



A SLIDING MODE BASED NEURAL NETWORK FOR DATA FUSION AND ESTIMATION USING MULTIPLE SENSORS

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ABSTRACT—In this study, a Neural Network (NN) based data fusion and estimation algorithm is developed, which could be applied in monitoring and detection applications that use measurements coming from multiple sensors. For NN based applications, a fast training approach which can also guarantee the global minimum is highly desirable and is subject for ongoing research. For this purpose, in this study, a novel robust training approach is developed for NNs, using a chattering-free sliding mode (SM) technique derived based on the Lyapunov theory. The proposed training approach exploits the robustness of SM theory, ensures fast training and global convergence while also providing a smoother estimation output due to eliminated chattering. In this study, Kalman filters are also designed to filter and fuse the data output of high bandwidth sensors with an aim to reduce the number of inputs, hence computational complexity in NNs. The developed NN algorithm, which has a feedforward structure and three layers, is tested using actual data collected from multiple sensors in a nuclear power plant, with the specific aim of estimating the neutron detector output. The performance of the novel SM based training approach is compared against the Levenberg-Marquardt (LM), which is currently the most commonly method for fast training in NNs. The performance of the proposed scheme demonstrates a considerable improvement over LM in terms of estimation accuracy and convergence rate. The results motivate the utilization of the SM based NN configuration in a variety of monitoring, detection and diagnostic applications which involve measurements from multiple sensors.

Key Words: Neural Network (NNs) estimator, sliding mode(SM) based training, Levenberg-Marquardt (LM), Lyapunov theory, nuclear power plants, multi-sensor networks