Synopsis of the Doctoral Thesis in Computer Science
(July 1999)

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Design of some Specific and Hybrid Architectures of Neural Networks, Fuzzy Logic and Genetic Algorithms and their Applications

Abstract: Soft Computing refers to a consortium of computational methodologies of which Fuzzy Logic (FL), Neural Networks (NN) and Genetic Algorithms (GA) are some of the principal components, all having their roots in Artificial Intelligence. In today's highly integrated world, when solutions to problems are turning out to be of cross disciplinary nature, Soft Computing is promising to become a powerful means for obtaining solutions to problems quickly, yet accurately and acceptably. Also, a combination of one or more of the methodologies mentioned – termed "hybrid systems", has resulted in the emergence of a class of systems such as Neuro-Fuzzy, Fuzzy-Genetic and Neuro-Fuzzy-Genetic systems. The healthy integration of these technologies has only resulted in extending the capabilities of the technologies viewed individually.

In this investigation, the design of the following specific and hybrid architectures, and their applications to real world problems have been undertaken.

1. Simplified Bidirectional Associative Memory (sBAM),
2. Training free Counterpropagation Network (TF-CPN)
3. GA based Backpropagation Network (GA-BPN)
4. GA based Multilayer Feedforward Network (GA-MFNN)
5. GA based Fuzzy Backpropagation Network (GA-Fuzzy BP)
6. Training free Self Organizing Network (TF-SONN) and
7. Simplified Fuzzy ARTMAP (SFAM) as a Pattern Recognizer

Practical Problems Solved: The specific and hybrid architectures proposed in the thesis have been applied to real world problems such as: Character Recognition, Fabric defect identification in Textile Technology, Pattern Classification, Fink Truss design, Knowledge base evaluation, Buckling of non-prismatic thin walled beams, K Factor design, Allowable stress limits determination of a beam subject to lateral loads, Earthquake damage evaluation, Prediction of natural mode shapes of Multistoried building frames, Satellite image recognition, Prediction of Shear stress patterns from Cross sectional Geometry, Prediction of Load from Yield patterns of Elasto-plastic clamped, simply supported plates and Determination of deflection in slabs of different geometry.

Original Contributions: Simplification and refinement of Wang and Don's Exponential BAM(1995), Elimination of the cumbersome training procedure adopted by Hecht Nielsen's CPN (1987) and Mukherjee's SONN (1997), GA based weight determination for conventional BPN and Lee and Lu's Fuzzy BP(1994), and a Moment based RST Invariant Feature Extractor for SFAM proposed by Kasuba(1993)

List of Publications:

Journals

1. Rajasekaran S and Vijayalakshmi Pai G A, Training free Counterpropagation Networks as Static hetero associative memories, *Indian Journal of Engineering and Material Sciences,* Vol. 4, pp. 245-253, Dec. 1997.

2. Rajasekaran S and Vijayalakshmi Pai G A, Simplified Bidirectional Associative memory for the retrieval of real coded patterns, *International Journal of Engineering Intelligent Systems*, Vol.6, No. 4, pp. 237-243, Dec. 1998.

3. Rajasekaran S and Vijayalakshmi Pai G A, Discussion on Self organizing Neural Networks for identification of Natural mode shapes, *ASCE Journal of Computing in Civil Engineering*, Vol. 12, No. 7, pp. 163-164, July 1998.

4. Rajasekaran S and Vijayalakshmi Pai G A, Simplified Fuzzy ARTMAP as Pattern Recognizer, *ASCE Journal of Computing in Civil Engineering*, Vol. 14, No. 2, pp. 92-99, April 2000.

5. Rajasekaran S and Vijayalakshmi Pai G A, Recurrent Neural Dynamic models for Equilibrium and Eigen value problems, *Mathematical and Computer Modelling*, 35, 229-240, 2002

6. Rajasekaran S and Vijayalakshmi Pai G A, Image recognition using Simplified Fuzzy ARTMAP augmented with a Moment based Feature Extractor, *International Journal of Pattern Recognition and Artificial Intelligence*, 14(4), pp. 1081-1095, 2000.

7. Rajasekaran S, Vijayalakshmi Pai G A and Jesmon P George, Performance comparison of two Genetic Algorithm based Backpropagation Networks, *Technology*, pp. 6-11, March 1997.

International Conferences / Symposia: No of publications - 5

National Conferences / Symposia: No of publications - 9