THESIS INFORMATION

Title:	**Identification, control of nonlinear system using a combined neural networks model and differential evolution algorithm**
Major:	Control Engineering and Automation
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Nonlinear systems with uncertainty and disturbance are very difficult to identify by mathematic models accurately. Hence, the control approaches based on mathematical models do not often meet the control requirements. Therefore, many studies based on intelligent control techniques by using various artificial intelligence approaches like neural networks, fuzzy logic and optimization algorithms have been developed in the past few years. To develop an efficient technique for identifying and controlling the nonlinear systems, in the thesis, an artificial intelligence approach by a combined neural networks and improved differential evolution algorithm is proposed. The main features of the proposed method are summarized as follows

Firstly, a conventional differential evolution (DE) algorithm and factors affecting the quality of the DE converge are proposed in research works. Then, improved versions of the DE algorithm called HDE and MDE are proposed.

Secondly, the HDE and MDE algorithm should be applied to train the MLP neural networks to achieve the global optimum solutions and improve the convergence speed.

Thirdly, the NNARX model which is used for identifying the nonlinear systems is created by combining the MLP neural networks with the nonlinear autoregressive exogenous (NARX) model. The weights of the NNARX model are optimized by the HDE or MDE algorithm.

Finally, the proposed hybrid PID-INN controller is used to control the nonlinear systems. The ideas of the proposed controller are as follows. (i) The inverse NNARX (INN) model is utilized to dynamically identify all nonlinear features of the nonlinear systems. The parameters of the INN model are optimized by the HDE or MDE algorithm; (ii) a combination of the INN model that provides a feedforward control signal and the conventional PID controller is used to increase the accuracy and eliminate the steady-state error in the control; (iii) the BP or aBP based Sugeno fuzzy model is used for online updating the weights of the INN model to adapt well to disturbances and dynamic variations of nonlinear system in its operation. Thanks to these combinations, the proposed controller possesses good control quality, strong adaptive ability and robustness in the presence of external disturbances. Simulation and experimental results demonstrated the feasibility and benefits of the proposed control approach.

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