Study of K+NN Assistor, Principle and Control Applications

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ABSTRACT

K+NN assistor is based on a neural network(NN), with five important scaling factors SE, SDE, SU, Ka, Kb, to enlarge each signals. SE is the gain for error input of NN, SDE is the gain for error rate input of NN, SU is the gain for NN ouput, Kb is the gain parallel with NN output. Finally, combined NN output and Kb is in series with another gain Ka to constitute the whole structure of a K+NN assistor. These five scaling factors could effectively further improve system ’s response under different plants and the respective controllers. Firstly, how many neurons in hidden-layer of K+NN impact on control system is discussed, while K+NN as a controller is considered. From the theories of neural networks and support vector machine (SVM), a feedforward multi-layer neural network with only one hidden-layer is suggested. From SVM viewpoint, selection of neural networks with small weights is highly supported for robustness consideration. Selection of 2, 5, 8, 12 neurons for the hidden-layer is investigated under different plants. After simulation, we infer that two neurons in hidden-layer is good enough. Finally, K+NN as an assistor to different controllers to affect the response of linear and nonlinear plant is examined in the simulations. PID is not quite a well chosen type to control highly complex nonlinear or linear plants with high orders. K+NN assistor in this case can improve the transient/steady-state of the original control system with the conventional controllers. In this case, the parameters of controller must be synchronized to be adjusted with K+NN assistor parameters. K+NN assistor can be used to improve systems with either a FLC controller or Hybrid controller. All parameters to be adjusted can be off-line found by using PSO technique.

Keywords : Neural Network (NN) ; Fuzzy Logic Controller (FLC) ; Particle Swarm Optimization (PSO) ; PID ; Scaling Factors

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