Intrusion detection for water distribution systems based on an hybrid particle swarm optimization with back propagation neural network

Oyeniyi, AA; Ouahada, K; Abu-Mahfouz, Adnan MI; Rimer, S and Alimi, KO

Abstract:
The increasing integration of advanced information and communication tools in industrial control systems (ICS) has vastly increased the vulnerabilities and threats of intrusions into the various critical infrastructures which include the water distribution system, electrical power system, etc. that rely on the ICS systems. Currently, providing and ensuring adequate security for these ICS infrastructures are major concerns globally. The quick and accurate detection of any intrusive action into the ICS systems is highly important. Traditional intrusion detection systems (IDS) have exhibited worrying forms of limitations and shortcomings due to the heterogeneity of different cyberattacks and intrusions. Thus, there are needs to devise effective security measures. This paper proposes an IDS model based on the hybridization of particle swarm optimization (PSO) with back-propagation neural network (BPNN) for classifying intrusions in water system infrastructure. The PSO is used to optimize the parameters for the BPNN, thus improving the efficiency of classification. For the validation of the proposed method, the iTrust Lab's secure water treatment dataset was used for experimentation. Using prominent classification metrics, the 97% accuracy and 98.7% precision results achieved using the developed BPNN-PSO model is better compared to other methods including models from related works. Thus, the proposed model can meet the requirements of cyberattacks and intrusions detection in practical water distribution infrastructure.