Special Section on Computational Intelligence in Image Processing

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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 hand-written 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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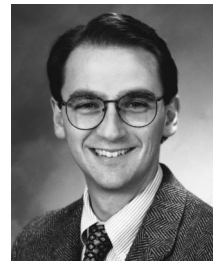
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