A HYBRID FUZZY AND NEURAL APPROACH WITH VIRTUAL EXPERTS AND PARTIAL CONSENSUS FOR DRAM PRICE FORECASTING

TOLY CHEN
Department of Industrial Engineering and Systems Management
Feng Chia University
No. 100, Wen-Hwa Road, Taichung 40724, Taiwan
tolychen@ms37.hinet.net

Received September 2010; revised February 2011

ABSTRACT. To further enhance the accuracy and precision of DRAM price forecasting, a hybrid fuzzy and neural approach with virtual experts and partial consensus is proposed. In the proposed methodology, some virtual experts form a committee. These virtual experts construct their own fuzzy linear regression (FLR) equations to forecast the price of a DRAM product from various viewpoints. Each FLR equation can be transformed into two equivalent NP problems to be solved. Subsequently, partial-consensus fuzzy intersection is applied to aggregate fuzzy price forecasts into a polygon-shaped fuzzy number, in order to improve the precision. After that, a back propagation network is constructed to defuzzify the polygon-shaped fuzzy number and to generate a representative/crisp value, so as to enhance the accuracy. A practical case is used to evaluate the effectiveness of the proposed methodology. According to the experimental results, the proposed methodology improved both the precision and accuracy of DRAM price forecasting by 75% and 65%, respectively.

Keywords: DRAM, Price, Forecasting, Fuzzy, Neural, Virtual expert, Partial consensus

1. Introduction. Dynamic random access memory (DRAM) is a type of volatile memory products. It uses capacitors to store information, and can be encapsulated into memory working modules. DRAM has been widely used in computer related applications, communication systems and other electronic devices. DRAM price is therefore crucial for the electronics industry. Of course, DRAM price is determined by supply and demand sides in this industry and fluctuates over time, but the long-term trend does exist and can be roughly quantified [1].

There are two viewpoints when it comes to forecasting the price of a DRAM product [2]. The first viewpoint, the input-output relationship viewpoint, is to determine those factors (e.g., demand, supply, economic conditions and raw material costs) that are influential in the price, and then apply different approaches (e.g., multiple linear regression (MLR) and artificial neural network (ANN)) to modeling the relationship between the price and these factors in order to forecast the future price. The second viewpoint, the time-series viewpoint, is to treat the fluctuation in the price as a type of time series. Theoretically, there are many approaches, e.g., moving average (MA), weighted moving average (WMA), exponential smoothing (ES), MLR and ANN that can be applied to forecast the price. Generally speaking, an ANN is suitable for modeling a short-term nonlinear pattern of the price, while traditional approaches such as MA, WMA and ES have good performances when the trend in the price is stable. Sepeslter and Sze [3] proposed the π rule, which describes the trend in the average price of packaged DRAM chips as a logarithmic function of time. The π rule states that in the face of rapid price declines, the peak volume of chips