Chapter 27
Ultra High Frequency Sigmoid and Trigonometric Higher Order Neural Networks for Data Pattern Recognition

Ming Zhang
Christopher Newport University, USA

ABSTRACT

This chapter develops a new nonlinear model, Ultra high frequency siGmoid and Trigonometric Higher Order Neural Networks (UGT-HONN), for data pattern recognition. UGT-HONN includes Ultra high frequency siGmoid and Sine function Higher Order Neural Networks (UGS-HONN) and Ultra high frequency siGmoid and Cosine functions Higher Order Neural Networks (UGC-HONN). UGS-HONN and UGC-HONN models are used to recognition data patterns. Results show that UGS-HONN and UGC-HONN models are better than other Polynomial Higher Order Neural Network (PHONN) and Trigonometric Higher Order Neural Network (THONN) models, since UGS-HONN and UGC-HONN models to recognize data pattern with error approaching 0.0000%.

INTRODUCTION

The contributions of this chapter will be:

- Introduce the background of HONNs with the pattern recognition of HONNs.
- Develop a new UGT-HONN model for ultra-high frequency data pattern recognition.
- Provide the UGT-HONN learning algorithm and weight update formulae.
- Applications of UGT-HONN model for data pattern recognition.

This chapter is organized as follows: Section “BACKGROUND” gives the background knowledge of HONNs and pattern recognition applications using HONNs. Section “UGT-HONN MODELS” in-

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troduces UGT-HONN structure and different modes of the UGT-HONN model. Section LEARNING ALGORITHM OF UGT-HONN MODELS provides the UGT-HONN model update formula, learning algorithms, and convergence theories of HONN. Section "UGT-HONN TESTING" describes UGT-HONN computer software system and testing results for data pattern recognition.

BACKGROUND

Artificial Neural Network (ANN) techniques had been widely used in the pattern recognition area. Sankar and Mammone (1991) study speaker independent vowel recognition using neural tree networks. Sethi and Jan (1991) analyze decision tree performance enhancement using an artificial neural networks implementation. Yao, Freeman, Burke, and Yang (1991) experiment pattern recognition by a distributed neural network.

Artificial Higher Order Neural Network (HONN) had been widely used in the pattern recognition area too. Reid, Spirkovska, and Ochoa (1989) show rapid training of higher-order neural networks for invariant pattern recognition. Spirkovska and Reid (1990) suggest connectivity strategies for higher-order neural networks applied to pattern recognition. Lisboa and Perantonis (1991) display the invariant pattern recognition using third-order networks and zernlike moments. Kanaoka, Chellappa, Yoshitaka, and Tomita (1992) built an artificial higher order neural network for distortion un-variant pattern recognition. Perantonis and Lisboa (1992) test the rotation and scale invariant pattern recognition by high-order neural networks and moment classifiers. Schmidt and Davis (1993) check the pattern recognition properties of various feature spaces for higher order neural networks. Spirkovska and Reid (1994) try higher order neural networks to apply 2D and 3D object recognition. He, and Siyal (1999) operate Improvement on higher-order neural networks for invariant object recognition. Park, Smith, and Mersereau (2000) employ target recognition based on directional filter banks and higher-order neural network. Kaita, Tomita, and Yamanaka (2002) research on a higher-order neural network for distortion invariant pattern recognition. Voutriaridis, Boutalis, and Mertzios (2003) seek ridge polynomial networks in pattern recognition. Foresti and Dolso (2004) look into an adaptive high-order neural tree for pattern recognition. Artyomov and Yadid-Pecht (2005) provide modified high-order neural network for invariant pattern recognition.

Selviah (2009) focuses on high speed optical higher order neural networks for discovering data trends and patterns in very large database. Selviah describes the progress in using optical technology to construct high-speed artificial higher order neural network systems. The chapter reviews how optical technology can speed up searches within large databases in order to identify relationships and dependencies between individual data records, such as financial or business time-series, as well as trends and relationships within them. Two distinct approaches in which optics may be used are reviewed. In the first approach, the chapter reviews current research replacing copper connections in a conventional data storage system, such as a several terabyte RAID array of magnetic hard discs, by optical waveguides to achieve very high data rates with low crosstalk interference. In the second approach, the chapter reviews how high speed optical correlators with feedback can be used to realize artificial higher order neural networks using Fourier Transform free space optics and holographic database storage.

Wang, Liu, and Liu (2009) investigate on complex artificial higher order neural networks for dealing with stochasticity, jumps and delays. This research deals with the analysis problem of the global exponential stability for a general class of stochastic artificial higher order neural networks with multiple mixed time delays and Markovian jumping parameters. The mixed time delays under consideration comprise