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FUZZY NEURAL NETWORK ENERGY CONTROL SYSTEM

Annotation. The synthesis and study of neuron system of automatic control system, autonomous power supply. As a result, was constructed membership functions for terms of input variables, according to a preliminary study of the neural network.

Keywords: neural network, the membership function, independent power supply, solar battery, wind power plant

The aim is to study the synthesis and neural fuzzy automatic control system (ACS) independent power supply system (IPSS) based wind-solar systems and reserve power generator.

Materials and methods of research. In [1], the general view, structural and functional schemes IPSS. The main sources of energy for the IPSS was selected solar and wind energy as well as a backup - power. According to the design of the scheme electrical function [1], the connection of a source of energy (SE) is using power electronic keys that the scheme electrical structural [1] in the form of block switching sources.

There is the problem - to develop ACS IPSS, which should optimize the energy for autonomous consumer, given the conditions in which it is planned to implement IPSS (energy potential, the energy needs of the consumer, etc.).

For definiteness further study was made of the conditions of Kirovohrad region that are in [2-4].

The architecture of the complex decision-making fuzzy neural ACS IPSS shown in **(fig. 1)**. The input data come on the power, which are able to provide solar battery (SB) and wind turbine (WT). The third input parameter - power required consumer. Depending on their values switching device must provide one of the modes:

- Mode 1 - just connect solar battery.
- Mode 2 - connecting solar panels and wind turbines.
- Mode 3 - connect the solar cell, wind turbine and reserve power generator.

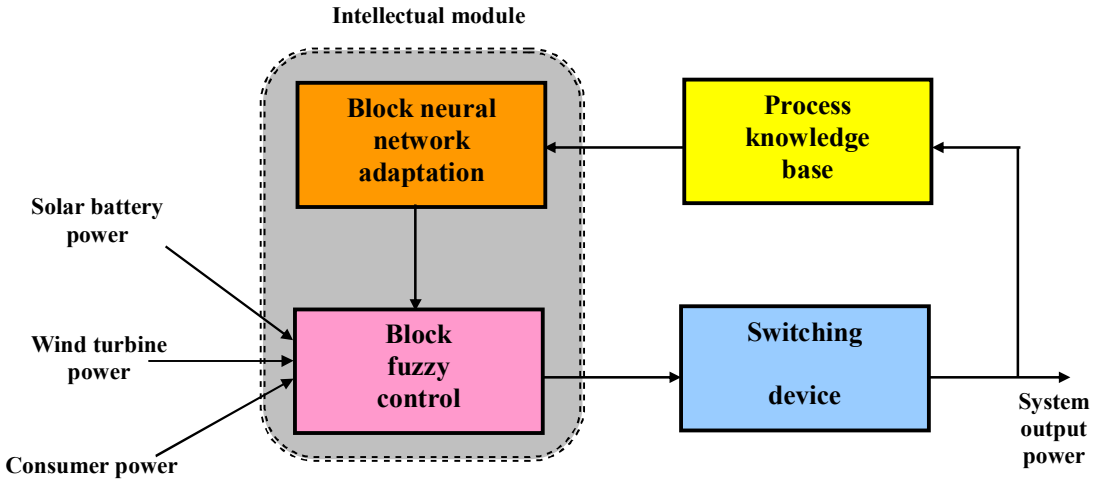


Figure 1 – Architecture ACS IPSS

Initially using a neural network using peer data is adequate configuration management system based on fuzzy logic. Then, the start IPSS. During the operation constantly updated knowledge base process. When discrepancies or quality control after a certain period of time (set by expert specialist) information from the database is transferred to the intelligent module where using a neural network is made re fuzzy system. All this is based on back propagation algorithm (gradient method), which can be implemented using the GUI hybrid (fuzzy) neural network module ANFIS Editor (Fuzzy Logic Toolbox) in the application package system MatLab® [5, 6].

Input parameters:

- Power that can provide SB: 0 ... 2.5 kW;

- Power that can provide WT: 0 ... 6 kW;

- Power required consumers: 0 ... 7 kW.

The initial setting of the system:

- Select one of 3 modes (standard units to record a 1 to 3).

