PARTICLE SWARM OPTIMIZATION FOR NARX STRUCTURE SELECTION
- APPLICATION ON DC MOTOR MODEL -

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ABSRACT

This thesis was presents the nonlinear identification of a DC motor using Binary Particle Swarm Optimization (BPSO) algorithm, as a model structure selection method, replacing the typical Orthogonal Least Squares (OLS) used in system identification. The BPSO algorithm is an evolutionary computing technique put forward by (Kennedy and Eberhart, 1997). By representing its particles technique as probabilities of change (bit flip) of a binary string, the binary string was then used to select a set of repressor as the model structure, and the parameter estimated using QR decomposition. The DC motor dataset was simulated to test the performance of the new model structure selection approach. The findings indicate that the BPSO-based selection method has the potential to become an excellent and effective method to determine parsimonious NARX model structure in the system identification model. The NARX model structure was used to model the system dynamic. The several optimizations on the neural network training have been performed and several regularizations of the training have been considered. Similar investigate in nonlinear identification as done in its linear counterpart. The NARX coupled with suitable regularisations have outperformed the linear models. Even though the linear models are sufficient for this system, the nonlinear model can represent the system better.

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CHAPTER 1

INTRODUCTION

1.1 Overview

System identification is defined as the task of inferring a mathematical model of dynamic systems based on a series of measurements collected from the system [1]. It is a well established technique for modeling of complex systems that have dynamics which are not well understood or difficult to model [2]. In recent years, system identification has garnered widespread attention beyond mathematical and control systems theory into a wider sphere including biomedical, engineering, finance, and operation research [3]. This is because of several factors [4]: (i) theoretical advancements of nonlinear systems, which has provided design methodologies to model nonlinear systems; (ii) development of efficient identification methods for treatment of empirical nonlinear models; (iii) improvements in control hardware and software that enables the incorporation of complex nonlinear models in its design.

A highly efficient and accurate model for modeling nonlinear systems, called NARX (Nonlinear Autoregressive Model with Exogenous Inputs) was introduced in [5] as a model is a general and convenient system identification model that can describe any non-linear system well [6]. Particle Swarm Optimization (PSO) is a stochastic optimization algorithm based on the flocking/swarming behavior of animals in nature [16]. It is a