Chapter 12
Artificial Higher Order Neural Network Models

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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.

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BACKGROUND

In 1995, Zhang, Murugesan, and Sadeghi (1995) develop 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) create 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 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