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Editorial

Dynamic Neural Networks for Model-Free Control and Identification

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Neural networks have been used to solve a broad diversity of problems on different scientific and technological disciplines. Particularly, control and identification of uncertain systems have received attention since many years ago by the natural interest to solve problem such as automatic regulation or tracking of systems having a high degree of vagueness on their formal mathematical description. On the other hand, artificial modeling of uncertain systems (where the pair output-input is the only available information) has been exploited by many years with remarkable results.

Within automatic control and identification theory, neural networks must be designed using a dynamic structure. Therefore, the so-called dynamic neural network scheme has emerged as a relevant and interesting field. Dynamic neural networks have used recurrent and differential forms to represent the uncertainties of nonlinear models. This couple of representations has permitted to use the well-developed mathematical machinery of control theory within the neural network framework.

The purpose of this special issue is to give an insight on novel results regarding neural networks having either recurrent or differential models. This issue has encouraged application of such type of neural networks on adaptive control designs or/and no parametric modeling of uncertain systems.

The contributions of this issue reflect the well-known fact that neural networks traditionally cover a broad variety of the thoroughness of techniques deployed for new analysis and learning methods of neural networks. Based on the recommendation of the guest editors, a number of authors were invited to submit their most recent and unpublished contributions on the aforementioned topics. Finally, five papers were accepted for publication.

So, the paper of P. K. Kim and S. Jung titled "*Experimental studies of neural network control for one-wheel mobile robot*" presents development and control of a disc-typed one-wheel mobile robot, called GYROBO. Several models of the one-wheel mobile robot are designed, developed, and controlled. The current version of GYROBO is successfully balanced and controlled to follow the straight line. GYROBO has three actuators to balance and move. Two actuators are used for balancing control by virtue of gyroeffect and one actuator for driving movements. Since the space is limited and weight balance is an important factor for the successful balancing control, careful mechanical design is considered. To compensate for uncertainties in robot dynamics, a neural network is added to the nonmodel-based PD-controlled system. The reference compensation technique (RCT) is used for the neural network controller to help GYROBO to improve balancing and tracking performances. The paper of R. C. Rodríguez and W. Yu "*Robust adaptive control via neural linearization and compensation*" proposes a new type of neural adaptive control via dynamic neural networks. For a class of unknown nonlinear systems, a neural identifier-based feedback linearization controller is first used. Dead-zone and projection techniques are applied to assure the stability of neural identification. Then four types of compensator are addressed. The stability of closed-loop system is also proven. "*Dynamics model abstraction scheme using radial basis functions*" is presented in the paper of S. Tolu et al. where a control model for object manipulation is presented. System dynamics depend on an unobserved external context, for example, work load of a robot manipulator. The dynamics of a robot arm change as it manipulates objects with different physical properties, for example, the mass, shape, or mass distribution. Active sensing strategies to acquire object dynamical models with a radial basis function neural network (RBF) are addressed. The paper "*An output-recurrent-neural-network-based iterative learning control for unknown nonlinear dynamic plants*" presented by Y.-C. Wang and C.-J. Chien deals with a design method for iterative learning control system by using an output recurrent neural network (ORNN). Two ORNNs are employed to design the learning control structure. The first ORNN, which is called the output recurrent neural controller (ORNC), is used as an iterative learning controller to achieve the learning control objective. To guarantee the convergence of learning error, some information of plant sensitivity is required to design a suitable adaptive law for the ORNC. Therefore, a second ORNN, which is called the output recurrent neural identifier (ORNI), is used as an identifier to provide the required information. The problems related to "*3D nonparametric neural identification*" are presented in the paper of R. Q. Fuentes et al., there, the state identification study of 3D partial differential equations (PDEs) using the differential neural networks (DNNs) approximation is given. The adaptive laws for weights ensure the "practical stability" of the DNN trajectories to the parabolic three-dimensional (3D) PDE states. To verify the qualitative behavior of the suggested methodology, a nonparametric modeling problem for a distributed parameter plant is analyzed.

These papers were exploring dissimilar applications of neural networks in control and identification from very different point of view. Despite the number of papers, the spirit of neural networks as a model-independent tool has been emphasized. Moreover, the number of practical examples included in the papers of this issue gives an additional contribution to the theory of dynamic neural network.

