

## **ABSTRACT**

The purpose of this thesis is to build a neural controller, i.e. a controller based on neural networks, as a means for controlling nonlinear systems. Neural networks constitute an artificial intelligence technique which is becoming very popular within the last few years. Their nonlinear structure makes them ideal for modeling nonlinear systems. Among the different neural network architectures, we selected the Radial Basis Function (RBF) architecture because of its simple structure and the fast learning algorithms it employs. Moreover, the fuzzy means algorithm has been utilized for training the RBF networks, as it provides more accurate models in shorter computational times, compared to conventional methodologies.

The proposed approach was used for controlling a nonlinear DC motor which was simulated using Matlab. Initially we have generated input-output data from the DC motor in order to build an RBF dynamical model of the system. Then neural network models were utilized for control purposes.

Model Predictive Control (MPC) methodologies employ neural networks trained to calculate the output of the system using as input the manipulated variable. Then, an optimization problem is formulated, aiming to minimize the deviation between the actual output and the set point value. However, calculating the solution to the optimization problem is rather computationally demanding, while no optimality is guaranteed. In this work we present a different way to utilize neural networks for control purposes, training the neural controller to learn directly the inverse law that governs the dynamical behavior of the system. This means that the RBF neural controller, uses as inputs the set point value, the current state vector and the current value of the disturbance variable, while produces as output the current value of the manipulated variable.

Results have shown that the proposed approach is fast and reliable, while it exhibits superior performance compared to classical control methodologies, like PID controllers.

The proposed neural controller together with the results from its application to the control of the nonlinear DC motor, were presented in the international conference IEEE International Symposium on INnovations in Intelligent SysTems and Applications (INISTA 2011).