Effective modeling was used three blocks: 150 sets of expert data Training data and Testing data and 35 sets Chesking data. Three blocks further improves the quality of management system, as it enables to ensure that there was no re-training network [6]. Information blocks filled to the specific neural network synthesis - data should vary smoothly and maximally saturated fill the entire area of their values. The standardization of parameters and dimension reduction matrix inputs have not performed as they are interconnected and technologically changing sequence in the same areas.

By activating ANFIS Editor, downloaded study sample **(fig. 2)**.

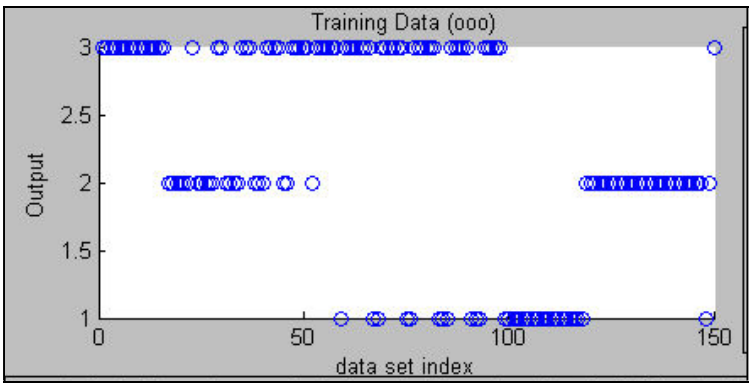


Figure 2 – Training sample

After the cycle approvals have chosen to belong “gbellmf”, and 1000 training periods, resulting in mean-square error is 4.76% shown in **(fig. 3)**.

After repeated cycles **(fig. 4)** failed to reach the average arithmetical error in the amount of 5.888%.

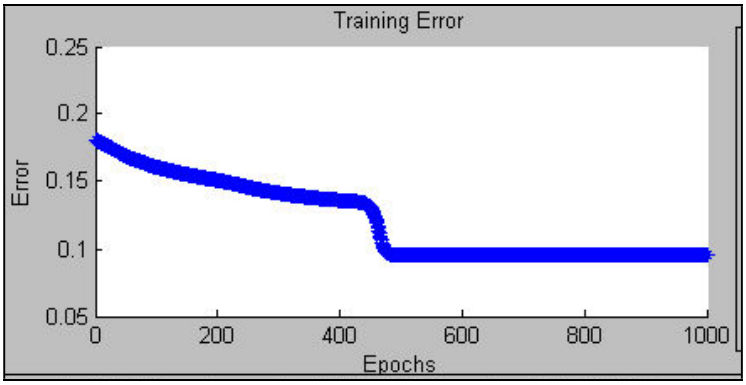


Figure 3 – The quality of education using membership functions – "gbellmf"

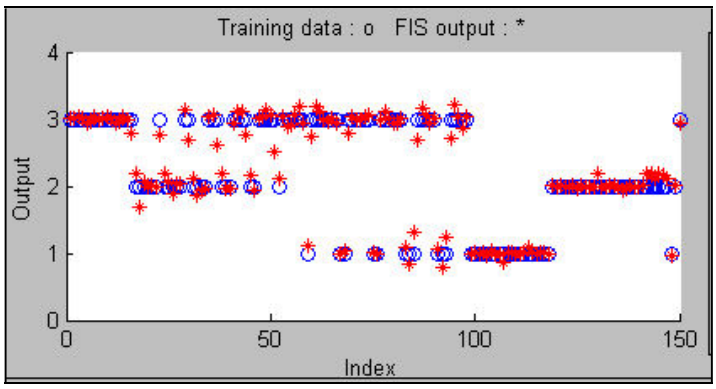


Figure 4 – The quality of functioning fuzzy control system with sample after additional cycles

Then download checker block data **(fig. 5)**, which confirmed the adequacy of fuzzy systems: arithmetic average error - 6.279% and no effect of retraining.

