Chapter 8

Intelligent Radial Basis Function Neural Network for Intrusion Detection in Battle Field

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ABSTRACT

Defense at boundary is nowadays well equipped with perimeter protection, cameras, fence sensors, radars etc. However, in battlefield there is more feasibility of entering of a non-native human and unknowing stamping of the explosives placed in the various paths by the native soldiers. There exists no alert system in the battlefield for the soldiers to identify the intruder or the explosives in the field. Therefore, there is a need for an automated intelligent intrusion detection system for battlefield monitoring. This chapter proposes an intelligent radial basis function neural network (RBFNN) technique for intrusion detection and explosive identification. The proposed intelligent RBFNN implements some intellectual components in the algorithm to make the neural network think before learning the training samples. Involvement of intellectual components makes the learning process simple, effective and efficient. The proposed technique helps to reduce false alarm and encourages timely detection thereby providing extensive support for the native soldiers and save the life of the mankind.

INTRODUCTION

Automation does not involve human intervention. Automation of a system is feasible and successful as it involves the integration of wireless sensor network and information technology. Automation in real world applications involves machine learning algorithms.

Machine learning is a software tool that constructs algorithms which can learn data and make predictions on its own. These software tools substitute human intelligence for various applications such as speech recognition, pattern classification, face recognition, etc., there are different kinds of learning techniques applied for different real world problems. Machine learning that involve mathematics for derivative process of learning is termed as data mining algorithms. Similarly, machine learning that are derivative free and
the algorithms are inspired from human biology and nature are termed as soft computing techniques. The complexity in implementation of data mining approaches bends to implement soft computing learning algorithms. Most commonly, the learning techniques are classified as supervised, unsupervised, hebbian, reinforcement and competitive. Selection of above mentioned learning technique is entirely based on available data sample. Most of the real-world applications have patterns/samples that has input and output relationship. Therefore, supervised learning that has training samples with prior known input and output relationship is highly suitable for proposed intrusion detection system in battle field.

The most commonly used supervised learning algorithm is Artificial Neural Network (ANN) technique. ANN is inspired from the biological human nervous system. ANN is one of the learning algorithms in soft computing approach. Wide usage and suitability of soft computing approach for automation is due to its simplicity, adaptability, flexibility, and derivative free model. ANN supervised learning includes algorithms such as Back Propagation Neural Network (BPNN), Adaptive Neural Fuzzy Inference System (ANFIS) and Radial Basis Function Neural Network (RBFNN). Due to the complexity of the algorithm and complex network structure, the BPNN and ANFIS are not suitable for real time or dynamically changing applications.

Learning algorithms require complete training data set to build a model. In real world, the training data is nonlinear and non-stationary. Existing neural network model utilizes whole data set for processing, adjusts the network parameters, grows the network size without pruning and uses entire sample data for training. These approaches increase the complexity of the model, poor generalization, low learning accuracy and large model size. Compared to other neural networks, RBFNN is widely suitable for static and dynamic applications due to its flexibility, speed, accuracy (Han, H.-G., & Qiao, J.-F., 2012; Sajavičius, 2014; Várkonyi-Kóczy, 2016) and simple structure. Therefore, this chapter proposes a novel Radial Basis Function neural network for battlefield monitoring that includes higher level thinking components. The proposed Intelligent RBFNN uses intellectual components such as sample addition, sample deletion and neuron addition.

The remainder of this chapter is organized as follows. Section I presents the preliminaries of the Radial Basis Function Neural Network. Section II describes the recent developments carried out by various researchers on Radial Basis Function Networks. Section III discusses the proposed intellectual radial basis function neural network for intrusion detection in battle field. Section IV details the Intrusion detection in Battle field for alert generation using intelligent RBFNN- A case study. Section V gives the results and discussions. Section VI discusses the conclusion.

Preliminaries on RBFNN

The guiding principle of RBFNN is covers theorem which states that “A complex pattern-classification problem cast in high-dimensional space non-linearly is more likely to be linearly separable than in a low dimensional space.” Figure 1 shows the traditional Radial Basis Function Neural Network.

A RBF Neural Network (Martel, J. M., & Platte, R. B., 2016) consists of mainly three layers along with a nonlinear radial basis functions. The layers are Input layer, Hidden layer and Output layer. The hidden layer performs nonlinear mapping from input space to higher dimensional space by using activation function in the network.

Due to the universal approximation capability of Gaussian function (J. Rashidinia et al, 2016) it is highly preferred. The number of nodes in the hidden layer is highly dependent on the input patterns
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