Chapter 12
Artificial Higher Order Neural Network Models

Ming Zhang
Christopher Newport University, USA

ABSTRACT

This chapter introduces the background of HONN model developing history and overview 24 applied artificial higher order neural network models. This chapter provides 24 HONN models and uses a single uniform HONN architecture for ALL 24 HONN models. This chapter also uses a uniform learning algorithm for all 24 HONN models and uses a uniform weight update formulae for all 24 HONN models. In this chapter, Polynomial HONN, Trigonometric HONN, Sigmoid HONN, SINC HONN, and Ultra High Frequency HONN structure and models are overviewed too.

INTRODUCTION

The contributions of this chapter will be:

- Introduce the background of HONN models' developing history.
- Overview 24 applied artificial higher order neural network models.
- Provide 24 HONN Models learning algorithm and weight update formulae.
- Using a single uniform HONN architecture for ALL 24 HONN models.
- Using a uniform learning algorithm for all 24 HONN models
- Using a uniform weight update formulae for all 24 HONN models

This chapter is organized as follows: Section background gives the developing history of applied artificial higher order neural network (HONN) models. Section Higher Order Neural Network structure and Models introduces a single uniform structure for all 24 HONN modes. Section Learning Algorithm and Weight Update Formulae provides the uniform learning algorithm for all 24 HONN models and provides weight update formulae for all 24 HONN models. Section Future Research Directions predicts the future development direction in applied artificial higher order neural network area. Section Conclusion gives the summery of the 24 HONN models.

DOI: 10.4018/978-1-5225-0788-8.ch012

BACKGROUND

In 1995, Zhang, Murugesan, and Sadeghi (1995) develops very basic applied artificial higher order neural network model, called Polynomial Higher Order Neural Network (PHONN), for economic data simulation. PHONN can simulate data using higher order (order from 2 to 6) polynomial functions. In 1997, Zhang, Zhang, & Fulcher (1997) creates second very basic applied artificial higher order neural work model, called Trigonometric polynomial Higher Order Neural Network(THONN) models and THONN group models for financial prediction. PHONN models can model data by using higher order trigonometric functions, or by using groups of higher order trigonometric functions. In 1999, Zhang, Zhang, & Keen (1999) builds THONN system for analyzing higher frequency non-linear data simulation & prediction. The analyzing errors are always around from 1% to 5%.

Starting from 2000, new applied artificial higher order neural network models are developed, based on PHONN and THONN models. Lu, Qi, Zhang, & Scofield (2000) study the PT-HONN models for multi-polynomial function simulation. Zhang, Zhang, & Fulcher (2000) apply higher order neural network group models for financial simulation. Qi, Zhang, & Scofield (2001) use M-PHONN model for rainfall estimation. Zhang (2001) tests the financial data simulation using A-PHONN model. Zhang, & Lu, (2001) also use M-PHONN model in studying financial data simulation. A-PHONN Model is also used in rainfall estimation (Zhang, & Scofield 2001).

From 2002, adaptive higher order neural network models are studied. And new HONN models continue to be developed. Xu, and Zhang (2002) present an adaptive activation function for higher order neural networks. Based on the different data, HONN adaptively chose the best function(s) for the special data. Zhang (2002a) investigates the rainfall estimation by using PL-HONN model. Zhang (2002b) also researches the financial data simulation by using PL-HONN model. Zhang, Xu, & Fulcher (2002) suggest the neuron-adaptive higher order neural network models for automated financial data modeling. Zhang, & Crane (2004) operate rainfall estimation using SPHONN model. Zhang, & Fulcher (2004) examine higher order neural networks for weather prediction.

New HONN models are developed from 2005. Crane, and Zhang (2005) generate data simulation system by using SINCHONN model. Fulcher, & Zhang (2005) introduce different higher order neural network models in the system and processing areas. Zhang (2005) build a data simulation system using sinx/x and sinx polynomial higher order neural networks. Fulcher, Zhang, and Xu. (2006) overview the application of higher order neural networks to financial time series prediction. Zhang (2006) make a data simulation system using CSINC polynomial higher order neural networks. Zhang (2007) also build a data simulation system using YSINC polynomial higher order neural networks.

Starting from 2008, building new HONN models with the error approaching 0 became a hot research direction. Before 2008, the HONN error always is between 1% and 5%. For a lot of applications, error between 1% and 5% is acceptable. But for nonlinear and discontinued data simulation, errors close to zero are welcomed. To solve this problem, Zhang (2008) design a higher order neural network nonlinear model and find the new HONN modes has better running result than SAS software. The simulation data error is close to zero. Zhang (Ed.) (2009a) edit a book called *Artificial Higher Order Neural Networks for Economics and Business*, in which includes new HONN model with error close to zero. Zhang (2009b) compares the running result between artificial higher order neural networks and SAS software for economics and business. The research results show that HONN model is better than SAS software if both simulate nonlinear and discontinued data. Zhang, M. (2009c) develop an ultra-high frequency