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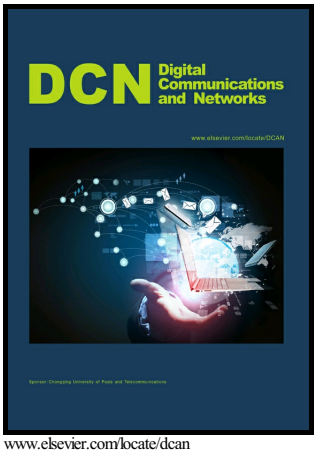

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A Network Security Situation Prediction Model based on Wavelet Neural Network with Optimized Parameters

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Abstract

The security incidents ion networks are sudden and uncertain, it is very hard to precisely predict the network security situation by traditional methods. In order to improve the prediction accuracy of the network security situation, we build a network security situation prediction model based on Wavelet Neural Network (WNN) with optimized parameters by the Improved Niche Genetic Algorithm (INGA). The proposed model adopts WNN which has strong nonlinear ability and fault-tolerance performance. Also, the parameters for WNN are optimized through the adaptive genetic algorithm (GA) so that WNN searches more effectively. Considering the problem that the adaptive GA converges slowly and easily turns to the premature problem, we introduce a novel niche technology with a dynamic fuzzy clustering and elimination mechanism to solve the premature convergence of the GA. Our final simulation results show that the proposed INGA-WNN prediction model is more reliable and effective, and it achieves faster convergence-speed and higher prediction accuracy than the Genetic Algorithm-Wavelet Neural Network (GA-WNN), Genetic Algorithm-Back Propagation Neural Network (GA-BPNN) and WNN.

Index Terms: Network security, INGA, situation prediction, WNN, adaptive genetic algorithm

I. INTRODUCTION

With the social development and greater communication requirements among people, big data increasingly becomes a cornerstone technology for our lifestyle [1-3]. The network plays a more and more important role in our daily life, including computer networks, wireless communication networks, etc. [4-6]. Correspondingly, the network-attack becomes more frequent and harmful when people get online to transmit and receive private data. According to the existing literature, it is very hard to solve these security problems only by the single defense method. Under such a tough environment, The Network Security Situation Awareness (NSSA), a comprehensive technology which obtains and processes the security information, has received extensive attention [7-9].

The research on NSSA mainly focuses on three stages. The 1st stage is the extraction of the network security situational factors [10], [11], the 2nd stage is the assessment of network security information [12], [13] and the 3rd stage is the Network Security Situation Prediction (NSSP) [14]. The NSSP, as the final step of the whole situation awareness, analyzes and deals with the previous and current situation information, and then makes a prediction for the future. To solve a series of technical problems in the situation prediction, a lot of scholars began taking some in-depth exploration into the prediction methods. The authors of [15] built a Hidden Markov Model to connect the past and future information in NSSA, then predicted the future security situation reliably. The authors of [16] analyzed the characteristics of the network situation, and proposed a prediction model based on a generalized regression neural network. The authors of [17] used the residual error correction function of the interval Verhulst model to explore the rule of network situation, and then introduced grey theory. The authors of [18] constructed an evaluation model of the hierarchical network structure and used a support vector machine (SVM) to predict the nonlinear characteristics for the network situational value. In addition, many various prediction methods were introduced in [19-21]. However, the scale of networks are getting larger and larger, these traditional prediction algorithms mentioned above have some problems,

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