Adaptive Output Feedback Control For Highly Uncertain Nonlinear Systems Using Single Hidden Layer Neural Networks

Authors
H Ait-Abbas, M Belkheiri, B Zegnini

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Description
We develop an adaptive output feedback control methodology for highly uncertain nonlinear systems, in the presence of unstructured uncertainties, such as unmodelled dynamics, and unknown dimension of the regulated system. Given a smooth reference trajectory, the objective is to design a controller that forces the system measurement to track it with bounded errors. A linear in parameters neural network is introduced as an adaptive signal. A simple linear observer is proposed to generate an error signal for the adaptive laws. The network weight adaptation rule is derived from Lyapunov stability analysis, and guarantees that the adapted weight errors and the tracking error are bounded. The theoretical results are illustrated in the design of a controller for a fourth–order nonlinear system of relative degree two, and a tunnel diode circuit example having full relative degree.