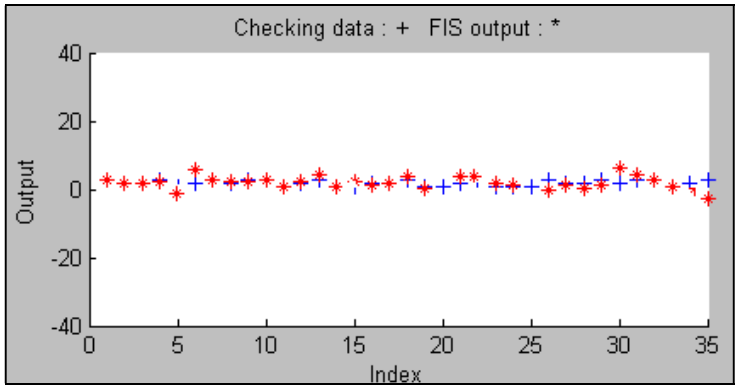


Figure 5 – Quality operation system in fuzzy chesking data

ACS fuzzy synthesized IPSS shown in **(fig. 6)**. The algorithm processing information - Sugeno. In our case, the system of fuzzy control will include 17 productions fuzzy rules. In the context of fuzzy logic in the process of phasing understand the values of functions of fuzzy sets (terms) and based on common input data [7].

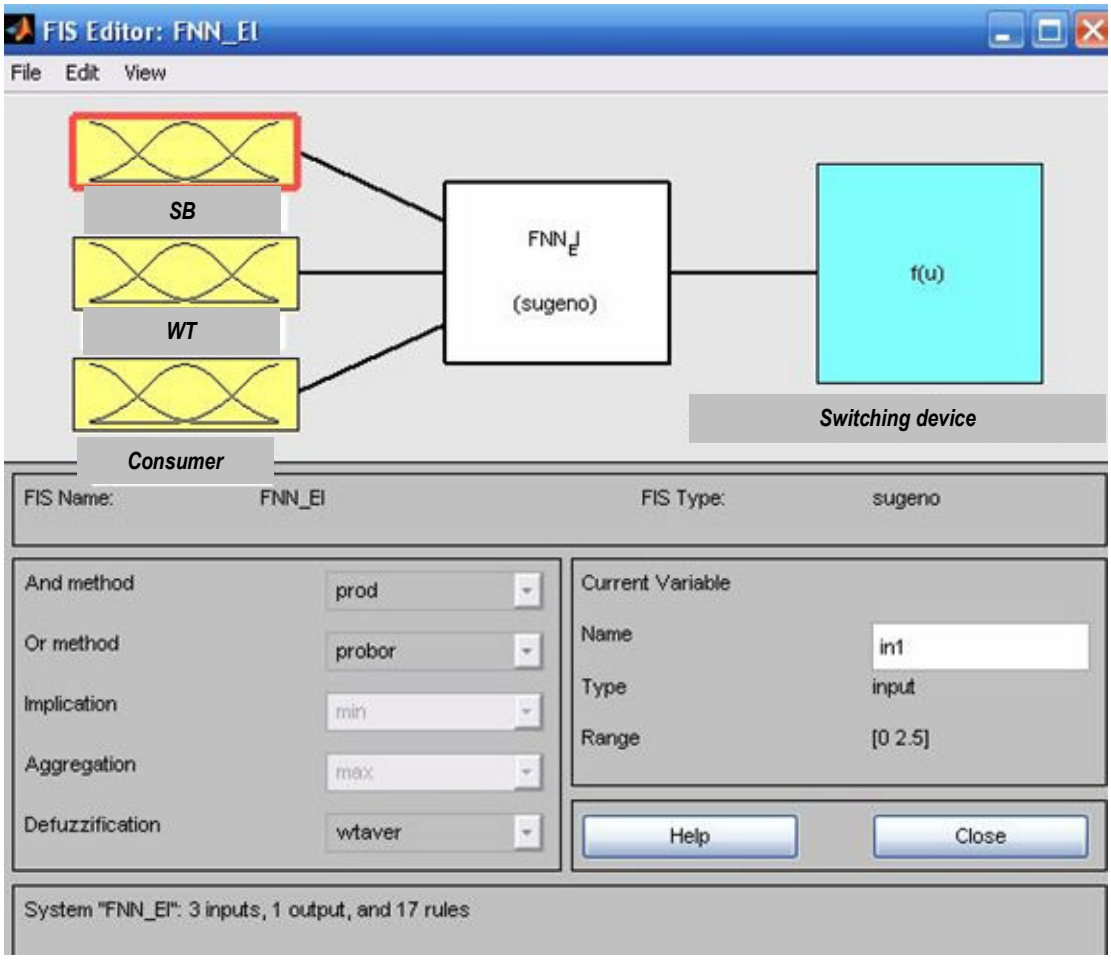
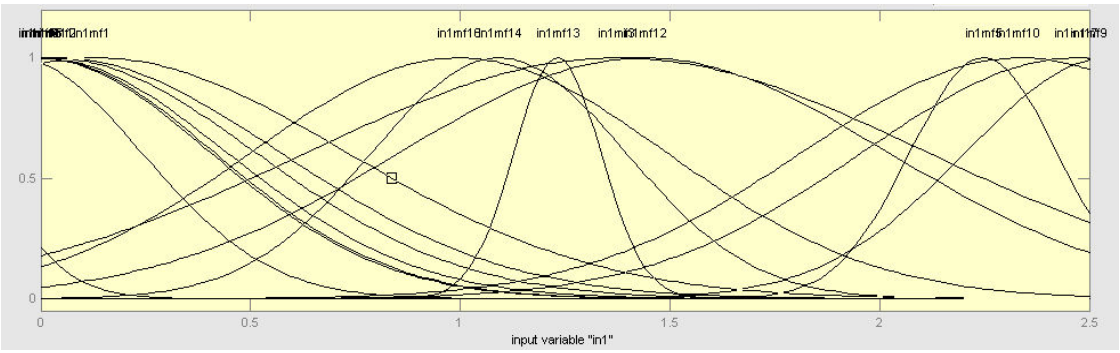


