Identification of real-time maglev system using ga based low complexity based ANN

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Abstract

In the recent past identification of nonlinear plant is a significant work has done by many researcher and it is found to be an emerging area for further research due to its wide application. In this article, the characteristics and behavior of a real time maglev plant has been identified using an efficient low complexity based Artificial Neural Network (ANN) based on functional expansion technique i.e. functional link artificial neural network (FLANN). The weights of FLANN has been iteratively updated by a heuristic optimization algorithm i.e. a natural genetics. So that the error needs to minimized, which is considered as a cost function. To demonstrate the robust identification performance of the Maglev plant Mean square error (MSE) and CPU time is considered for analysis. The simulation results justify the proposed model robustly identifies the characteristics and parameters of non-linear dynamic maglev plant.

Keywords: Non-linear System; System Identification; FLANN; Maglev plant; Chebyshev Expansion; GA.

Introduction

The principle of identification is to formulate a mathematical modeling of plant by taking its input-output data. A mathematical modeling of a system can be determined by using laws of nature or through the experimentation. Out of many techniques to find out the mathematical modelling (using parameter estimation) of the system, direct modeling and inverse modeling, have most attractive features [1], [2]. As maximum plants are non-linear and dynamic in nature, their identification is a thought provoking. Accurate and fast identification of above system is still a nightmare. Identification of non-linear plants finds application in the area of control system, power system, communication, instrumentation and many other fields.

To perform the above task in highly non-linear environment, an ANN is the best solution for it. As ANN can take the non-linear decision based on the objective. Pao et al. have proposed FLANN to overcome the above issue [3], [4], [5]. The FLANN is one of its kind and it holds the advantages of both single layer and multi-layer network. Mainly the FLANN is popular for its simple structure and less computation complexity due to absence of the hidden layer. The input of the FLANN gets functional expanded and combined to a linear combiner. The functional expansion of inputs gets by different expansion method like power series expansion, trigonometric expansion and Chebyshev expansion [6]. In this article, the Chebyshev expansion has been used to functionally expand the input.
The FLANN model has been trained by using the GA technique. This is a random search algorithm, which is based on the three steps, which includes selection, crossover, and mutation. Using these steps, the cost function is minimized. Here, the error is considered as the cost function. The performance of the proposed identification technique has been studied in terms of error, MSE and the CPU time.

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