# FUZZY INFERENCE SYSTEM

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**ABSTRACT:** This paper describes the implementation of fuzzy set theory and Fuzzy Inference System (FIS) for prediction of electric load. The proposed technique utilizes fuzzy rules to incorporate historical weather and load data. The use of fuzzy logic effectively handles the load variations due to special events. The fuzzy logic has been extensively tested on actual data obtained from the Czech Electric Power Company (ˇCEZ) for 24-hour ahead prediction. Test results indicate that the fuzzy rule base can produce results better in accuracy than artificial neural networks (ANNs) method.

**Keywords:** fuzzy sets, fuzzy logic, fuzzy inference system, prediction implementation, employees.

## INTRODUCTION

Short-term load forecasting (STLF) of power demand plays a very important role in the economic and secure operation of power systems [1]. Improvement in accuracy of load forecasts results in substantial savings in operating cost and also increase the reliability of power supply. In order to predict the future load accurately, numerous forecasting techniques have been used during the past 40 years.

Fuzzy logic model has been selected as an alternative method for the load forecasting problem in this paper. It is a suitable technique in case when the historical data are not real numbers, but linguistic values [4]. This paper presents the results of a preliminary investigation of the feasibility of use of a fuzzy logic model for short-term load forecasting. In this research, historical load and weather data are converted into fuzzy set theory to produce fuzzy forecasts and defuzzification is performed to generate a point estimate for system load.

Fuzzy logic is a tool for representing imprecise, ambiguous, and vague information. Fuzzy set operations are grounded on a solid theoretical foundation, although they deal with imprecise quantities, they do so in a most precise, and well-defined way. Fuzzy operations that act on the membership functions lead to consistent and logical conclusion [3]. If we use appropriate membership function definitions and rules, we can achieve useful results. One of the most useful properties of the fuzzy set approach is that contradictions in the data need not cause problems. Fuzzy systems are stable, easily tuned and can be conventionally validated. Designing of fuzzy sets is very easy and simple. Abstract reasoning and human-like responses in cases involving uncertainty and contradictory data are the main properties of fuzzy systems.

