

Guest Editorial on Decision Making in Human and Machine Vision

GRANULAR information processing is one of the human-inspired problem-solving aspects of natural computing, as information abstraction is inherent in human thinking and reasoning processes, and plays an essential role in human cognition. Among the different facets of natural computing fuzzy sets, rough sets and their hybridization are well accepted paradigms that are based on the construction, representation and interpretation of granules, as well as the utilization of granules for problem solving. These tools are also known as primary constituents of soft computing whose objective is to provide flexible information processing capability for handling real-life ambiguous situations. They have been successfully employed in various image processing tasks, including image segmentation, enhancement and classification, both individually or in combination with other computing techniques. The reason of such success is rooted to the fact that they provide powerful tools to describe uncertainty, naturally embedded in images, which can be exploited in various image processing tasks.

Granular computing offers a novel approach to managing uncertainty in discovering data dependencies, relevance of features, mining of patterns, feature space dimensionality reduction, and classification of objects in image analysis. The individual capability of fuzzy sets, rough sets, artificial neural networks, genetic algorithms and probabilistic reasoning in granular processing for performing these tasks has been established adequately. This is the topic discussed in this issue where the effectiveness of neural computing and probabilistic reasoning along with other computing paradigms is demonstrated in certain decision-making tasks in human and machine vision.

Biologically-inspired or artificial neural networks are adopted in the papers authored by Quinton *et al.*, and Ferone and Maddalena. In “The cat is on the mat. Or is it a dog? Dynamic competition in perceptual decision making,” by Quinton *et al.*, the authors report a biologically motivated neural model based on dynamic competition and active vision, which uses predictive power of the features for computing evidence accumulation and guiding active vision. The reported results about simple perceptual decision-making tasks highlight how perceptual decision-making and the resolution of perceptual ambiguities are efficiently handled with dynamic competition, parallel specification and selection of multiple alternatives through prediction.

In “Neural background subtraction for PTZ cameras,” by Ferone and Maddalena, the authors proposed a neural-

based background subtraction approach to moving object detection in image sequences taken from PTZ cameras, where the background model automatically adapts in a self-organizing way to changes in the scene background. Results on several real image sequences and comparisons with state-of-the-art methods demonstrate the accuracy of the proposed approach in segmenting images in moving foreground, independently from background variations such as waving trees, shadows cast by moving objects, and PTZ camera variations.

Probabilistic or abductive reasoning is adopted in the papers authored by Borji *et al.*, Zhang *et al.*, and Atif *et al.* In “What/where to look next? Modeling top-down visual attention in complex interactive environments,” by Borji *et al.*, the authors model top-down overt visual attention based on graphical models for probabilistic inference and reasoning. Specifically, a dynamic Bayesian network is described to infer probability distributions over attended objects and spatial locations directly from observed data, or better from manual annotations of objects in video scenes or by state-of-the-art object detection/recognition algorithms. The proposed model is shown to be more effective in employing and reasoning over spatiotemporal visual data compared with the state-of-the-art.

In “Human pose estimation and tracking via parsing a tree structure based human model,” by Zhang *et al.*, the authors designed two efficient Markov chain dynamics under the data-driven Markov chain Monte Carlo framework to explore the high dimensional state space in human pose estimation and tracking, later parsing the tree structure state space into a lexicographic order according to the image observations and body topology. Experimental results demonstrate the efficiency and effectiveness of the proposed method in estimating and tracking various kinds of human poses, even against cluttered backgrounds, in poor illumination or under partial self-occlusion.

Scene understanding can also benefit from prior structural knowledge and reasoning. In “Explanatory reasoning for image understanding using formal concept analysis and description logics,” by Atif *et al.*, the authors formulated a model-based scene understanding as an abductive reasoning process, according to which a scene is considered an observation and the interpretation is defined as the best explanation on the basis of the terminological knowledge, part of a description logic about the scene context, obtained from morphological operators applied on the corresponding concept lattice. It is also shown that the adopted operators are sound and complete, satisfying peculiar rationality postulates of abductive reasoning.

However, over the years, the synergistic combination of two or more technologies have been found to be more effective than individuals. This is of particular relevance in image recognition or vision system where algorithms of different kinds may need to be designed to represent and manipulate the uncertainties, involved at every processing stage, arising from fuzziness in boundary regions, rough resemblance in gray levels and pixels, and randomness in occurrence of levels. These algorithms may, in turn, enable the system to retain as much information content of the data as possible till the highest level is reached. The output of the system will then possess minimal uncertainty and, unlike conventional systems, will not be biased or affected much by lower level decisions.

ALFREDO PETROSINO, *Senior Member, IEEE, Guest Editor*
University of Naples Parthenope
Napoli 80133, Italy

SANKAR K. PAL, *Fellow, IEEE, Guest Editor*
Indian Statistical Institute
Kolkata 700108, India

Alfredo Petrosino (SM'09) is Full Professor of Computer Science at the University of Naples Parthenope, Napoli, Italy, where he heads the research laboratory CVPRLab (<http://cvprlab.uniparthenope.it>). He has held various positions at the University of Salerno, Salerno, Italy, the International Institute of Advanced Scientific Studies, and the National Institute for the Physics of Matter, and was a Researcher and Senior Researcher at the National Research Council. He taught at the University of Salerno, the University of Naples Federico II, Napoli, and the University of Naples Parthenope. He has co-edited ten books and more than 100 research publications in the areas of computer vision, image and video analysis, pattern recognition, neural networks, fuzzy and rough sets, and data mining.

Prof. Petrosino is a member of the International Association for Pattern Recognition, USA, and the International Neural Networks Society, USA. He is an Associate Editor of the *Pattern Recognition Journal*, a member of the Editorial Board of *Pattern Recognition Letters*, *International Journal of Knowledge Engineering* and *Soft Data Paradigms*, and an Editor of *Fuzzy Sets and Systems*, *Image and Vision Computing*, and *Parallel Computing*.

Sankar K. Pal (F'93) received the Ph.D. degrees from Calcutta University, Kolkata, India, and Imperial College, London, U.K.

He joined the Indian Statistical Institute, Kolkata, in 1975, as a CSIR Senior Research Fellow where he became a Full Professor in 1987, a Distinguished Scientist in 1998, and the Director in 2005. He is currently a Distinguished Scientist with the Indian Statistical Institute and was its former Director. He is also a J. C. Bose Fellow with the Government of India. He founded the Machine Intelligence Unit and the Center for Soft Computing Research at the institute in Kolkata which are enjoying international recognition. He was with the University of California, Berkeley, CA, USA, University of Maryland, College Park, MD, USA, the NASA JSC, Houston, TX, USA, and U.S. Naval Research Laboratory, Washington, DC, USA. He has co-authored 17 books and more than 400 research publications in the areas of pattern recognition and machine learning, image processing, data mining, web intelligence, soft computing, and bioinformatics.

Dr. Pal is a fellow of the TWAS, IAPR, IFSA, and all four national academies for science and engineering in India. He has been serving as a Distinguished Visitor of the IEEE Computer Society since 1987 and has held several visiting positions in Italy, Poland, Hong Kong, and Australian universities. He has been on editorial boards of more than 20 journals, including IEEE TRANSACTIONS. He has received several national and international awards, including the most coveted science award, the S. S. Bhatnagar Prize, in 1990 and the civilian award Padma Shri in 2013 in India.