ABSTRACT

Stability analysis is important in the design and application of fuzzy neural networks, which could be used to solve some engineering problems such as signal processing, pattern recognition, associative memories, and optimization, etc. In this thesis, Takagi - Sugeno model is extended to the stability analysis of the equilibrium point for Hopfield neural networks, Cohen - Grossberg neural networks, Bidirectional Associative Memory neural networks, Cohen - Grossberg Bidirectional Associative Memory neural networks and Markovian, jumping recurrent neural networks with time varying delays including both discrete and distributed delays. By constructing a new Lyapunov-Krosovskii functional the global stability to different models of fuzzy neural networks such as fuzzy recurrent neural networks (FRNNs), fuzzy Hopfield neural networks (FHN'Ns), fuzzy Cohen-Grossberg neural networks (FCGNNs), fuzzy Bidirectional Associative Memory neural networks (FBAMNNs) and fuzzy Cohen-Grossberg Bidirectional Associative Memory neural networks (FCGBAMNNs) are investigated. By using generalized Lyapunov functional, stochastic analysis approach and ltd’s differential formula, delay dependent conditions are obtained for ensuring the stability of the considered neural networks. In the derivation process we choose a generalized Lyapunov functional and introduce a parameterized model transformation with free weighting matrices to it, in order to obtain stability region. In fact, these techniques lead to generalize and less conservative stability condition that guarantee the wide stability region. The derived criteria for the global asymptotic stability of FRNNs, FHN'Ns, FCGNNs, FBAMNNs and FCGBAMNNs with discrete and distributed time-varying delays which are represented by the Takagi-Sugeno (T-S) fuzzy models are expressed in terms of Linear Matrix Inequalities (LMIs). Numerical examples and simulation results are given to illustrate the effectiveness of the theoretical results. Finally, the obtained stability conditions are compared with existing results to show the conservativeness of the proposed methods.