind to celebrate the 50th anniversary of the field of Artificial Intelligence (AI) (Casals and Fernández-Caballero, 2007; Fernández-Caballero et al., 2008), with the aim of showing the interdisciplinarity of the fields of Pattern Recognition (PR), Intelligence and Perception, being them artificial or natural. Pattern Recognition is a field with a strong relation to Artificial Intelligence, although basically oriented to solve engineering problems in a large number of applications, and other systems like perception where the processing of sensory data is required for its interpretation.

The name of Artificial Intelligence was coined by J. McCarthy (Dartmouth College, New Hampshire), M.L. Minsky (Harvard University), N. Rochester (I.B.M. Corporation) and C.E. Shannon (Bell Telephone Laboratories) in 1955, when they proposed to hold the "Dartmouth summer research project on ARTIFICIAL INTELLIGENCE", known now as the Dartmouth Conference. The Dartmouth Conference was held during the summer of 1956, to discuss various aspects of learning and intelligence that could be simulated on machines. Pattern Recognition had been one of the important fields in AI (Minsky, 1961) until the early 1970's when the first IJCPR (International Joint Conference on Pattern Recognition) was organised. The name of Pattern Recognition appeared later on with the objective of developing techniques in the area of classification oriented to solve engineering problems. Both areas share objectives and applications that can be solved in different ways.

Pattern Recognition is the research area which studies the operation and design of systems that recognise patterns in data. It embraces sub-disciplines like discriminant analysis, feature extraction, error estimation, cluster analysis (together sometimes called statistical pattern recognition); grammatical inference, parsing and matching (sometimes called syntactical and structural pattern recognition). Pattern Recognition is largely related to other techniques such as Computer Vision, Fuzzy Sets, Neural Networks and Kernel Classifiers and to fields like Speech Recognition and Biological Perception, among others.

Pattern Recognition is a discipline that started at the beginning of the 1960's (Sebestyen, 1962; Nilsson, 1965; Fu, 1968; Fukunaga, 1972; Meisel, 1972; Duda and Hart, 1973) in the area of statistical pattern recognition, focusing on the development of techniques based on the statistical and probability theory. Several incipient problems were first studied using these techniques; learning theory, for example, was first analyzed as a statistical pattern recognition problem (Nilsson, 1965) and the first models to explain biological neural nets, Perceptrons (Rosenblatt, 1962; Minsky and Papert, 1969), were also based on those techniques. The field of Pattern Recognition was then extended to new techniques that allow to describe patterns by a set of repetitive primitives, based on grammar theory (Fu, 1974) and matching structured patterns (strings, trees and graphs) (Pavlidis, 1972; Pavlidis, 1977; Bunke and Sanfeliu, 1990). In the last few years, new statistical techniques have become popular in the field (e.g. Bayesian Networks and Kernel classifiers, where Support Vector Machines (SVM) is one of the most well-know techniques of the last one).

The field of Pattern Recognition became very soon related to perception because of the similarity of the underlying processes in both disciplines. Perception is defined in psychology and the cognitive sciences as the process of acquiring, interpreting, selecting and organizing sensory information. Pattern Recognition is defined as the process of acquiring, processing, extracting features and classifying input patterns, for example from sensors. In both disciplines the sensory information is acquired, processed and then interpreted (classified) to give an output that in the case of perception systems will be used for interpreting, selecting or organizing.

Perception is a basic system in human beings to learn and interact with the environment, where all the sensory systems are involved (vision, auditory, tactile, smell and taste sensors). Although other perception systems may be useful, they are not used by human beings (for example, infrared or ultraviolet vision). Vision was one of the earliest perception systems to be studied, due to its large scope of applicability. The first work on vision was done in the decade of the 1950's and the first system to recognize 3D

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objects was fulfilled by L. Roberts (Roberts, 1963). Later, 3D scene analysis (blocks or indoor and outdoor scenes) became popular in AI. Optical character reading was also another of the pioneer works on vision, due to its important applications such as reading the addresses in envelopes for automatic classification (Fischer et al., 1962).

At present, Pattern Recognition is almost in all the areas of perception, where vision systems are probably the most known; and they are used in biometrics, industry, medicine, space, robotics, natural science, etc. Nonetheless, speech recognition systems have also become very popular as interactive helping systems in telephonic systems. During the last few years, multimodal human interaction is receiving increasing attention due to the necessity of tools for human-robot interaction in dynamic and changing environments. In this area, Pattern Recognition and Computer Vision are basic techniques, and examples of them are interactive translation and transcription of music and text images, interactive retrieval of multimedia content, interactive face recognition and other biometric applications, medical imaging assisted diagnosis, computer assisted document layout analysis, multimodal dialogue systems (for mobile telephones and information access devices like PDAs), cooperative tracking and recognition of human actions or assisted vehicle driving and human-robot interaction.

This special issue not only presents some novel works on Pattern Recognition, Artificial Intelligence and Perception, but also on application of PR techniques (such as statistical PR theory) or clustering to problems in AI (such as machine translation, news classification, or social pattern classification).