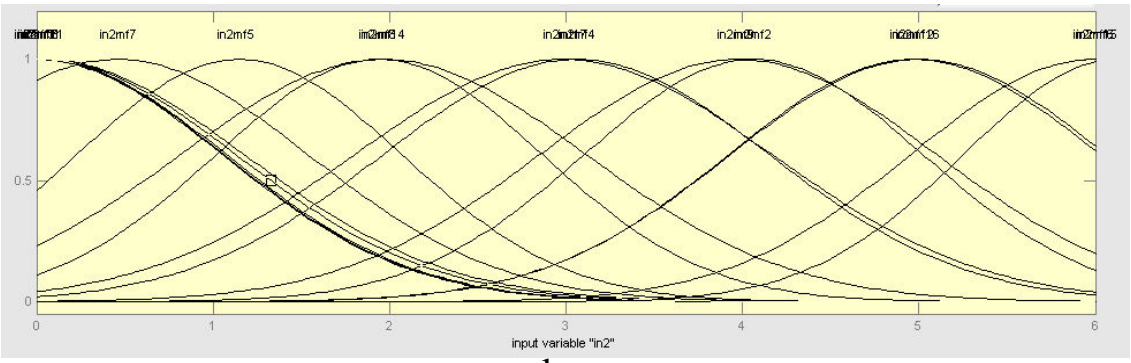
Figure 6 – Structure Fuzzy ACS IPSS in FIS-Editor MatLab®

The aim of phasing analysis is to establish consistency between the separate output variable fuzzy control system and the value of membership function of term the corresponding input linguistic variable.

In **(fig. 7)** functions for the terms of input variables, and the **(fig. 8)** - fuzzy rules for fuzzy productions ACS IPSS with customized parameters of membership functions.



