Monitoring system, STATUS selskohozyaystvennыh rate this agreement and Accept Control Strategy ahrobyolohycheskym BUILDING field.

Monitoring, model, peremennыe norms vnesenyya, prognostic, kompensatsyonnaya technology.

The paper present an implementation model prognostically-compensation technology variable application rates of technological material using information technology systems to monitor the status of agricultural land, which allows for on basis of revised estimates of soil obtained from the monitoring system to assess the state of agricultural land and to take control strategy agrobiological potential field.

Monitoring, model, variable rate application, predictive-compensation technology.

UDC 631,589

EFFICIENCY OPTIMIZATION CONTROL SYSTEM USING GENERALIZED FUNCTIONS DESIRABILITY OF HARRINGTON

VA Miroshnyk, A. Dudnik, Ph.D.

A study selection algorithm optimal control decisions based on the use of generalized functions Harrington desirable to improve energy efficiency in the management of biotechnical systems.

Optimization, biotechnical system energy efficiency.

Problem. Operation of biotechnical systems which contain a combination of biological and technical component associated with the use of a significant amount of energy [1,2,7]. Notable examples of such systems are industrial poultry houses built greenhouses, livestock facilities and so on. However, despite the high level of effectiveness of control systems that are able to maintain the required accuracy of the parameters and use powerful computing capabilities of modern automation, still unable to lower power consumption at maximum performance.

Analysis of recent research. Algorithms stabilization process parameters at a given level do not involve the use of a criterion of optimization that ultimately appears in

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energy waste. Building management systems that include optimal control algorithm for finding the solution, but take into account the peculiarities of biological and biotechnical system component is an important task of research, because it will not only reduce energy costs but also provide high qualitative and quantitative performance indicators of biological objects [5].

The purpose of research is the justification criterion optimization control system parameters as functions of dimensionless desirability of Harrington, which includes local criteria to minimize and maximize energy performance of a biological object.

Research results. As you know, the optimization criterion is the control value (maximum or guaranteed) Decision of the objective function among a plurality of control actions. Thus, for the studied system is proposed to use to bring many local criteria to one objective function by the method using a generalized function desirability of proposed E. Harrington, which can be described by the equation coordinated product:

$$F(x) = \prod_{k=1}^{s} f_k(x)^{\lambda_k} \rightarrow \max, \qquad (1)$$

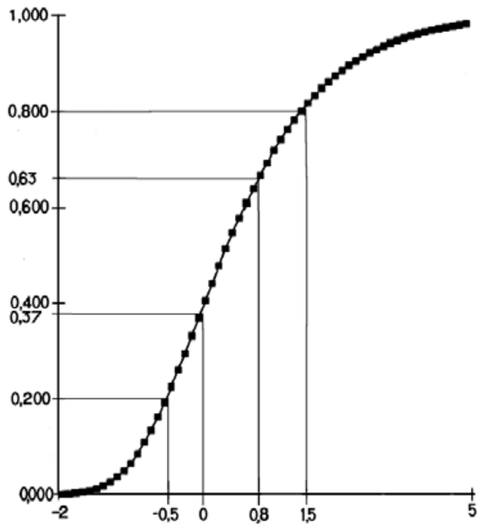
where local criteria fk is the increase in mass of plants through photosynthesis, energy consumption for heating the air in the greenhouse and ventilation costs of CO2 on plant nutrition and λ_k – weight, which $\lambda_k \geq 0,\ \ \sum_{k=1}^{s} \lambda_k = 1$. Optimization parameters are: x1– natural gas consumption for heating greenhouses m3 increase in dry matter by the growth and development of tomato% and temperature, which should be optimal for a particular grade, C.

Results. In order to synthesis of mathematical Dependence of biological object (tomato) conducted active multifactorial experiment [3,4].

As a result of active multifactorial experiment dependence of the intensity of photosynthesis microclimate in the form of a polynomial equation:

in = 1,51847 + 0,14802x1 + 0,499x2 + 0,281 x3 + 0,032x1x2 -
-0,023x1x3 - 0,397x2x3 - 0,0013x12 - 0,164x22 + 0,179x32,
(1)

where x1 - Temperature, oC; x2 - the intensity of solar radiation, W / m2; x_3 - CO2 content,%.



