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Huang-Hilbert Transform Based Wavelet Adaptive Tracking Control for a Class of Uncertain Nonlinear Systems Subject to Actuator Saturation

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Abstract: In this paper a novel Huang-Hilbert Transform (HHT) based adaptive tracking control strategy is proposed for a class of uncertain systems subjected to actuator saturation. HHT is used in this work for the online feature extraction of the uncertainties in the systems which are approximated by Wavelet Neural Networks (WNNs). Adaptation laws are developed iteratively using the Intrinsic Modal Functions (IMF) for the online tuning of wavelets parameters. The uniformly ultimate boundedness of the closed-loop tracking error is verified even in the presence of WNN approximation errors and bounded unknown disturbances, using the Lyapunov approach and with novel weight updating rules. Finally some simulations are performed to verify the effectiveness and performance of the theoretical development.

Keywords: *Hilbert-Huang transform; empirical mode decomposition; intrinsic mode function; wavelet neural networks; adaptive control; Lyapunov functional.*

1 Introduction

In many practical systems, the system model always contains some uncertain elements; these uncertainties may be due to additive unknown internal or external noise, environmental influence, nonlinearities such as hysteresis or friction, poor plant knowledge, reduced-order models, and uncertain or slowly varying parameters. The analytical study of adaptive nonlinear control systems involving online approximation structures has evolved considerably during the last decade [1–3] The design of online approximation based controllers can be broken up into two stages: first, the unknown nonlinearity is represented by some online approximators. Hence, the designer needs to choose a specific

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