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Editorial

Neural networks: Algorithms and applications

This special issue of *Neurocomputing* includes 24 original articles which are extended versions of selected papers from the Fourth International Symposium on Neural Networks (ISNN 2007).

As a sequel to ISNN 2004/ISNN 2005/ISNN 2006, ISNN 2007 was held in June 2007, in Nanjing, China, an old capital of China and a modern metropolis with 2470-year history. ISNN 2007 provided a high-level international forum for scientists, engineers, and educators to present the state-of-the-art of neural network research and applications in diverse fields. The symposium featured plenary speeches given by worldwide renowned scholars, regular sessions with broad coverage, and some special sessions focusing on popular topics.

Based on the recommendation of symposium organizers and reviewers, a number of authors were invited to submit an extended version of their conference papers for this special issue of *Neurocomputing*. All these articles were thoroughly reviewed once more by at least two independent experts and accepted for publication.

The special issue covers broad aspects of neural networks from theoretical analysis to applications. The selected 24 articles can be divided into three groups. The first group consists of six papers (Ji, Zhang and Wei; Amiri et al.; Wang, Jian, and Guo; Shen and Li; Xu, Wang, and Liao; Liao, Luo, and Zeng) that deal with stability analysis of neural networks. The second group has six papers on prediction using neural networks (Valenzuela et al.; Zhou et al.; Huang, Chen and Li; Wang, Men and Lu; Lin et al.; Qiao and Wang). The third group contains 12 papers which discuss other applications of neural networks such as learning machines (Wei and Li; Huang et al.; Er and Zhou; Lim), clustering and classification (Lee and Yang; Cervantes et al.; Tong, Liu and Tong), approximation (Cao, Xie and Xu; Wang, Yang, Wu and Luo), identification (Kong et al.) and control (Zhang et al.; Wang et al.).

The special issue starts with the first group which begins with the paper by Ji, Zhang, and Wei on global robust stability of Cohen-Grossberg neural networks with multiple delays and uncertainties. The stability criteria take the form of linear matrix inequality (LMI) and turn out to be less restrictive. In the second paper, Amiri et al. investigate the dynamical behavior and the stability properties of fixed points in a feedback autoassociative memory, propose a multi-layer perceptron (MLP) for associative memory and show the advantages over a self-feedback neural network through computer simulations. Wang, Jian, and Guo discuss the existence and uniqueness and the global exponential stability of the equilibrium point for Cohen–Grossberg type BAM neural networks with time-varying delays and continuously distributed delays, and derive several sufficient conditions ensuring existence and uniqueness of the equilibrium point and the global exponential stability which include some previously known criteria. Shen and Li study the problem of finite-time boundedness for neural networks with parameter uncertainties, derive a sufficient condition to guarantee finite-time boundedness for uncertain neural networks, and give a sufficient condition for certain system. These results are validated by several examples. Xu, Wang, and Liao analyze the stability of high-order Hopfield type neural networks with uncertainties which are assumed to be bounded. Some sufficient conditions are established to guarantee the existence of a globally asymptotically stable equilibrium point for all admissible parametric uncertainties, and the region can be estimated about the equilibrium point of the nominal neural network that contains the equilibria for each parameter vector in the given subset of the parameter space. Liao, Luo, and Zeng study the global exponential stability in the Lagrange sense for various continuous time delayed recurrent neural networks with two different activation functions. Based on the parameters of the system, detailed estimation of global exponential attractive sets and positive invariant sets are presented without any hypothesis on their existence. These theoretical analyses result in narrowing the search field of optimization computation, associative memories, chaos control, and synchronization and provide convenience for applications.

Then, the special issue continues with the second group which starts with the paper by Valenzuela et al. In this paper, the authors present a new procedure to predict time series using paradigms such as fuzzy systems, neural networks, and evolutionary algorithms and obtain an expert system based on paradigms of artificial intelligence so that the linear model can be identified automatically,

