

Guest Editors' Introduction to the Special Section on Energy Minimization Methods in Computer Vision and Pattern Recognition

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THIS issue contains the second special section of papers on Energy Minimization Methods in Computer Vision and Pattern Recognition (EMMCVPR), the first of which was published in the November 2003 issue of *TPAMI*. The papers in this special section address the topical problems of optimization via graph-cuts, learning complex deformable models in the absence of correspondences, and graph-spectral methods for image segmentation.

The first paper in the special section, "What Energy Functions Can Be Minimized via Graph Cuts?" by V. Kolmogorov and R. Zabih, is devoted to graph-cut algorithms applied to the solution of optimization problems in computer vision. In particular, the authors characterize the set of energy functions that can be minimized by this class of algorithms. In addition to its theoretical importance, this paper will be of interest to researchers contemplating the application of graph-cut algorithms to a specific problem: The paper gives conditions for the success of this choice and shows how to build the appropriate graph.

In the next paper, "Unsupervised Learning of an Atlas from Unlabeled Point-Sets," H. Chui, A. Rangarajan, J. Zhang, and C. Morison Leonard describe a fast and efficient method for atlas estimation from unlabeled point-sets. Correspondences, deformations, and the atlas are simultaneously estimated. The problem is posed as one of Bayesian maximum a posteriori probability estimation. The method has been applied to 2D atlas estimation and a 3D implementation is also described on a real hippocampal data set.

The final paper, "Segmentation Given Partial Grouping Constraints" by S.X. Yu and J. Shi, addresses the issue of

clustering with prior partial grouping information by casting it as a constrained optimization problem. This formulation allows the propagation of the available (sparse) partial grouping information to the remaining unlabelled data. The approach is carried out using the normalized cuts criterion and applied to real image segmentation problems. The results reported testify to the feasibility of integrating image structures with partial prior knowledge in a single grouping method. They also show that it is possible to perform object-background segregation without full object knowledge.

We hope that the papers appearing in the two special sections will serve as a catalyst for further work and discussion in this exciting area.

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Mário A.T. Figueiredo (S'87-M'95-SM'2000) received the EE, MSc, and PhD degrees in electrical and computer engineering, all from the Instituto Superior Técnico (I.S.T.), the engineering school of the Technical University of Lisbon, Portugal, in 1985, 1990, and 1994, respectively. Since 1994, he has been with the Department of Electrical and Computer Engineering, I.S.T. He is also a researcher and area coordinator at the Institute of Telecommunications, Lisbon. In 1998, he held a visiting position with the Department of Computer Science and Engineering of Michigan State University, East Lansing. His scientific interests include image processing and analysis, computer vision, statistical pattern recognition, and statistical learning. He received the Portuguese IBM Scientific Prize in 1995 for his work on unsupervised image restoration. He is an associate editor of the journals *Pattern Recognition Letters*, *IEEE Transactions on Image Processing*, and *IEEE Transactions on Mobile Computing*; he is also a guest coeditor of special issues of the journals *IEEE Transactions on Pattern Analysis and Machine Intelligence* and *IEEE Transactions on Signal Processing*. He was cochair of two workshops on energy minimization methods in computer vision and pattern recognition (EMMCVPR '01, held in Sophia Antipolis, France, and EMMCVPR '03, held in Lisbon, Portugal). He is a senior member of the IEEE.

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Edwin R. Hancock studied physics as an undergraduate at the University of Durham and graduated with honors in 1977. He remained at Durham to complete the PhD degree in the area of high-energy physics in 1981. Following this, he worked for 10 years as a researcher in the fields of high-energy nuclear physics and pattern recognition at the Rutherford-Appleton Laboratory (now the Central Research Laboratory of the Research Councils). During this period, he