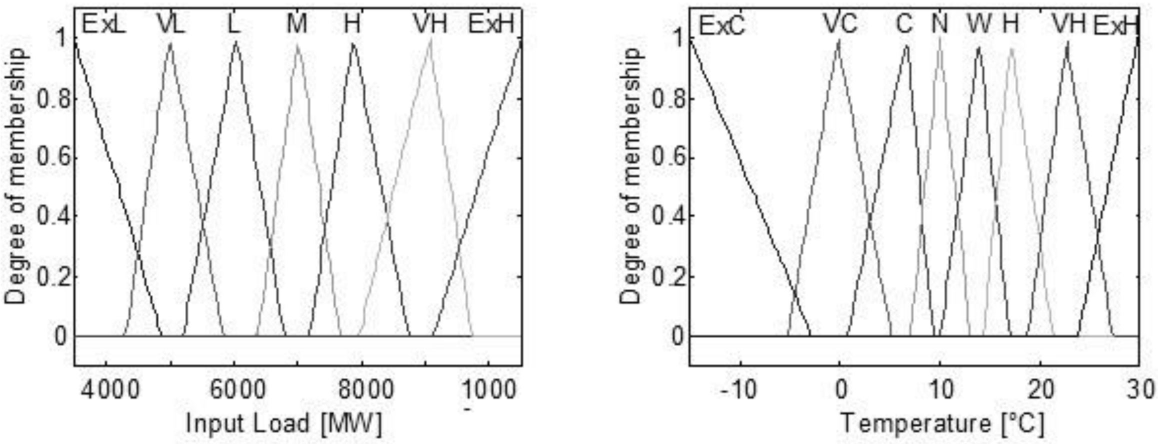


Fig. 2. Triangular type membership functions for input load, input temperature

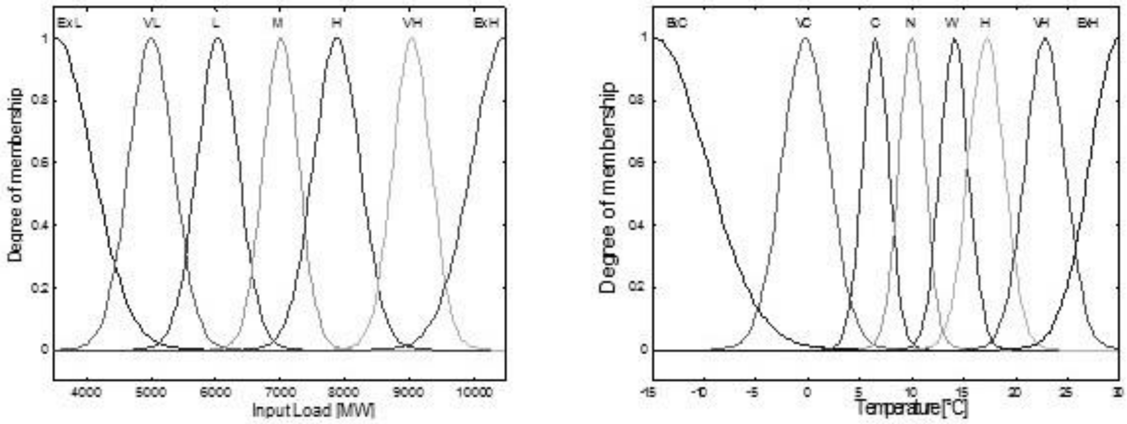

Fig. 3. Gaussian curve membership function for input load and input temperature

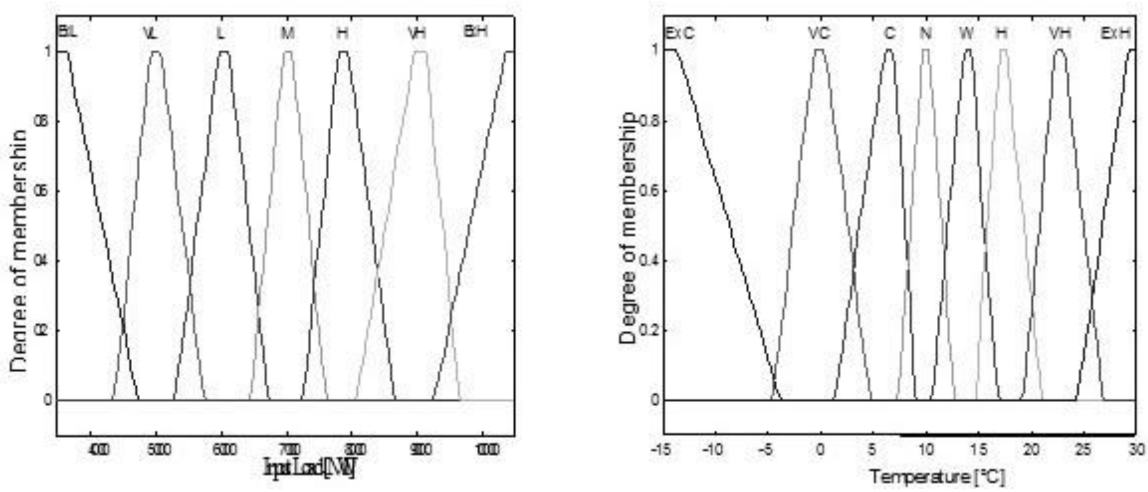


Fig. 4. Trapezoidal membership function for input load and input temperature

FUZZY RULES FOR PREDICTION OF LOAD

Heuristic and expert knowledge are often expressed linguistically in the form of If-Then rules. These rules can be extracted from common senses, intuitive knowledge, general principles and laws, and other means that reflect actual situations. For example "If the temperature is extremely cold, Then load demand will be very high" is an example of logic statement. The input temperature is sorted into eight categories and labeled as Extremely Cold (ExC), Very Cold (VC), Cold (C), Normal (N), Warm (W), Hot (H), Very Hot (VH), and Extremely Hot (ExH). The input and output load is sorted into seven categories and labeled as Extremely Low (ExL), Very Low (VL), Low (L), Normal (N), High (H), Very High (VH), and Extremely High (ExH) as shown in Figure 2.

A tentative list of input and output variables using statistical analysis, and engineering judgements was compiled. The input and output variables within the [0, 1] region was normalized. The next step was the selection of the shape of the fuzzy membership for each variable. This is purely arbitrary, but one usually starts with a particular shape of membership function and changes it if the forecasting accuracy is not good. The triangular shaped mappings shown in Figure 2 are very common, however, alternative shapes, such as Gaussian and trapezoidal curve with different amounts of function overlapping, were also used as shown in Figure 3 and 4, respectively.

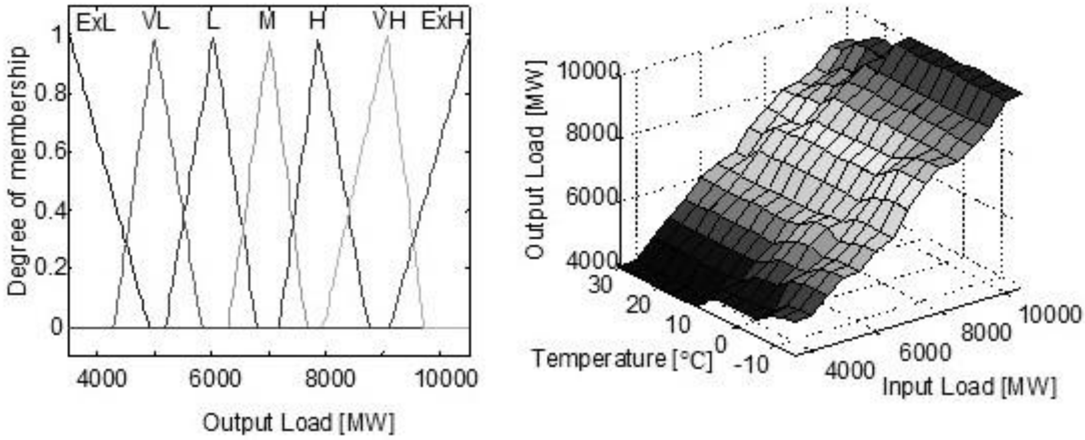


Fig. 5. Triangular type membership functions for output load and FIS surface for triangular input

## CONCLUSIONS

A forecasting technique based on fuzzy logic approach has been presented in this paper. This approach can be used to forecast loads with better accuracy than ANN technique. The flexibility of the proposed approach, which offers a logical set of rules, readily adaptable and understandable by an operator, may be a very suitable solution to the implementation and usage problem that has consistently limited the ad-option of STLF models. This technique is simple to implement on a personal computer and allows for operator intervention. Some inspirational models are in.