Acknowledgments

The editors wish to thank the editorial board for providing the opportunity to edit this special issue on modeling and adaptive control with dynamic neural networks. The guest editors wish also to thank the referees who have critically evaluated the papers within the short stipulated time. Finally we hope the reader will share our joy and find this special issue very useful.

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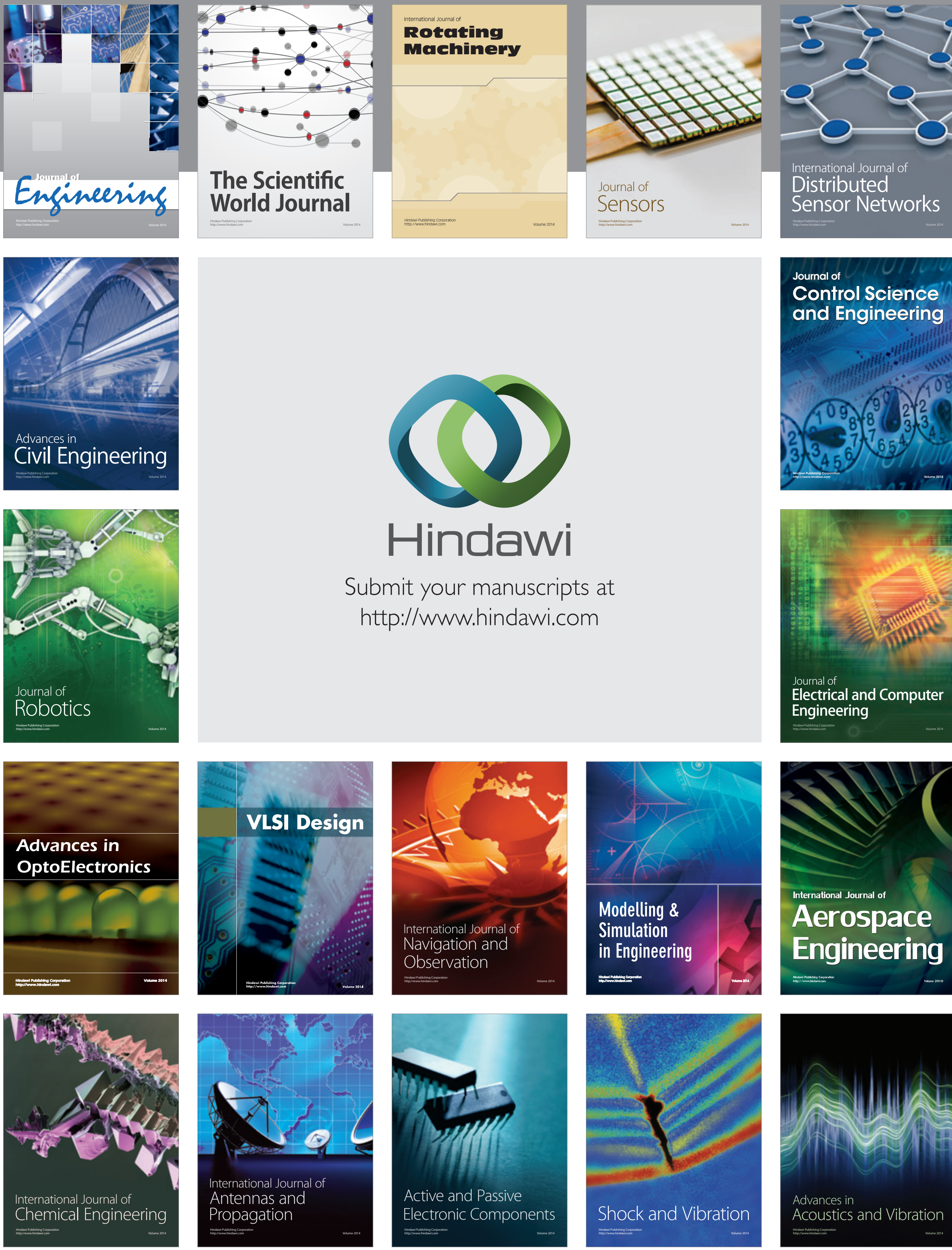
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