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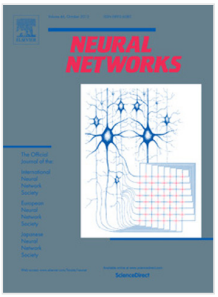

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Adaptive PID Control Based on Orthogonal Endocrine Neural Networks

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Abstract

A new intelligent hybrid structure used for online tuning of a PID controller is proposed in this paper. The structure is based on two adaptive neural networks, both with built-in Chebyshev orthogonal polynomials. First substructure network is a regular orthogonal neural network with implemented artificial endocrine factor (OENN), in the form of environmental stimuli, to its weights. It is used for approximation of control signals and for processing system deviation/disturbance signals which are introduced in the form of environmental stimuli. The output values of OENN are used to calculate artificial environmental stimuli (AES), which represent required adaptation measure of a second network—orthogonal endocrine adaptive neuro-fuzzy inference system (OEANFIS). OEANFIS is used to process control, output and error signals of a system and to generate adjustable values of proportional, derivative, and integral parameters, used for online tuning of a PID controller. The developed structure is experimentally tested on a laboratory model of the 3D crane system in terms of analysing tracking performances and deviation signals (error signals) of a payload. OENN-OEANFIS performances are compared with traditional PID and 6 intelligent PID type controllers. Tracking performance comparisons (in transient and steady-state period) showed that the proposed