Synthesis of a mathematical model of control system that operates in the test facility Bioengineering (PAT "Combine" Greenhouse ") carried out using statistical data on the dependence of natural gas for heating greenhouses from the following options: external and internal air temperature and solar radiation intensity, ie static characteristics of the object (Fig. 1). The mathematical model of a polynomial equation of second order equations where the coefficients determined by the least squares method. The dependence of natural gas from the air temperature in the greenhouse (T1, C), external temperature (T C) and the intensity of solar radiation (R, W / m2).

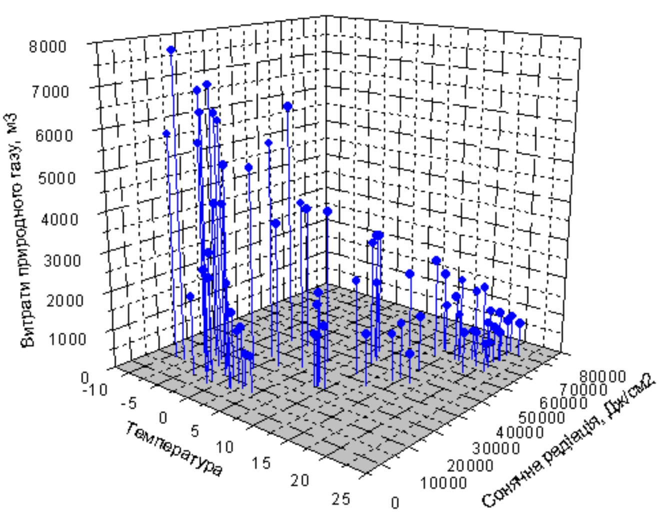


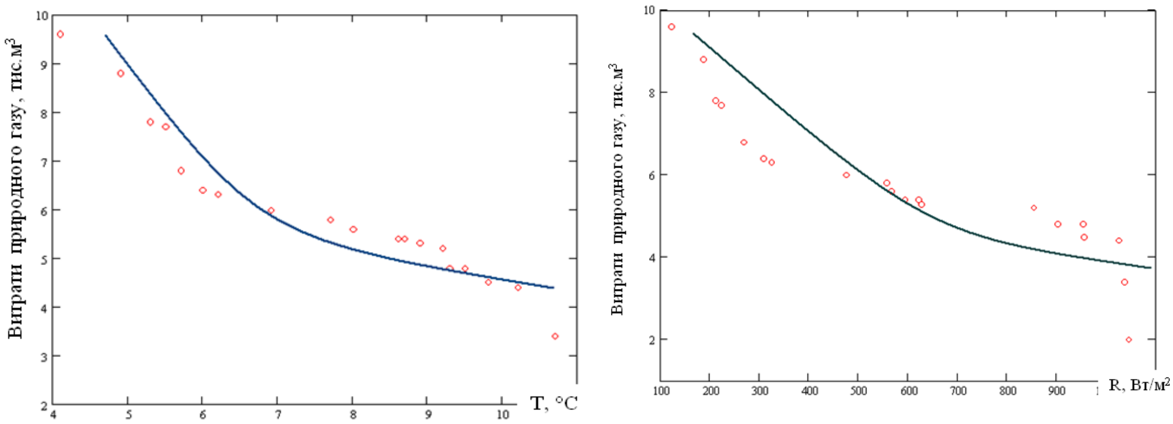
Fig. 1. The static characteristic biotechnical system.

$$P(T,T1,R) = -6{,}213 \cdot 10^{-3} + 1{,}86 \cdot T + 5{,}92 \cdot T1 + 0{,}038 \cdot R + 0{,}314 \cdot T \cdot T1 - \\ - 3{,}257 \cdot 10^{-3} \cdot T \cdot R + 7{,}41 \cdot 10^{-4} \cdot T1 \cdot R - 0{,}056 \cdot T^2 - 0{,}023 \cdot T1^2 + 1{,}39 \cdot 10^{-5} \cdot R^2 \qquad (2)$$

Mean square error defined by the expression:

$$SP := \sqrt{\frac{\sum_{i} \left(P_i - PP\left(T1_i, T_i, R_i\right)\right)^2}{N}} \qquad (3)$$

Fig. 2 shows the experimental and calculated depending on the cost of natural gas on the temperature and the intensity of solar radiation.



a) b)

Fig. 2. Dependence (experimental and calculated) of natural gas from the external air temperature (a) and the intensity of solar radiation (b).