2. A preview of the papers

Seventeen papers were planned for this special issue on "Pattern Recognition in Interdisciplinary Perception and Intelligence". Unfortunately, due to a failure of the production process, three papers were published as regular papers. The first three papers in this special issue are close to the natural intelligence present in many Pattern Recognition techniques. Thus, the paper titled "Learning to learn: from smart machines to intelligent machines" by B. Raducanu and J. Vitrià makes a review of different learning strategies and context types that are involved in the learning process. This paper also presents the results of a study on cognitive development applied to the problem of face recognition for social robotics. In "Applying machine consciousness models in autonomous situated agents", R. Arrabales Moreno and A. Sanchis de Miguel briefly describe the most relevant current approaches to the implementation of scientific models of consciousness. Moreover, a novel pragmatic functional approach to machine consciousness is proposed and discussed. The paper entitled "Agent based modelling and simulation for the analysis of social patterns" by J. Pavón, M. Arroyo, S. Hassan and C. Sansores proposes the use of agent-based graphical modelling languages, which can help to specify social systems as multiagent systems in a more convenient way. This is complemented with transformation tools which enable to analyse and derive emergent social behavioural patterns by using the capabilities of existing simulation platforms.

The next three papers of the special issue deal with clustering/classification techniques. The paper "Boosting recombined weak classifiers" by J.J. Rodríguez and J. Maudes proposes a variant of the most well-known boosting method, AdaBoost. It is based on considering, as the base classifiers for boosting, not only the last weak classifier, but a classifier formed by a number of the last selected weak classifiers. The paper by E. González, A. Adán, V. Feliú and L. Sánchez titled "Active object recognition based on Fourier descriptors clustering" presents a new 3D object recognition/pose strategy based on Fourier descriptors clustering for silhouettes. The method solves the ambiguity problem – due to object symmetries or similar projections belonging to different objects – by taking a minimum number of additional views of the scene which are selected through a heuristic next best view algorithm. In third place, the paper "On the use of different loss functions in statistical pattern recognition applied to machine translation" by J. Andrés-Ferrer, D. Ortiz-Martínez, I. García-Varea and F. Casacuberta deals with the minimisation of the classification risk. The risk function is defined in terms of loss functions that measure the penalty for wrong decisions. The work is focused on the study of different loss functions, and especially on those loss functions that do not depend on the class proposed by the system.

The next two papers are related to the use of Neural Networks in Pattern Recognition. "Towards the experimental evaluation of novel supervised fuzzy adaptive resonance theory for pattern classification" by A. Akhbardeh, Nikhil, P.E. Koskinen and O. Yli-Harja is a paper presenting a comparative analysis of novel supervised fuzzy adaptive resonance theory, multilayer perceptron and competitive neural trees networks over three pattern recognition problems, namely the two well-known patterns IRIS and Vowel data, and biological Hydrogen data. The paper with the title "Real-time facial feature localization by combining space displacement neural networks" by S.M. Hanif, L. Prevost, R. Belaroussi and M. Milgram presents a new facial feature localizer that uses a kind of auto-associative neural network trained to localize specific facial features (like eyes and mouth corners) in orientation-free face images.

Segmentation and Scene Understanding are very interesting topics in Pattern Recognition. The following three papers are related to them. "3D scene analysis from a single range image through occlusion graphs" by P. Merchán, A.S. Vázquez, A. Adán and S. Salamanca is a paper that presents a new strategy to extract knowledge about the objects and their relative location in a complex scene when a single range image is taken. The paper "On the correspondence between objects and events for the diagnosis of situations in visual surveillance tasks" by R. Martínez,

M. Rincón, M. Bachiller and J. Mira explores a constructivist approach based on using the usual Artificial Intelligence techniques and methods to establish correspondences between the entities and relations of the ontologies at object and activity levels in visual surveillance systems. Lastly, the paper "Modeling human color categorization", by E.L. van den Broek, Th.E. Schouten and P.M.F. Kisters, introduces a unique colour space segmentation method, founded on features of human cognition, where 11 colour categories are used in processing colour.

"The scaling problem in the pattern recognition approach to machine translation" by D. Ortiz-Martínez, I. García-Varea and F. Casacuberta is a paper proposing a general framework that deals with the scaling problem in statistical machine translation without introducing significant time overhead by means of the combination of different scaling techniques. This new framework is based on the use of counts instead of probabilities, and on the concept of cache memory.

The special issue closes with a couple of papers on learning and optimization. "BayesChess: A computer chess program based on Bayesian networks" by A. Fernández and A. Salmerón introduces a chess program able to adapt its game strategy to its opponent, as well as to adapt the evaluation function that guides the search process according to its playing experience. The adaptive and learning abilities have been implemented through Bayesian networks. And lastly, the paper "Multi-dimensional visual tracking using scatter search particle filter" by J.J. Pantrigo, A. Sánchez, A.S. Montemayor and A. Duarte proposes an algorithm called scatter search particle filter (SSPF), which hybridizes particle filters and the scatter search metaheuristic. Specifically, the authors compare the performance in different instances of 2D articulated object tracking problem and 2D multiple object tracking.

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Antonio Fernández-Caballero
Instituto de Investigación en Informática de Albacete (I3A), Departamento de Sistemas Informáticos, Universidad de Castilla-La Mancha, Spain
Tel.: +34 967 599200; fax: +34 967 599224
E-mail address: caballer@dsi.uclm.es

Alberto Sanfeliu
Institut de Robótica i Informática Industrial (UPC-CSIC), Department of Enginyeria de Sistemes, Automatica i Informatica Industrial, Universitat Politècnica de Catalunya, Spain

Yoshiaki Shirai
Department of Human and Computer Intelligence, School of Information Science and Engineering, Ritsumeikan University, Japan

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