Neuro-Observer with Application to Longitudinal Motion of an Aircraft with Big Attack Angle

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Abstract— In this paper a neural network observer for nonlinear systems is presented. The proposed neuro-observer is a three-layer feedforward neural network (NN), trained by means of the error backpropagation learning algorithm; according to this algorithm, the neural network training process becomes a nonlinear function optimization problem. The weights and the biases are permanently modified in order to minimize the mean squared error between the actual outputs and the NN desired outputs in a gradient descent manner. The good results of the neural networks are due to their capacity of nonlinear functions' approximation. The observer also includes a correction term which guarantees the good tracking as well as bounded neural network weights. The neural network is used to parameterize the nonlinearities of the system. The validation of the proposed observer scheme is made through Matlab/Simulink numerical simulation to reconstruct the unavailable state variables of a big attack aircraft longitudinal motion. In fact, the motion of the aircrafts with big attack angle is a nonlinear and complex system, which makes difficult the design and the implementation of efficient control and observation laws. It will be shown that all the components of the error vector tend to zero, this fact proving both the proper functioning of the NN and the very good estimation of the state variables.