a



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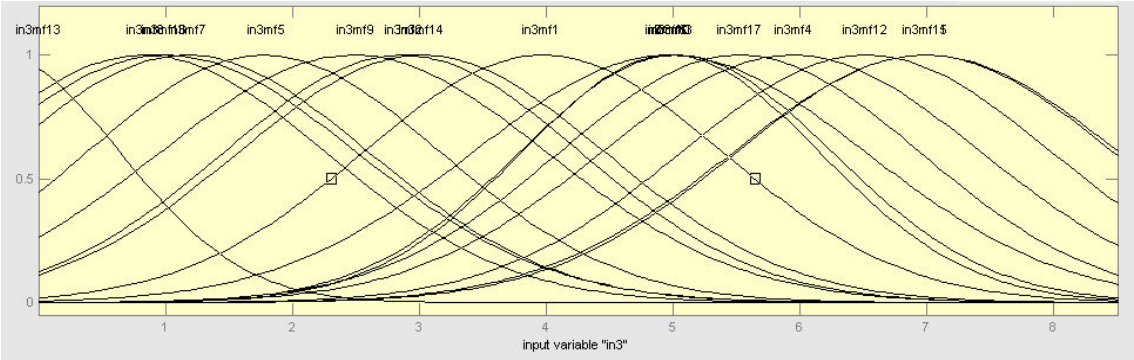

c

Figure 7 – Charts terms of membership functions for input variables: a) - "power SB"; b) - "power WT"; c) - "power consumer"

The software code such fuzzy system using functional blocks MatLab® easily regenerate the code programming language FCL (Fuzzy Control Language). This will enable encapsulate software developed in the language of fuzzy control FCL, in the functional unit (based on the standard IEC 1131-3) programmable logic controllers (PLC - Programmable Logic Controllers) in the form of structured text. FCL described in the standard IEC 1131-7, which identified goals of development language, its basic structure.

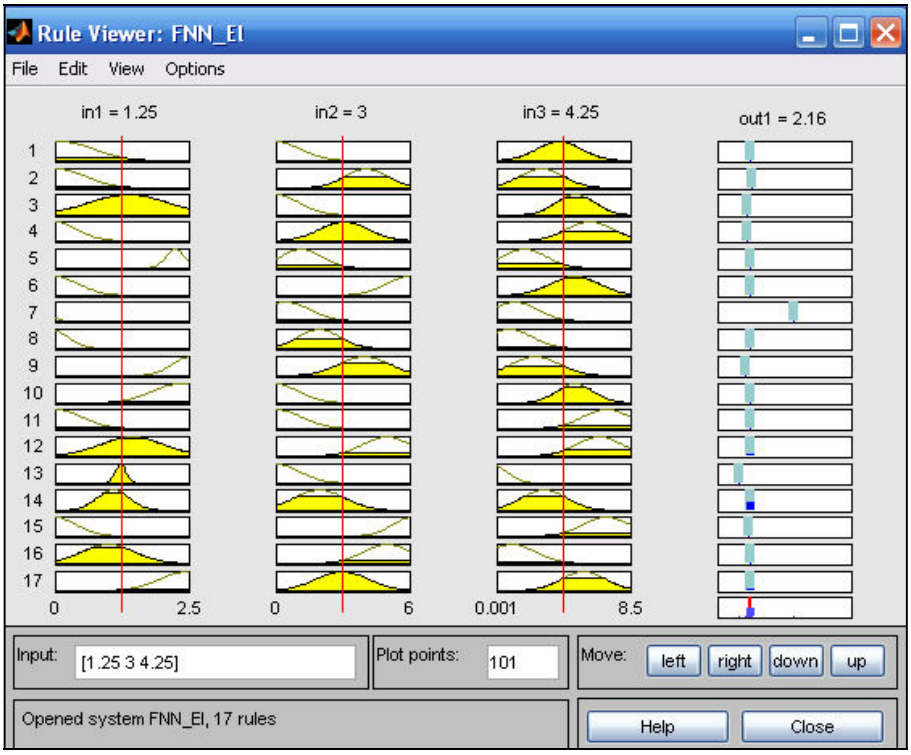

Figure 8 – Terms productions fuzzy ACS IPSS, customized neural network

Interaction fuzzy control algorithm with IPSS programming environment, in this case you can use such as SCADA-system ISaGRAF and Trace Mode, must be hidden from other programs of this environment. That is why the implementation of the algorithm operation IPSS ACS software can be made functional unit, for example, in language FBD / LD.

Conclusions. Using neural network to streamline the structure of fuzzy ACS in the course of IPSS, under certain conditions (energy needs of consumer, weather conditions and other areas.). The proposed method to create the ACS can be used for systems that are based on other renewable energy sources.

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