Special Section on Computational Intelligence in Image Processing

Ling Guan
University of Sydney
Department of Electrical Engineering
Sydney, New South Wales 2006
Australia
E-mail: ling@ee.usyd.edu.au

Sun-Yuan Kung
Princeton University
Department of Electrical Engineering
E-Quad B230
Princeton, New Jersey 08544

David B. Fogel
Natural Selection, Inc.
3333 North Torrey Pines Court, Suite 200
La Jolla, California 92037

This special section serves as a forum for recent developments in computational intelligence (CI) in image processing. CI covers a broad range of intelligent techniques. Although neural networks, fuzzy logic, and evolutionary computation have been recognized as the mainstream, other techniques incorporating human intelligence have also contributed to the evolution of CI. In image processing, CI has provided new approaches to integrate human intelligence into the research and development of methodology, algorithms, and systems. Some of the CI-based techniques have produced results which cannot be achieved by the traditional methods.

The 15 papers published in this special section cover a wide range of computational intelligence techniques and applications in various image processing tasks. The first paper by Kobayashi et al. presents evolutionary programming for identifying the reflective function using stereo vision and shape from shading in shape reconstruction.

Three papers in the section explore modularity and hierarchy of neural networks. Takatsuka and Jarvis show that, incorporating human perception, the cascade of different neural networks is able to learn and recognize 3-D objects that consist of various shapes of surface. Taur and Tao introduce the concept of fuzzy texture spectrum, and show that, combined with a hierarchical decision-based neural network, the method can yield high accuracy in texture classification. Kong and Guan demonstrate that a hierarchical tree Kohonen map is able to accurately represent 2-D shapes and contribute to effective detection and elimination of impulse noise.

The next two papers are concerned with neural networks in segmentation, a difficult yet important task in image processing. Both papers incorporate statistical methods to establish the processing models. While Chen and Chen explicitly map a cellular neural network onto the image spatial domain, Zhang and Wang use a Markov random field approach to implicitly simulate the features of recurrent back-propagation networks, taking human perception into consideration.

We have four papers dealing with popular applications of neural networks and fuzzy functions. Rabi and Lu developed a system based on a recurrent neural network to perform image guided speech recognition. The system is able to distinguish between words with common segments, and tolerates to a great extent variable-duration words of the same class. Wong and Yau introduce a linear neural network method to resolve limited angle problems in computer-aided tomography. Lu, Chi, and Siu use a fuzzy membership function as an after-processing step to improve the performance of a backpropagation network in length estimation of digital strings in automatic off-line digit recognition. Liou and Tai propose a maximum a posteriori criterion to evolve the self-organizing map in image restoration.

To properly acknowledge the contribution of other techniques to CI, five papers dealing with the evidence-based method, an approach closely related to fuzzy analysis, are also included. Lam, West, and Caelli compare the performance of different decision making techniques, and show that “legal constructs” contribute to the training of classifiers. In the analysis of 3-D
man-made objects, Gao proposes using object faces as perceptual entities in accordance with the perceptual phenomena of face-shape consistency and face-pose consistency. Ahmed and Ward present a general system to allow the user to select the degree of having branches in thinning algorithms in handwritten character recognition. Grigoryan and Dougherty studied the robustness of optimal binary filters, which have important applications in document processing. Finally, Chang and Chang demonstrate that edge based motion estimation and region based contour tracking are able to produce very low bit rate video coding of high quality.

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Ling Guan received his PhD degree in electrical engineering from University of British Columbia, Canada, in 1989. He was a Research Engineer at Array Systems Computing Inc., Toronto, Canada, in machine vision and signal processing before starting his academic career with the University of Sydney, Australia, in October 1992, where he is currently a Senior Lecturer in electrical engineering, and is leading the Signal and Multimedia Processing Group. His research interests include computational intelligence, adaptive image and signal processing, computer vision and machine learning, and multimedia signal processing. Since 1994, he has served as an Associate Editor for the Journal of Real-Time Imaging. He is a coguest editor of the Proceedings of the IEEE Special Issue on Computational Intelligence, and a coguest editor of the special section on computational intelligence in image processing for SPIE/IS&T’s Journal of Electronic Imaging. He also serves on the editorial boards of CRC Press’ book series on image processing. He has been involved in organizing numerous international conferences, including the cochairship of the IEEE workshop on real-time applications in 1996 (Montreal), and the program cochairship of IEEE “International Conference on Engineering of Complex Computer Systems” in 1998 (California). He has been invited to speak at numerous international conferences, and has published more than 80 technical papers. He is a senior member of IEEE, and a member of SPIE. He is also a member of the IEEE Signal Processing Society Technical Committee on Neural Networks in Signal Processing.

Sun-Yuan Kung received his PhD degree in electrical engineering from Stanford University and is a professor of electrical engineering at Princeton University. Since 1990, he has served as an Editor-In-Chief of the Journal of VLSI Signal Processing and associate editor on several IEEE Transactions. He has authored more than 300 technical publications. He has authored three books, VLSI Array Processors (Prentice Hall, 1988), Digital Neural Networks (Prentice Hall, 1993), and Principal Component Neural Networks (John Wiley, 1996). He is a Fellow of IEEE. He was appointed as an IEEE-SP Distinguished Lecturer from 1994 to 1996. He received 1996 IEEE Signal Processing Society’s Best Paper Award and 1992 IEEE Signal Processing Society’s Technical Achievement Award. His research interests include VLSI array processors, neural networks, and multimedia signal processing.

David B. Fogel received the PhD degree in engineering sciences (systems science) from the University of California at San Diego (UCSD) in 1992. He was a systems analyst at Titan Systems, Inc. from 1984 to 1988, a senior principal engineer at ORINCON Corporation from 1988 to 1993, and is now the executive vice president and chief scientist at Natural Selection, Inc. in La Jolla, California. He has published more than 100 papers on evolutionary computation in journals and conferences, and is the author of two books, most recently Evolutionary Computation: Toward a New Philosophy of Machine Intelligence (IEEE Press, 1995). He serves as the editor-in-chief of the IEEE Transactions on Evolutionary Computation. He is co-editor-in-chief of the Handbook of Evolutionary Computation (Oxford, 1997), associate editor of BioSystems, and is a member of the editorial boards of Evolutionary Computation and Fuzzy Sets & Systems. He was the technical program chairman for the 1995 IEEE “International Conference on Evolutionary Computation” in Perth, Australia, and is program chairman for the 1998 IEEE “International Conference on Evolutionary Computation” to be held as part of the “World Congress on Computational Intelligence,” in Anchorage, Alaska in May 1998. He was the founding president of the Evolutionary Programming Society (1991) and has served on numerous program committees of conferences in the area of evolutionary computation. He is a member of many technical societies including the American Association for Artificial Intelligence, the Evolutionary Programming Society, Sigma Xi, the American Association for the Advancement of Science, the New York Academy of Sciences, and the IEEE. He is also an associate member of the Center for the Study of Evolution and the Origin of Life (CSEOL) at University of California, Los Angeles.