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Preface

Ever since the seminal papers by Hopfield and Tank were published in the 1980s, artificial neural networks have been extensively applied to solving optimization and control problems. A lot of effort went into both theoretical and application-oriented research. Various improvements to the initially proposed Hopfield models and several entirely new ideas have come out as a result. On the one hand - much better mappings of optimization problems onto neural networks have been developed. On the other hand - the purely gradient local search type of the Hopfield models has been extended to global optimization methods by combining them with stochastic or chaotic simulated annealing procedures, or other non-gradient optimization techniques.

This special issue aims at presenting various applications of neural network methods to solving optimization and control problems. The goal is to make this presentation as diverse as possible, given the constraints of time and volume of this issue. The methods presented herein include classical Hopfield models and a large number of their modifications, elastic net and self-organizing-maps-based approaches, cascade-correlation network, feed-forward and partly recurrent architectures, evolving multilayer perceptrons, neuro-fuzzy models, and hardware-oriented networks. Application domains include "academic" optimization benchmark problems (such as the travelling salesman problem or the N-queens problem), as well as very practical ones, such as interior lighting design, truck backer-upper control, cold rolling mill thickness control, cartographic description of water basins on satellite images, electrical power demand forecasting, or time series prediction.

The issue begins with two tutorial papers on neural network approaches to solving combinatorial optimization problems. The first one, by Smith, Potvin and Kwok, is a presentation and in-depth discussion of two main classes of neural optimization methods, namely the Hopfield-type gradient models and the deformable template matching methods. The other tutorial paper (by Mańdziuk) focuses on various deterministic, stochastic, chaotic and hybrid extensions of the binary and continuous Hopfield models. In the subsequent paper, a new search method based on chaotic neurodynamics developed by Nanba, Hasegawa, Nishita and Aihara and its successful application to solving lighting design problem are presented. The effictiveness of the proposed chaotic optimization method is confirmed by its comparison with the gradient-type neural network, simulated annealing method and genetic algorithm approach.

In the volume's fourth paper (Funabiki, Kurokawa and Ohta) the N-queens problem is revisited from the VLSI hardware implementation viewpoint. Recon-

figurable hardware devices proposed by the authors allow for designing scalable neural optimization architectures with high-speed computation capabilities.

The two papers that follow are devoted to neuro-fuzzy systems. The application domains are control problems (Rutkowski and Cpaka) and approximation of static and dynamic nonlinear systems (Linh and Osowski).

The next three papers focus on applying neural networks to real-life optimization and control problems. Frayman, Wang and Wan present an approach to the cold rolling mill thickness control problem, a well known steel industry issue, by using the cascade-correlation network. Zaremba and Palenichka address the issue of automatic cartographic description of water basins on satellite images. Self-organizing maps with local shape attributes are applied to solve it. In the next application-oriented paper (Grzenda and Macukow), neural networks are combined with evolutionary programming in an effort to solve the problem of forecasting short-term electrical power demand in Poland.

Finally, the last paper in the volume (Mańdziuk and Miko/lajczak), provides application results of several neural architectures to the chaotic time series prediction problem. The paper's underlying concept is to offer an experimental comparison of feed-forward and partly recurrent networks.

Hoping that the reader would find the volume's content interesting, I should like to thank the authors for their commitment in providing papers for this special issue and the reviewers for their tireless efforts. Without resolve on both sides, the final quality of the volume would have been impossible to achieve.

Warsaw, June 2002