Various membership functions have been discussed, and for the particular application data sets, their effects on model performance have been demonstrated. The proposed model has been able to generate fore-casts with a MAPE frequently below 2.8 % for working days, 3.6 % for weekends and 3.4 % for special days. The simulation results demonstrate the effectiveness of the fuzzy model for 24-hour ahead prediction.

## LITERATURA

1. Mamdani, E.H.: Applications of fuzzy logic to approximate reasoning using linguistic synthesis, IEEE Transactions on Computers, Vol. 26, No. 12, pp.1182-1191 (1977)

2. Sugeno, M.: Industrial applications of fuzzy control, Elsevier Science Pub. Co. (1985)

3. Zadeh, L.A.: The concept of a linguistic variable and its application to approximate reasoning, Parts 1, 2, and 3, Information Sciences, Academic Press, New York (1975)

4. Zˇ ´AK, L. Fuzzy Objects and Fuzzy Clustering. Proc. 8th Zittau Fuzzy Colloquium, Zittau, 2000, pp 293 – 302, ISBN 3-00-006723-X.

5. Muhammad Riaz Khan, Libor ˇZ´ak and ˇCestm´ır Ondru°ˇsek, Fuzzy Logic Based Short Term Electric Load Forecasting, ELEKTRO 2001, 4th Inter- national Scientific Conference, ˇZilina, 2001, pp 19-25, ISBN 80-7100-836-2

6. Zak, L. Application Of Fuzzy Logic To Time Series. In Aplimat 2005, 4nd International Conference. Bratislava: FME STU Bratislava, 2005. p. 549-555. ISBN: 80-969264-1- 1.

7. D. Valiˇs, L. ˇZ´ak and O. Pokora, "Contribution to system failure occurrence prediction and to system remaining useful life estimation based on oil field data," Proceedings of the Institution of Mechanical Engineers, Part O: Journal of Risk and Reliability, vol. 229, no. 1, pp. 36-45, 2015.

8. D. Mazurkiewicz, "Computer-aided maintenance and reliability management systems for conveyor belts," Eksploatacja i Niezawodnosc - Maintenance and Reliability, vol. 16, no.3, pp. 377-382, 2014.

9. D. Mazurkiewicz, "Tests of extendability and strength of adhesive-sealed joints in the context of developing a computer system for monitoring the condition of belt joints during conveyor operation," Eksploatacja i Niezawodnosc - Maintenance and Reliability, vol. 3, pp. 34-39, 2010.

10. A. Glowacz, "Diagnostics of direct current machine based on analysis of acoustic signals with the use of symlet wavelet transform and modified classifier based on words," Eksploatacja i Niezawodnosc – Maintenance and Reliability, vol. 16, no. 4, pp. 554-558, 2014.

11. A. Glowacz, "Diagnostics of synchronous motor based on analysis of acoustic signals with the use of line spectral frequencies and k-nearest neighbor classifier," Archives of Acoustics, vol. 39, no. 2, pp. 189-194, 2014.

12. S. Cornak et al. (2011, November). Lifetime extension of engine oil using additives. Presented at MendelNet. [online]. Avaiable:
https://mnet.mendelu.cz/mendelnet2011/mendelnet 2011 fulltext.pdf

13. Yuldashev, A. V. (2024). PRINCIPLE OF FORMING AN INTELLECTUAL MODEL OF DIAGNOSING OBJECT STATES. Economy and Society, (3-2 (118)), 436-440.

14. Valijon o'g, Y. L. A., Saydulla o'g, N. Y., Shavkat o'g, N. S., & Ubaydulla o'g'li, X. S. (2023). CONSTRUCTION OF NUMERIC CONTROL SYSTEMS USING FUZZY MODULE. RESEARCH. UZ, 28(5), 31-37.

15. Valijon o‘g, Y. L. A., Shavkat o‘g, J. E., Hakimjon o‘g, S. H., & Farkhod o‘g, M. F. (2023). KNOWLEDGE REPRESENTATION MODELS IN ARTIFICIAL INTELLIGENCE. RESEARCH. UZ, 28(5), 22-30.

16. Valijon o‘g, Y. L. A., Davlat o‘g, X. R., & Tirkash o‘g, I. G. A. (2023). DESIGNING A SUGENO-TYPE SYSTEM USING FUZZY LOGIC. Journal of new century innovations, 43(2), 97-106.