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Titov M.G., student of group 122-23-2
(*Dnipro University of technology, Dnipro, Ukraine*)

APPLICATION OF FUZZY LOGIC ALGORITHMS FOR ENERGY CONSUMPTION FORECASTING

Fuzzy logic is a form of multi-valued logic in which the truth values of the variables can be any real number between 0 and 1, inclusive. It is used to deal with the concept of partial truth, where the truth value can vary between completely true and completely false. This contrasts with traditional Boolean logic, where truth values are binary - either true or false. Fuzzy logic provides a more flexible way to reason and make decisions under uncertainty and imprecision, making it particularly useful in artificial intelligence and machine learning for applications that mimic human decision making[1-2].

The ability of fuzzy logic to deal with imprecise and uncertain information makes it valuable in a variety of applications:

1. Control systems. Fuzzy logic controllers are widely used in industrial control systems, home appliances like washing machines, and automotive systems. For example, in a washing machine, fuzzy logic can control the wash cycle based on the type and amount of laundry, optimizing water and energy consumption.

2. Image processing and computer vision. In computer vision, fuzzy logic can improve image segmentation and object recognition by dealing with the ambiguity and fuzziness inherent in visual data. For example, in medical image analysis, fuzzy logic can help determine the boundaries of tumors or lesions where the edges may not be clearly defined.

3. Decision making and expert systems. Fuzzy logic is used in expert systems to simulate human reasoning. For example, in AI in agriculture, fuzzy logic can help create systems that advise farmers on irrigation or fertilization based on various uncertain factors such as soil type, weather conditions, and plant health.

Fuzzy logic plays an important role in some branches of artificial intelligence (AI) and machine learning (ML), especially in hybrid systems. While modern deep learning models often rely on probabilistic and statistical methods, fuzzy logic provides a complementary approach for dealing with symbolic reasoning and expert knowledge. It can be integrated with neural networks and other ML methods to create systems that are both robust and interpretable. For example, in reinforcement learning (RL), fuzzy logic can be used to define state spaces, actions, or reward functions in a way that is more understandable to humans. (FIG.1).

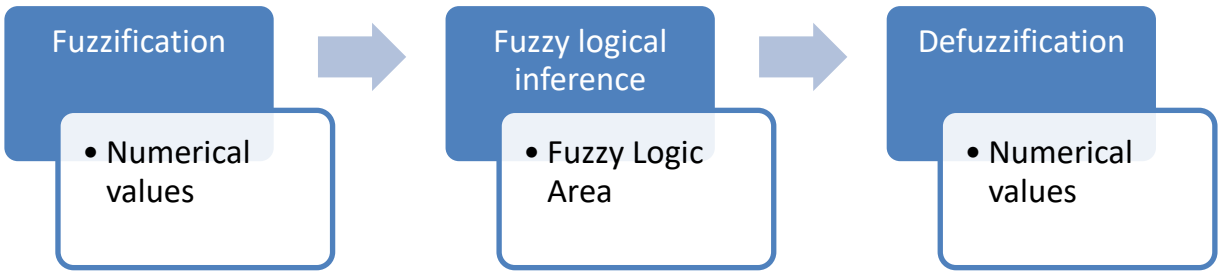

Fig.1 . Fuzzy logic diagram

Smart Grids or intelligent networks are “smart” actively adaptive networks that combine complex control and monitoring tools, information technologies, and communication tools that provide significantly higher performance and allow generating, distribution, and utility companies to provide the population with higher quality energy [3-7]. Smart grids are new systems for generating electric power, complex branched power transmission networks, innovative monitoring and diagnostic systems, qualitatively new communication systems between energy facilities, microprocessor-based electricity metering systems, etc. of course, a fundamentally reorganized protection of these networks.

The use of fuzzy logic provides opportunities to solve certain problems in the field of heat and electricity consumption management, as well as forecasting processes in heat and electricity networks. Unlike traditional methods, the development of energy resource management and distribution methods based on a forecast using fuzzy logic can provide certain energy savings. Since the costs of processing and loss of thermal energy will be minimized where there is no need for it.

REFERENCE

1. Fadyeyeva, I. G., & Gryniuk, O. I. (2019). Fuzzy logic as a Risk-Controlling Instrument in the Context of the Proactive Management of the Oil and Gas Producing Enterprises. Business Inform, 4(495), 212–220. https://doi.org/10.32983/2222-4459-2019-4-212-220

2. Кайдан, Н., & Величко, С. (2022). НЕЧІТКА СИСТЕМА ОБРОБКИ ТЕКСТОВИХ ДАНИХ. Збірник наукових праць фізико-математичного факультету ДДПУ, (12), 50–59. https://doi.org/10.31865/2413-26672415-3079122022261510

3. OLISHEVSKYI I.H. (2024). DATAWARE AND SOFTWARE OF THE AUTOMATED TECHNOLOGY FOR COMPUTER-INTEGRATED CONTROL OF HEAT PUMP SYSTEMS. MEASURING AND COMPUTING DEVICES IN TECHNOLOGICAL PROCESSES, (2), 205–212. https://doi.org/10.31891/2219-9365-2024-78-23

4. OLISHEVSKYI I.H. (2024). RESULTS OF DEVELOPMENT AND RESEARCH OF THE TECHNOLOGY FOR AUTOMATED ENERGY-EFFICIENT CONTROL OF HEAT PUMP SYSTEMS BY MEANS OF COMPUTER EXPERIMENT. Herald of Khmelnytskyi National University. Technical Sciences, 335(3(1), 419-428. https://doi.org/10.31891/2307-5732-2024-335-3-58

5. OLISHEVSKYI I.H. Automated methodology of calculating parameters for non-traditional technology of heating mode of hydro-storage power plant station / OLISHEVSKYI I.H., GUSEV O.YU., OLISHEVSKYI H.S. // Електротехніка та електроенергетика. / Запорізький нац. ун-т «Запорізька політехніка». – Запоріжжя, 2023. – № 1. – С. 36-42. https://doi.org/10.15588/1607-6761-2023-1-4

6. Olishevskyi, I., & Olishevskyi, H. (2021). Automated method of calculation of parameters for non-traditional heating technologies and conditioning of buildings. Electrical Engineering and Power Engineering, (3), 40–47. https://doi.org/10.15588/1607-6761-2021-3-4

7. Moroz, B.I., Shvachych, H.H., Selehei, A.M., Krekoten, M.A., Olishevskyi, I.H., Zhamanbayev, B.U. (2024). Model for optimal control of charge loading parameters of metal-reducing plants. Naukovyi Visnyk Natsionalnoho Hirnychoho Universytetu, (6), 129–135. https://doi.org/10.33271/nvngu/2024-6/129