

The application of Adaptive Neuro-Fuzzy Inference Systems in time series forecasting

郭承德、白炳豐

E-mail: 9423569@mail.dyu.edu.tw

ABSTRACT

In this paper, we apply ANFIS (Adaptive Neuro-Fuzzy Inference Systems) to the modeling of a forecasting system for the Taiwan Stock Market. Fundamentally, ANFIS is about taking a fuzzy inference system (FIS) and tuning it with a backpropagation algorithm based on some collection of input output data. This allows your systems to learn. The consequences of the precision of prediction, adaptive network-based fuzzy inference system leads to the highest accuracy, compared to neural network ranks the second, and Multiple Regression is the lowest among the three. Keywords: fuzzy theory, time series, Adaptive Neuro-Fuzzy Inference Systems (ANFIS)

Keywords : fuzzy theory ; time series ; Adaptive Neuro-Fuzzy Inference Systems (ANFIS)

Table of Contents

授權書 iii 中文摘要 iv ABSTRACT v 誌謝 vi 目錄 vii 圖目錄 x 表目錄 xii 第一章 緒論 1 1.1 研究背景與動機 1 1.2 研究目的 2 1.3 研究流程 3 第二章 文獻探討 4 2.1 時間序列 4 2.2 適應性類神經模糊推論系統 5 第三章 研究方法 7 3.1 模糊理論 7 3.1.1 模糊理論概論 7 3.1.2 模糊集合 8 3.1.3 歸屬函數(membership function) 8 3.1.4 模糊集合的基本運算 11 3.1.5 模糊規則 12 3.1.6 模糊蘊涵(fuzzy implication) 13 3.1.7 模糊推論(fuzzy reasoning) 14 3.2 模糊系統介紹 15 3.2.1 模糊化 (Fuzzifier) 16 3.2.2 推理引擎(Inference Engine) 16 3.2.4 規則庫(Rule Base) 16 3.2.5 解模糊 (Defuzzifier) 17 3.3 ANFIS網路架構介紹 20 3.4 研究步驟 26 3.4.1 收集資料 27 3.4.2 資料分析與處理 27 3.4.3 建立ANFIS系統 28 3.4.4 參數修正 30 第四章 ANFIS系統應用預測系統實例 31 4.1 實例應用與分析 31 4.2 結果與分析 53 第五章 結論與未來研究方向 62 5.1 結論 62 5.2 未來研究方向 63 參考文獻 64

REFERENCES

- 【1】 J.-S. Roger Jang, " ANFIS: Adaptive-network-based fuzzy Inference systems " IEEE Trans. On systems, Man, and Cybernetics , Vo1.23, No.3, pp.665-685, 1993. 【2】 張智星、孫春在、水谷英二, Neuro-Fuzzy and Soft Computing, 1997. 【3】 Jang, J.S.R., " ANFIS Adaptive-Network-Based Fuzzy Inference system " IEEE Transactions on Systems, Man, and Cybernetics , Vo1.23, No.3, pp. 665-685, May/June 1991. 【4】 Zadeh L.A., " Fuzzy Sets " Information and control, 8, 1965, pp. 338-353. 【5】 Zadeh L.A., " Fuzzy Set as a basis for a theory of possibility, " Fuzzy Sets and Systems, 1, 1978, pp.3-28. 【6】 Hopfield, J.J., " Neural Networks and Physical Systems with Emergent Collective Computational Abilities " Proc. Natl. Sci. USA, 79, pp.2554-2558, 1982. 【7】 McCulloch, W.s., and Pitts, W., " A Logical Calculus of the Ideas Immanent in Nervous activity " Bulletin of Mathematical Biophysics 5: pp.115-133, 1943. 【8】 林銘君, 以ANFIS為架構設計大氣中液態水、可降水的資料反衍系統, 雲林科技大學, 電機工程, 碩士論文。 【9】 廖宏彬、蘇仲鵬、吳慧敏, ANFIS理論應用於教師人力需求預測模式之建構, 教育與心理研究, 國立政治大學, 民國90年, 24期, 1-18頁。 【10】 David A. Bowers著, 林佳容譯, 預測未來, 初版, 凱信出版事業有限公司, 民國88年5月。 【11】 徐??, 以模糊及類神經理論探討次微米MOSFET元件臨限電壓預測之研究, 大葉大學, 電機工程所, 碩士論文。 【12】 賴擁成, 三相感應電動機之自適模糊轉速控制器設計, 海洋大學, 電機工程所, 碩士論文。 【13】 林茂文, 時間序列分析與預測, 第三版, 華泰圖書文物公司, 民國79年6月。 【14】 郭明哲, 預測方法, 七版, 中興管理顧問公司, 民國74年9月。 【15】 K.N.; Tsoukalas, L.H.; Houstis, E.N., " Neurofuzzy characterization of financial time series in an anticipatory framework Pantazopoulos, " Computational Intelligence for Financial Engineering (CIFER), 1997., Proceedings of the IEEE/IAFE 1997, 24-25 March 1997 Pages: 50 – 56. 【16】 La Pensee, A.C.; Mort, N., " A neuro fuzzy time series prediction application in telephone banking ", Knowledge-Based Intelligent Information Engineering Systems, 1999. Third International Conference, 31 Aug.-1 Sept. 1999 Pages: 407 – 410. 【17】 Palit, A.K.; Doeding, G.; Anheier, W.; Popovic, D., " Back-propagation based training algorithm for Takagi-Sugeno type MIMO neuro-fuzzy network to forecast electrical load time series " Fuzzy Systems, 2002. FUZZ-IEEE'02. Proceedings of the 2002 IEEE International Conference on , Volume: 1, 12-17 May 2002 Pages: 86 – 91. 【18】 Kasabov, N.K.; Qun Song, " DENFIS: dynamic evolving neural-fuzzy inference system and its application for time-series prediction ", Fuzzy Systems, IEEE Transactions on , Volume: 10, Issue: 2, April 2002 Pages: 144 – 154. 【19】 Changjiu Zhou; Jagannathan, K., " Adaptive network based fuzzy control of a dynamic biped walking robot " , Intelligence and Systems, 1996., IEEE International Joint Symposium on , 4-5 Nov. 1996 Pages: 109 – 116. 【20】 Hassanzadeh, I.; Khanmohammadi, S.; Jiang, J.; Alizadeh, G. " Implementation of a functional link net-ANFIS controller for a robot manipulator " Robot Motion and Control, 2002. RoMoCo '02.