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without the need for human expert participation. Zhou et al. propose a novel method for recognizing gene in genomes which combines three famous gene-finding programs. Simulation results indicate that the proposed method has a powerful capability for gene prediction. Huang, Chen, and Li develop the neural network-based surface roughness Pokayoke (NN-SRPo) system to keep the surface roughness within a desired value in an in-process manner. Both the surface roughness prediction and machining parameters control are performed online during the machining process. A testing experiment demonstrates the efficacy of this NN-SRPo system. Wang, Men, and Lu develop an online SVM model to predict air pollutant levels using time series based on the monitored air pollutant database in Hong Kong downtown area. The experiment comparison between the online SVM model and the conventional SVM model (non-online SVM model) demonstrates the effectiveness and efficiency in predicting air quality parameters with different time series. Lin et al. forecast power loads using an adaptive self-tuning approach. The predictor uses the current state of power loads as its input and the next state of power loads can be forecasted precisely. Validation results using practical data indicate that this method is effective. Qiao and Wang propose a new learning algorithm for creating self-organizing fuzzy neural networks (SOFNN) to solve the problem of conventional input–output space partitioning. Simulation studies demonstrate that the present algorithm is superior in terms of compact structure and learning efficiency compared with other approaches.

Next, the special issue includes the third group which starts with the paper by Wei and Li. In their paper, a novel optimum extreme learning machines (ELM) construction method is developed. The performance of the proposed method through UCI benchmark datasets is investigated. Huang et al. extend previously proposed incremental extreme learning machine (I-EML) from real domain to complex domain. It is shown that as long as the hidden layer activation function is complex continuous discriminatory or complex bounded nonlinear piecewise continuous, I-ELM can still approximate any target functions in the complex domain. The universal capability of the I-ELM in complex domain is further verified by two function approximation problems and one channel equalization problem. Er and Zhou present a novel framework for automatic generation of fuzzy neural networks (FNNs) termed hierarchically generated fuzzy neural networks (HGFNN) for realizing machine intelligence. Simulation studies on mobile robot control demonstrate that the proposed method is superior to other existing approaches. Lim proposes a new solution applying the data least squares (DLS) method to the complex extreme learning machine (C-ELM). Simulations show that DLS-based C-ELM outperforms the ordinary-least-square-based method in channel equalization problems. Lee and Yang establish a clustering-based approach to infer recurrent neural networks as regulatory systems. The approach also deals with the scalability problem by developing a clustering method with several data analysis techniques. Experiments show that it can be used to infer gene regulatory networks successfully. Cervantes et al. present a novel SVM classification approach for large data sets by using minimum enclosing ball clustering. Several experimental results show that the approach proposed in this paper has good classification accuracy compared with classic SVM while the training is significantly faster than several other SVM classifiers. Tong, Liu, and Tong address a kind of unsupervised learning neural network model, which has special structure and can realize an evaluation and classification of many groups by the compression of data and the reduction of dimension. The example proves that this method can detect instructions without a mass of supervised data and it converges fast. Cao, Xie, and Xu give a constructive proof of a formula for the upper bound of the approximation error by feedforward neural networks with one hidden layer of sigmoidal units and a linear output when neural networks are designed to approximate arbitrary functions. An example is used to validate the theoretical result. Wang, Yang, Wu, and Luo discuss the problem of direction of arrival (DoA) estimation of ultra wideband (UWB) electromagnetic (EM) waves and present a radial-basis-function neural network (RBFNN)-based approach. The effectiveness of their scheme is demonstrated through several numerical examples. Results show that this method has the characteristic of high accuracy and robustness to mutual coupling, when compared to presently available methods in the literature. Kong et al. propose a novel approach for palmprint identification. A two-stage neural network structure is implemented to measure the degree of similarity in the identification stage. The experimental results demonstrate that the proposed approach is effective and feasible. Zhang et al. present an artificial bionic neural network to control fish-robot locomotion. The fish-robot, inspired by the Gymnarchus niloticus, is modelled as a multijoint dynamic system with parallel connections and composed of several motors. The principle of the central pattern generators (CPGs) governing the locomotion of fish is analyzed. Experimental results of startup, stop, forward swimming, and backward swimming show their validity and efficiency. Wang et al. design a spiking neural network (SNN) for a behavior controller of mobile robot to avoid obstacles using ultrasonic sensory signals. In the controller the integrated-and-firing model is used and the SNN is trained by Hebb learning. Fewer neurons are used in the SNNs of the controller than in classical NNs. Experimental results show that the proposed controller is effective with easy implementation.

Finally, as the guest editors of the special issue, we would like to thank all authors for their submissions. We also would like to express our sincere appreciation to all reviewers for their time and effort, and to the *Neurocomputing* editorial board for their patience and great help!

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