SLIDING WINDOW TRAINING ALGORITHMS USING MLP-NETWORK FOR CORRELATED AND LOST PACKET DATA

by

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ABSTRACT

Multilayer Perceptron neural networks (MLP) are mathematical/computational models inspired by imitating the biological central nervous system and its neurons. MLPs gained an immense attention due to its simplicity, good generalization and its ability to capture complex relationships between variables via a series of input-output measurements. MLPs are well-known tools used in nonlinear system identification, statistical modelling, adaptive control, signal, image processing and for many applications. The crucial part about MLP is the learning or training process in which the weights are tuned on the presence of input data to produce a reliable and accurate estimation. This thesis gives a systematic investigation of various MLP learning mainly Sliding Window (SW) learning mode which is treated as the adaptation of offline algorithms into online application. Consequently this thesis reviews various offline algorithms including: batch backpropagation, nonlinear conjugate gradient, limited memory and full-memory Broyden, Fletcher, Goldfarb and Shanno algorithms and different forms of the latest proposed binary ensemble learning. The research work also investigates several recursive algorithms including recursive Kalman filter (RKF) and extended Kalman filter (EKF) using extreme learning machine (ELM) and hybrid linear/nonlinear training technique by incorporating the free derivative concept. The SW learning is investigated with different resetting criterion, different step size choices and different window sizes in addition to improving the existing SW module by proposing different data store management (DSM) techniques that is used to reduce correlation inside the window store. The proposed data store management technique is combined with the central finite difference based gradient estimate to generate a model robust against both correlated data and irregular sampled data. Three nonlinear dynamical test cases are used as a benchmark in this thesis which is single, split level and V-shape tanks system with varying complexity and correlation level to provide suitable testing conditions.