also held adjunct teaching posts at the University of Surrey and the Open University. In 1991, he moved to the University of York as a lecturer in the Department of Computer Science. He was promoted to senior lecturer in 1997 and to reader in 1998. In 1998, he was appointed to a chair in computer vision. Professor Hancock now leads a group of some 15 faculty, research staff, and PhD students working in the areas of computer vision and pattern recognition. His main research interests are in the use of optimization and probabilistic methods for high and intermediate level vision. He is also interested in the methodology of structural and statistical pattern recognition. He is currently working on graph-matching, shape-from-X, image databases, and statistical learning theory. His work has found applications in areas such as radar terrain analysis, seismic section analysis, remote sensing, and medical imaging. He has published more than 80 journal papers and 300 refereed conference publications. He was awarded the Pattern Recognition Society medal in 1991 and an outstanding paper award in 1997 by the journal *Pattern Recognition*. In 1998, he became a fellow of the International Association for Pattern Recognition. He has been a member of the editorial boards of the journals *IEEE Transactions on Pattern Analysis and Machine Intelligence* and *Pattern Recognition*. He has also been a guest editor for special editions of the journals *Image and Vision Computing* and *Pattern Recognition*. He has been on the program committees for numerous national and international meetings. In 1997, with Marcello Pelillo, he established a new series of international meetings on energy minimization methods in computer vision and pattern recognition.



Josiane Zerubia received the MSc degree from the Department of Electrical Engineering at ENSIEG, Grenoble, France, in 1981, and the Doctor Engineer degree in 1986, the PhD degree in 1988, and an "Habilitation" in 1994, all from the University of Nice Sophia-Antipolis, France. She has been permanent research scientist at INRIA since 1989. She has been director of research since July 1995. She was head of a remote sensing laboratory (PASTIS,

INRIA Sophia-Antipolis) from mid-1995 to 1997. Since January 1998, she has been in charge of a new research group working on remote sensing (ARIANA, INRIA-CNRS-University of Nice). She has been an adjunct professor at Sup'Aero (ENSAE) in Toulouse since 1999. Before that, she was with the Signal and Image Processing Institute at the University of Southern California (USC) in Los Angeles as a postdoctoral researcher. She also worked as a researcher for LASSY (University of Nice and CNRS) from 1984 to 1988 and in the research lab of Hewlett Packard in France and in Palo Alto, California, from 1982 to 1984. She is a fellow of the IEEE. She was part of the IEEE IMDSP Technical Committee (SP Society) from 1997 to 2003, associate editor of the *IEEE Transactions on Image Processing* from 1998 to 2002. She has been member-at-large of the board of governors of the IEEE Signal Processing Society since 2002, area editor of *IEEE Transactions on Image Processing* since 2003. She has also been a member of the editorial board of the French Society for Photogrammetry and Remote Sensing (SFPT) since 1998. She has been cochair of two workshops on energy minimization methods in computer vision and pattern recognition (EMMCVPR '01, Sophia Antipolis, France, and EMMCVPR '03, Lisbon, Portugal), chair of a workshop on photogrammetry and remote sensing for urban areas, Marne La Vallee, France, 2003. Her current research interest is image processing using probabilistic models or variational methods. She also works on parameter estimation and optimization techniques.



Marcello Pelillo received the "Laurea" degree with honors in computer science from the University of Bari, Italy, in 1989. From 1988 to 1989, he was at the IBM Scientific Center in Rome, where he was involved in studies on natural language and speech processing. In 1991, he joined the faculty of the University of Bari, Italy, as an assistant professor of computer science. Since 1995, he has been with the University of Venice, Italy, where he is currently

an associate professor of computer science. He held visiting research positions at Yale University, University College London (England), McGill University (Canada), the University of Vienna (Austria), and York University (England). His research interests are in the area of computer vision, pattern recognition, and neural computation, where he has published more than 90 papers in refereed journals, handbooks, and conference proceedings. He has organized a number of scientific events, including the Neural Information Processing Systems (NIPS) 1999 Workshop on Complexity and Neural Computation: The Average and the Worst Case (Breckenridge, Colorado, December 1999). In 1997, he established a new series of international workshops devoted to energy minimization methods in computer vision and pattern recognition (EMMCVPR) and, in 2000, he was a guest coeditor of a special issue of the journal *Pattern Recognition* on this theme. In 2001, he was a guest coeditor of a special issue of the *IEEE Transactions on Pattern Analysis and Machine Intelligence* devoted to "graph algorithms in computer vision." He has been on the program committees of several international conferences and workshops and serves on the editorial board for the journal *Pattern Recognition*. Professor Pelillo is a member of the IEEE Computer Society, the International Association for Pattern Recognition, and the Pattern Recognition Society.