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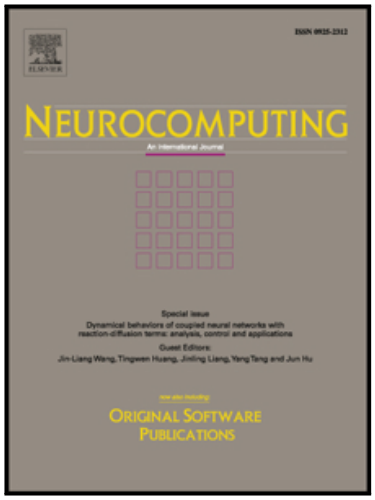

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Adaptive Neural Network Control of a Helicopter System with Optimal Observer and Actor-Critic Design

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Abstract

This paper proposes a methodology for developing an adaptive neural network controller for a simulated helicopter system. Since an indirect adaptive neural network framework is chosen, the controller comprises three interconnected neural networks called the observer, actor and critic. The actor and critic networks rely on the observer network responsible for state estimation. The main contribution of this paper is the development of an observer that has fast convergence capabilities in order to be used in a completely on-line stability control scheme. This improved convergence is obtained by uniquely modifying the observer network structure and update law. The observer parameters are also optimised by means of a genetic algorithm (GA) for improved performance. The developed observer is firstly evaluated on a first principle linear model and then on actual test flight data of an attack helicopter. The results indicate excellent performance in terms of the state estimation capability of the observer. Lyapunov's direct method is used to derive update laws for both the critic and actor networks and the control parameters of these networks are also optimised by means of a multi-objective GA. Actual data from a wind-tunnel test set-up were used for controller evaluation purposes.

Keywords: Artificial Neural Networks, Brunovsky canonical form, Genetic

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