Proceedings of the Third International Workshop on , 9-11 Nov. 2002 Pages:399 – 404. 【21】 Srinivasan, K.; Lakshmi, P. " Adaptive neuro-fuzzy controller for non-linear chemical mixing process " , Control, Automation, Robotics and Vision, 2002. ICARCV 2002. 7th International Conference on , Volume: 3 , 2-5 Dec. 2002 Pages:1626 - 1631 vol.3. 【22】 Jang, J.-S.R.; Sun, C.-T., " Predicting chaotic time series with fuzzy if-then rules " ,Fuzzy Systems, 1993., Second IEEE International Conference on , 28 March-1 April 1993. Pages:1079 - 1084 vol.2. 【23】 H.R.; Le-Ngoc, T., " On prediction of bursty traffic in broad -band satcom systemsMehrvan " , Communications, 1996. ICC 96, Conference Record, Converging Technologies for Tomorrow's Applications. 1996 IEEE International Conference on , Volume: 2 , 23-27 June 1996 Pages:926 - 930 vol.2. 【24】 Bambang Riyanto , Firman Febrianto , Carmadi Machbub, " ADAPTIVE-NETWORK-BASED FUZZY INFERENCE SYSTEM FOR FORECASTING DAILY GASOLINE DEMAND " , Proceedings of the Sixth AEESEAP Triennial Conference,2000. 【25】 Sftsos, A., " A comparison of various forecasting techniques applied to mean hourly wind speed time series " , Renewable Energy Volume: 21, Issue: 1, September 1, 2000, pp. 23-35. 【26】 Abdelrahim, E.M.; Yahagi, T., " A new transformed input -domain ANFIS for highly nonlinear system modeling and prediction " , Electrical and Computer Engineering, 2001. Canadian Conference on , Volume: 1 , 13-16 May 2001 Pages:655 - 660 vol.1. 【27】 Castillo, O.; Melin, P., " Simulation and forecasting complex economic time series using neural networks and fuzzy logic " , Neural Networks, 2001. Proceedings. IJCNN '01. International Joint Conference on , Volume: 3 , 15-19 July 2001 Pages:1805 - 1810 vol.3. 【28】 Shinn-Ying Ho ; Kuang-Chyi Lee ; Shih-Shin Chen ; Shinn-Jang Ho, " Accurate modeling and prediction of surface roughness by computer vision in turning operation using an neuro-fuzzy inference system " International Journal of Machine Tools & Manufacture 42(2002)1441-1446. 【29】 蒙以正, MATLAB5 專業設計技巧, 碁?資訊出版, 初版, 1998. 【30】 Heikki N.Koivo , FUZZY SYSTEMS , 2000. 【31】 J.-S.Roger Jang Ned Gully , Matlab Fuzzy Logic Toolbox , The Mathworks , 2版, 1997. 【32】 J.-S.Roger Jang Ned Gully , Matlab Fuzzy Logic Toolbox , The Mathworks , 4版, 2000. 【33】 E.H. Mamdani and S. Asslilan, " A fuzzy logic controller for a dynamic plant, " International Journal of Man-Machine Studies, Vo1.7, PP.1-13, 1975. 【34】 L.A.Zadeh, " Calculus of fuzzy restri- ctions " Fuzzy sets and their applications to cognitive and decision processes,1975. 【35】 L.A.Zadeh, " The concept of a linguistic variable and its application to approximate reasoning1,2,3. " Information Sciences , Vol.8., 1975. 【36】 楊英魁、孫宗瀛、鄭魁香、林建德、蔣旭堂, 模糊控制理論技術, 第二版, 全華圖書, 民國90年2月。 【37】 Takagi, T. and M. Sugeno (1985). Fuzzy identification of systems and its application to modeling and control. IEEE Transactions on Systems, Man and Cybernetics 15, 116 – 132. 【38】 蘇木春、張孝德, 機器學習:類神經網路、模糊系統以及基因演算法則, 全華科技圖書, 2版, 91年3月。 【39】 李允中、王小璠、蘇木春, 模糊理論及其應用, 全華科技圖書, 出版, 92年1月。 【40】 張斐章、張麗秋、黃浩倫; 類神經網路理論與實務, 東華書局, 初版, 92年9月。 【41】 [http: // www.cs.nthu.edu.tw/~jang/courses/cs5611/project / 15/](http://www.cs.nthu.edu.tw/~jang/courses/cs5611/project/15/)