Neuro-Fuzzy Nonlinear Dynamical System Approximations using High Order Neural Networks

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A new definition of Adaptive Neuro Fuzzy Systems is presented in this paper for the identification of unknown nonlinear dynamical systems. The proposed scheme uses the concept of Adaptive Fuzzy Systems (AFS) operating in conjunction with High Order Neural Network Functions (F-HONNFs). Since the plant is considered unknown, we first propose its approximation by a special form of an adaptive fuzzy system and in the sequel the fuzzy rules are approximated by appropriate HONNFs. Thus the identification scheme leads up to a Recurrent High Order Neural Network, which however takes into account the fuzzy output partitions of the initial AFS. The proposed scheme does not require a-priori experts' information on the number and type of input variable membership functions making it less vulnerable to initial design assumptions. Weight updating laws for the involved HONNFs are provided, which guarantee that the identification error reaches zero exponentially fast. Simulations illustrate the potency of the method and comparisons with well known benchmarks are given.