ADAPTIVE INTELLIGENT INVERSE CONTROL OF NONLINEAR SYSTEMS WITH REGARD TO SENSOR NOISE AND PARAMETER UNCERTAINTY (MAGNETIC BALL LEVITATION SYSTEM CASE STUDY)

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Abstract-Type-2 Fuzzy Neural Networks have tremendous capability in identification and control of nonlinear, time-varying and uncertain systems. In this paper the procedure of designing inverse adaptive type-2 fuzzy neural controller for online control of nonlinear dynamical systems will be presented. At first the structure of a novel class of Interval Type-2 Nonlinear Takagi-Sugeno-Keng Fuzzy Neural Networks (IT2-NTSK-FNN) will be presented. There is a class of nonlinear function of inputs in the consequent part of fuzzy rules. This IT2-NTSK-FNN comprises seven layers and the fuzzification is done in two first layers including type-2 fuzzy neurons with uncertainties in the mean of Gaussian membership functions. Third layer is rule layer and model reduction occurs in fourth layer via adaptive nodes. Fifth, sixth and seventh layers are consequent layer, centroid rules' calculation layer and output layer respectively. For training the network backpropagation (steepest descend) method with adaptive training rate is used. Finally, three methods including online adaptive inverse controller based on IT2-NTSK-FNN, IT2-TSK-FNN (linear consequent part) and Adaptive Neuro-Fuzzy Inference System (ANFIS) are employed to control of a magnetic ball levitation system. External disturbances and uncertainty in parameters are considered in the model of magnetic ball levitation system. Simulation results show the efficacy of the proposed method.

Index terms: Nonlinear Type-2 Fuzzy, Adaptive Inverse control, Magnetic ball levitation System.