

## FUZZY REGULATOR SYNTHESIS IN MICROCLIMATE CONTROL SYSTEM IN THE GREENHOUSES

**Annotation.** The cultivation of vegetables in a closed ground is getting more and more development. For year-round supply of fresh vegetables to the population around many large cities and industrial centers, large greenhouses have been established and the volume of construction of various cultivation facilities is increasing every year. In the design and construction of a variety of cultivation facilities, the main task is to create an artificial climate inside them, which will provide the optimal conditions necessary for the normal development and high productivity of crops. It is proposed to use a fuzzy regulator in order to increase the efficiency of vegetable production in greenhouses..

**Key words:** fuzzy controller, energy efficiency, control system, greenhouses.

Advanced countries of the world have successfully solved the issue of supply of crop production to the population during the year. This task is being implemented, including through the intensive use of structures of closed ground.

Microclimate has an important role in the formation of the crop of vegetables in the greenhouse economy. However, the existing systems of its provision in greenhouse premises have disadvantages: the temperature on the plant surface is not taken into account; The complex temperature influence of solar radiation, ambient temperature, fencing material and other external factors that have a random character is not evaluated. Such systems operate on the principle that the development of the control effect is consistent with the amount of product (vegetable) at the output and the quantitative parameters of the input quantities, although it is necessary to take into account the stochastic fluctuations in the parameters of the greenhouse and the change in the structure of the interrelations between them that take place in the actual conditions of functioning of the structures of the enclosed soil.

In the premises of greenhouses create an artificial climate and a regime is established in which rapid growth and high productivity of vegetable crops are provided irrespective of the season, weather and climate.

Results of the study of biotechnical objects allowed to make conclusion that their dynamic characteristics in production process are significantly changing, that does not allow to ensure optimal functioning of automation systems. Due to this fact, adaptive systems have developed, that made it possible to reduce the share of energy in structure of the cost of produced goods by 6-8% [1-3].

Through the use of neural network adaptation can optimize the structure of the SAC in real-time and create an energy-efficient updated database to know the modes of operation . The proposed approach differs from the known ones in that the use of a mathematical apparatus of fuzzy logic with neuromuscular adaptation, which was used to create SAC, allowed to predict and coordinate the processes of energy consumption and supply.

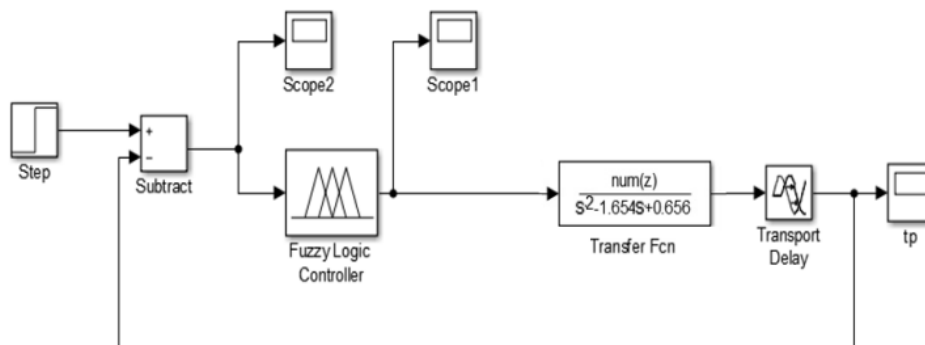


Figure 1. The structure of the system and the viewer rules

Previous studies [4] have shown that the use of such a control system based on fuzzy logic can improve the system's performance, and also reduce energy consumption up to 13%.

To study the mathematical models of the system was used a software package for modeling control systems with fuzzy controller in Simulink, the structure of the control system is shown in Fig.1.

Fuzzy logic Designer is used to adjust the fuzzy controller. The input shows the temperature range, according to which the angle of rotation of the control valve on the actuator will be adjusted (Fig.2). Up to the specified rules in the fuzzy controller, the optimal rotation angle will be selected accordingly to the temperature in the greenhouse.

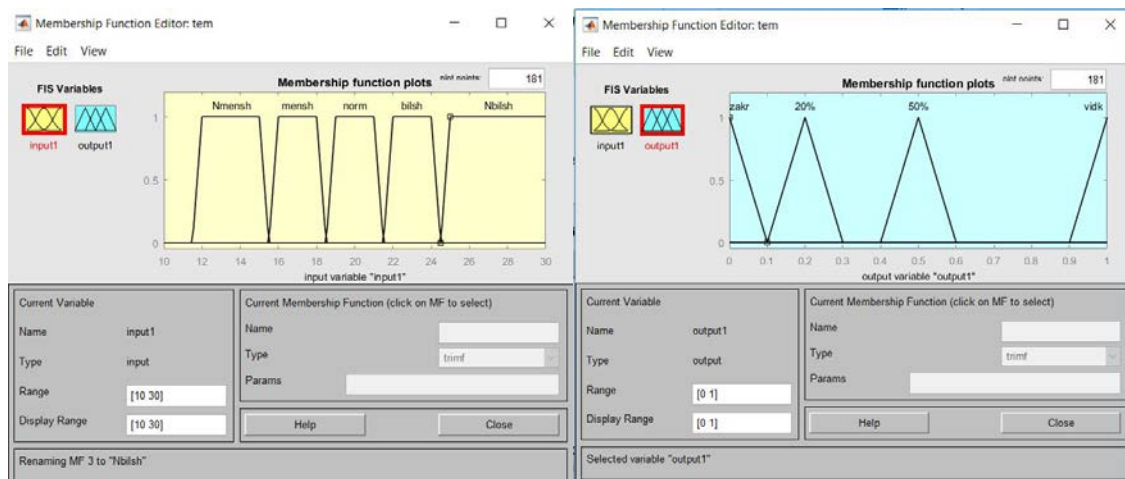


Figure 2. Graphical view of functions a) input b) output variables

The results of simulation of automatic control system of microclimate with the use of fuzzy controller in comparison with simulation results of the automatic control system of microclimate with the use of a regulator OVEN TPM148 shows less time adjustment.

The introduction of a fuzzy regulator into the system of automatic regulation of the microclimate in closed-ground structures allows improving the system of regulation and improving the initial results, increasing energy efficiency and reducing the economic costs of heating and humidification.

### Conclusions and prospects.

1. Usage of traditional stabilization algorithms in automation systems under conditions of high cost for energy resources makes such systems and enterprises energy-inefficient.

2. Usage of intelligent systems of control in the greenhouses, operating on the basis of knowledge base, allows:

- to substantial increase of energy efficiency of such systems, reducing energy consumption by 10-12% comparing to traditional stabilization positional algorithms;
- to increase of efficiency of decision making about the electric drives modes (heating system, ventilation etc.).

### Literature

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