

Chapter 89

Modified Differential Evolution Algorithm Based Neural Network for Nonlinear Discrete Time System

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ABSTRACT

Two main important features of neural networks are weights and bias connection, which is still a challenging problem for researchers. In this paper we select weights and bias connection of neural network (KN) using modified differential evolution algorithm (MDEA) i.e. MDEA-NN for uncertain nonlinear systems with unknown disturbances and compare it with KN using differential evolution algorithm (DEA) i.e. DEA-KN. In this work, MDEA is based on exploitation and exploration of capability, we have implemented differential evolution algorithm and modified differential evolution algorithm, which are based on the consideration of the three main operator's mutation, crossover and selection. MDEA-KN is applied on two different uncertain nonlinear systems, and one benchmark problem known as brushless dc (BDC) motor. Proposed method is validated through statistical testing's methods which demonstrate that the difference between target and output of proposed method are acceptable.

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INTRODUCTION

A neural network is a processing device, whose design and functioning was inspired by the human brain. In computing world neural networks has a lot of gain, also known as artificial neural network. Before discussing neural network let us focus on functioning of human brain. Human brain consisting of specific type of cell known as neuron, which does not regenerated, because provide us with our abilities to remember, think and apply previous experiences. Human brain consisting of about 100 billion neurons, each neuron was connected with 200000 (approximately) other neurons. The power of human brain is depends upon number of neurons and their interconnections. Neurons convey information via a host of electrochemical pathways (Pratihar, 2013). These neurons and their connections form a process which is not binary, not stable and not synchronous. In short artificial neural network are more powerful than electronic computers.

An artificial neural network may be defined as information processing model that are inspired by the biological nervous systems. This model tries to replicate the most basic functions of brains. Neural network represent a meaningfully different approach such as pattern recognition or data classification through a learning process. A neural network is used to learn patterns and relationships in data. The data may be the results of academic investigations that use mathematical formulations to model. Regardless of the specifics involvement, applying a neural network is significantly different from traditional approaches.

Artificial neural network, like people, learn by examples. In biological system, learning involves adjustment of synaptic connections that exist between the neurons. Various neural networks are now designed that are quite accurate to the target. Neural network methods is looking to the future via analysing past experiences has generated its own set of problems. For the explanation that how network will learn and why it recommends a particular decision has been difficult, based on inner working of neural network i.e. black boxes. To justify these decision making process, several neural network tools are available that explain the whole process, from these information, expert in the application may be able to infer which data plays a major role in decision making and its importance (Pratihar, 2013; Hu & Hwang, 2001).

Neural network have self adaptability and self learning capability to derive meaning from complicated or imprecise data. A trained neural network is known as an expert in particular categories of information it has been given to analyze. Some advantages of artificial neural network are given below:

- **Self-Organization:** An ANN can create its own representation of the information it receives during learning time.
- **Adaptive Learning:** AN ANN is endowed with the ability to learn how to do task based on the given data for training.
- **Real-Time Operation:** ANN computation may be carried out in parallel. Hardware devices are being designed and manufactured to take advantages of capabilities of ANN.
- **Fault Tolerance:** Partial destruction of neural network leads to the corresponding degradation of performances.

Biological Neural Networks

It is well known that human brain contains a huge number of neurons and their interconnections. A biological neuron or a nerve cell (Pratihar, 2013) consists of Soma or cell body, Synapses, Dendrites and the Axon the elements are as follows:

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