INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student	:	VINAY KUMAR PANDEY
Roll Number	:	10610230
Programme of Study	:	Ph.D.

Thesis Title: ADAPTIVE CONTROLLER DESIGN FOR NONLINEAR UNCERTAIN SYSTEMS USING MULTIPLE MODEL BASED TWO LEVEL ADAPTATION TECHNIQUE

Name of Thesis Supervisor(s)	:	Dr Indrani Kar and Prof Chitralekha Mahanta
Thesis Submitted to the Department/ Center	:	EEE
Date of completion of Thesis Viva-Voce Exam	:	30/07/2018
Key words for description of Thesis Work	:	Adaptive control, Multiple models, Two level adaptation, Nonlinear uncertain systems, Twin Rotor MIMO System, Feedback linearization.

SHORT ABSTRACT

Adaptive control technique is a popular and successful control strategy for controlling nonlinear uncertain systems. However, using adaptive control schemes in parametrically uncertain environments often leads to poor transient response and sluggish steady state response. Use of multiple estimation models has been found to be promising in addressing these issues. This thesis proposes an adaptive control method for nonlinear uncertain systems using multiple model based two level adaptation (MMTLA). At the first level, multiple models are used and a single model at the second level is proposed by combining these first level models for controlling different classes of nonlinear uncertain systems. The proposed control method is applied to nonlinear single-input single-output (SISO) systems with linear and nonlinear parameterizations, nonlinear multiple-input multiple-output (MIMO) coupled systems and nonlinear MIMO model following control systems. For all the considered systems, state transformation and feedback linearization method have been used to algebraically transform nonlinear system dynamics to linear ones. The unknown system parameters are assumed to be bounded within a set of compact parameter space. Multiple estimation models are distributed evenly in this region of uncertainty and their unknown parameters are tuned. The tuning laws for estimator parameters have been obtained using Lyapunov stability criterion. Stability analysis using Lyapunov's criterion has been carried out to assess the close loop stability and tracking error convergence of the overall system. The transient and steady state performances using the proposed scheme are evaluated by performing both simulation and experimental studies, which confirm superior performance of the proposed control technique over some existing adaptive control methods. The commonly known problems with adaptive control systems like oscillatory transient response, poor parameter convergence and sluggish response are found to be improved considerably by using the proposed multiple model based two level adaptation approach.