The objective function is generalized optimization criterion F (x) which minimizes energy costs f1 and allows maximum growth of tomatoes f2. In view of the greater importance of the first two factors, the weights selected in the following ratios:

$$F(X) = f1_б^{0,4} f2_б^{0,4} f3_б^{0,2} \rightarrow \max,$$

Levels of significance, while translating in the dimensionless form factor method Harrington, chosen by technological requirements. Restrictions on optimization options are:

$0 \le x1 \le 80{,}000$ m3; $15 \le x2 \le 35$ oC.

Fig. 3 shows the block diagram of the algorithm by which the transformation of local criteria in dimensionless form.

1) Enter values desirability di intervals and intervals of values of local optimization criterion in kind, responsible desirability fi.

2) Enter the converted value of natural local optimization criterion holder FH.

3-4) Calculation array of intermediate values of Ui.

5-8) Block diagram considers that with decreasing natural values of local optimization criterion desirability function will increase. Therefore, when the value exceeds the maximum criterion, it would be desirable "very poor" and the criterion value in dimensionless form Fb is equal to

0.01 and when less than the minimum, it is desirable to be "very good" and Fb is equal to 0.99.

9-12) intervals for interpolation criterion.

13) The conversion of natural forms in an intermediate criterion in setting using a linear interpolation.

14) Convert criterion of intermediate values in dimensionless form using desirability functions Harrington.

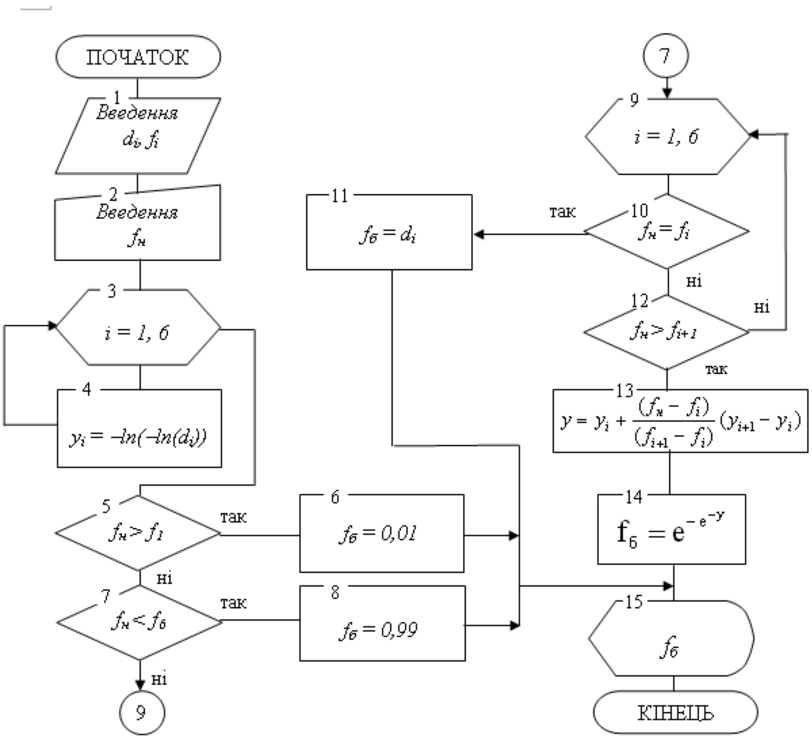


Fig. 3. Block diagram reduction criterion in dimensionless form by the method Harrington.

The result is the optimal value of microclimate (temperature) that result in a maximum increase in vegetable weight with minimal energy for heating.

Conclusions

When the functioning of complex biotechnological systems important indicator of its value is raised production costs and energy to it.

Synthesized mathematical model of growth vegetables and energy costs of growing tomatoes in greenhouses to exploit the generalized criteria to optimize Harrington.

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A rationale Choice optimal algorithm upravlyayuscheho solutions on the basis of application functions obobschennoy zhelatelnosty Harrynhtona with a view of the effectiveness энerhetycheskoy Increase in byotehnycheskymy management systems.

Optimization, byotehnycheskaya system энerhetycheskaya effectiveness.

The substantiation of optimal control algorithm was performed. The algorithm based on generalized Harrington function, which allows to increase energy efficiency of control systems for biotechnological objects.

Optimization, biotechnical system, energy efficiency.