Lehrstuhl Steuerung, Regelung und Systemdynamik

Bachelor/Master thesis
Programming

Model predictive control of a nonlinear MIMO system

Conditions

Duration: 4/6 Months
Requirements: Experience of control theory and Matlab programming
Language: German or English
Target groups: Bachelor/Master students

Content

In practice, the internal structure or mathematical relationship between inputs and outputs of nonlinear systems is hard to be achieved, classical control methods for the nonlinear system cannot easily work. Under this condition, neural networks have been applied very successfully in the identification and control of nonlinear dynamical systems. The universal approximation and prediction capabilities of the multilayer perceptron have made them useful for representing nonlinear models or controllers. In theory, any systems can be approximated by a multilayer neural network, which is generally sufficient with one hidden layer and one output layer.

The purpose of this thesis is to control a nonlinear multi-input multi-output (MIMO) system using a neural network-based model predictive control, which is based on neural network ability of prediction. With the predictive capability, the possible control inputs will be generated on a given set of rules (controllers) considering actuation limitations. The realized control input results from the application of a performance measure. The main objective of this thesis is to develop the existing neural network-based model predictive control by considering a predefined structure for the controller instead of doing optimization at each time step which leads to a high computational time. The main idea is to compare existing approaches with the new one developed in this thesis in order to increase real-time implementation capability.

The steps of this project are as follows:

- A brief literature review of neural network-based model predictive control
- Understanding and analyzing the existing approach and programs
- Theoretical and practical developments of the existing approach
- Replacing of optimization procedure by suitable set of controller rules
- Implementation of the developed approach on a MIMO system
- Analysis and improvement of results
- Complete and detailed documentation/presentation of the research results

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