ABSTRACT

Stability is the most important property of all kinds of systems. The abundance of research done in the areas of stability analysis of neural networks and fuzzy systems, and the back propagation procedure is universal and these areas are constantly pursued to understand the ever growing developments associated with it.

In this thesis, new and simple procedures are suggested to formulate main matrices, sub matrices and vertex matrices that are used to represent the neural network system. Extending Lyapunov's stability theorem, schemes are proposed to ascertain the stability using the vertex matrices; a heuristic approach is also presented for the construction of positive definite matrix used in Lyapunov's equation for stability testing. A new interpretation is deduced on the choice of slope parameter of the activation function, which simplifies the stability aspect of neural networks. Further, simple and sufficient conditions for inferring the unstable situation are proposed; these conditions are easily applicable without having computational overheads.

Simple procedures are presented for stabilization of neural networks, trained by back propagation procedure. Extending Lyapunov's stability theorem, the neural network is stabilized by appropriately estimating a slope parameter and utilizing it in the binary/bipolar sigmoidal activation function. To enhance the stabilization, simple design procedures that employ error feedback and self-loop are suggested. Further, a new weight update scheme is also proposed for the back propagation procedure.
Extending Lyapunov's stability theorem, the stability analysis of fuzzy systems represented by linear matrix inequality is carried out. Simple design procedures for the choice of fuzzy controllers are presented for stabilizing the fuzzy systems. Further, extending Routh and Fuller's Tables, schemes are proposed to obtain aperiodic stability of fuzzy systems.

The newly proposed procedures are illustrated through examples.