Call for Papers

International Journal of Adaptive Control and Signal Processing

Special Issue on

Learning Issues in Feedback Control of Uncertain Dynamical Systems

In the past two decades, there has been a great deal of interest in developing adaptive and learning controllers for uncertain nonlinear systems. Adaptive control using neural networks (NNs) has been one of the main areas of focus. By making use of the general approximation and online learning ability of NNs, adaptive NN controllers have been designed for dynamical systems with uncertain nonlinearities and disturbances. Earlier work on NN-based adaptive control was to employ NNs for system identification and identification-based indirect adaptive control. In later work, closed-loop system structures and stability issues were studied. Various modifications to back-propagation in feed-forward or recurrent NNs have been presented that guaranteed closed-loop stability and weight error boundedness. Recently, NNs have entered the mainstream of control theory as a natural extension of adaptive control to a broad class of nonlinear systems with unknown parameters and nonlinearities. In addition, NN control has been used in conjunction with other control approaches to extend the class of systems that yields to nonparametric control methods.

Although there has been a lot of progress in NN-based adaptive control, there are still lots of learning issues to be studied in adaptive NN control and in feedback control of general uncertain dynamical systems. It is well known that learning is a very desirable characteristic of advanced control systems. Issues in learning have been discussed since about the 1960s together with adaptive control topics, pattern classification, and self-organizing systems. As learning means "acquiring knowledge or skills", a feedback control system with learning properties is one that has the capabilities (i) to acquire knowledge through stable closed-loop interactions with the plant and its environment, (ii) to store the knowledge in memory, and (iii) to reuse the learned knowledge (also called past experience). This is when similar control situations reoccur so that stability and control loop performance can be improved. However, just to gain knowledge in dynamical closed-loop control processes, i.e., learning in a non-stationary environment, is a very difficult problem which has remained unsolved for a long period of time. Furthermore, how to store knowledge in dynamical closed-loop control processes, and how to exploit the knowledge learned in closed-loop control systems, towards improving stability and performance are difficult problems that remain. To address these difficulties reinforcement learning (RL), approximate dynamic programming (ADP) and deterministic learning (DL) methods have all been studied in recent years. However, there are still many challenges in developing learning capabilities in feedback control of general uncertain nonlinear systems.

To solve the above difficult problems related to learning issues in feedback control of uncertain dynamical systems, it will be beneficial to bring together the researchers from adaptive control, neural networks, machine learning and operations research. This special issue will provide a forum for different research efforts towards new learning theory for feedback control with applications to real-world uncertain dynamical systems.

The goals of the proposed special issue are:

- To highlight the on-going research in the field of learning and control, and in particular learning in dynamical or non-stationary environments with its applications to real-world problems.
- To present to the adaptive control and the neural networks community and to others interested in learning and control systems, in general, a variety of new and challenging research directions and their proposed solutions, originating from real-world problems.

The Special Issue papers will cover topics of interest that include a broad range of learning and control problems for uncertain dynamical systems, especially in knowledge acquisition, representation, storage

and utilization in closed-loop feedback control processes. Papers are encouraged but not limited to the following topics:

- Reinforcement learning for adaptive optimal control,
- Approximate dynamic programming and adaptive critics,
- Statistical learning, support vector machines and Gaussian processes for control,
- Deterministic learning theory,
- Dynamical pattern recognition in feedback control,
- Recurrent neural networks for adaptive learning control,
- Applications in aerospace, robotics and industrial process feedback control,

Papers which are mainly linked to approaches based on traditional adaptive control ideas are not sought; papers should reflect the influence of computer science related ideas such as neural nets and reinforcement learning to qualify for consideration in the special issue.

Important Dates:
Submission of full manuscript: **November 30, 2011**

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