THESIS INFORMATION

Title: **IDENTIFICATION AND CONTROL OF NONLINEAR TIME-DELAY SYSTEMS USING MULTILAYER FUZZY LOGIC COMBINING SOFT COMPUTING ALGORITHM**

PhD. Student: **Cao Van Kien**

Major: **Control Engineering and Automation**

Major code: **62.52.02.16**

Training institution: **Ho Chi Minh City University of Technology, Viet Nam National University Ho Chi Minh City**

Scientific Supervisors: **Prof. Ho Pham Huy Anh**

Nonlinear systems with uncertainties and disturbances make it difficult to accurately identify the mathematical model of the system. Therefore, the conventional control approaches based on the mathematical model almost do not meet the quality requirements. Therefore, more and more research is focused on intelligent models and controllers applying soft computing techniques based on artificial neural networks, fuzzy logic, and evolutionary optimization algorithms. In this thesis, the author proposes multilayer fuzzy model trained by the differential evolution algorithm to identify and control the nonlinear system. The main contributions of the thesis are summarized as follows:

The first contribution is a multilayer Fuzzy model used in the identification and control nonlinear systems. Multilayer Fuzzy models are created by combining multiple Fuzzy MISO models. Each multilayer Fuzzy MISO model is made up of many traditional Takagi-Sugeno Fuzzy models. The structure and laws of the multilayer Fuzzy model are optimally identified using the differential evolution (DE) algorithm. The results show that multilayer fuzzy model can be used in MIMO model identification and the flexibility of the model has been shown in experiments.

The second contribution is a cascade training algorithm, which uses to train a multi-layered fuzzy model sequentially. The experimental results show that the method increases accuracy and reduces calculation time compared to conventional methods.

Regarding the control problem, the author has two contribution that combining the optimal soft computing algorithm and adaptive control algorithm. The first is a novel adaptive fuzzy sliding

mode algorithm that is the adaptive law has been newly designed and takes advantage of the ability of optimal computing algorithms to identify the initial parameters of the controller. The second control problem is an adaptive inversed model control algorithm that applies the optimal multilayer Fuzzy model by DE algorithm combined with an adaptive fuzzy control algorithm. Both proposed controllers have the characteristics of combining optimization algorithm with an adaptive control algorithm to increase controller quality at startup and guarantee the system meets Lyapunov's stability theory.

Scientific Supervisors	PhD. Student
Prof. Ho Pham Huy Anh	Cao Van Kien