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PRECISION DISPENSING SYSTEMS MANAGEMENT PROCESS MATERIALS

LV Aniskevych, PhD

The analysis capabilities of precision dispensing process materials in case of unforeseen changes in the values of dynamic parameters dosing systems in precision farming technology using methods of optimal control of technical systems.

Dosage, material technology, optimum control.

Problem. In carrying out such manufacturing operations as sowing, or in making fertilizers, pesticides, trace elements, etc. in precision farming technology (TC) as necessary to ensure precision dispensing process materials (TM) and high spatial precision delivery past a given point of the field.

It should be noted that provided the mechanized manufacturing operations in the field are characterized by a wide range of course various disturbing factors - irregularities of the field variation agrobiological parameters of soil temperature regimes change the system and so on. Dynamic parameters that characterize the state of metering of agricultural machinery, thus have optimal value.

Analysis of recent research. Formation of optimal control law $U(t)$ metering system vendors engines depends on the objectives of management, and the presence of a priori information about the state of the system and the nature of acting on it disturbances.

Dynamic object of regulation - dosing system by selling cars - also characterized by a certain condition and size parameters of its constituents, and the dynamics of its behavior in general is described by a nonlinear vector equation of the form:

$$\overline{x}' = f(\overline{x}, \overline{a}, t) + \varphi(\overline{x}, \overline{a}, t)\overline{U}, \qquad (1)$$

where $f(\overline{x}, \overline{a}, t)$ and $\varphi(\overline{x}, \overline{a}, t)$ - Known vector and matrix functions;

$\overline{x}$ - Vector of the object;

$\overline{a}$ - Parameter vector object;

$\overline{U}$ - Vector control actions.

In solving problems of analytical construction of optimal control system density distribution of TM on the area of the field can use the algorithm for constructing optimal control systems based on direct statement of the problem of analytical construction of optimal regulators [1].

Consider the possibility of applying optimal control algorithm for AA Krasovskii [2] on the example of the operation of pneumatic seed drill sowing system technology for variable application rate (HA) TM [3] (Fig. 1).

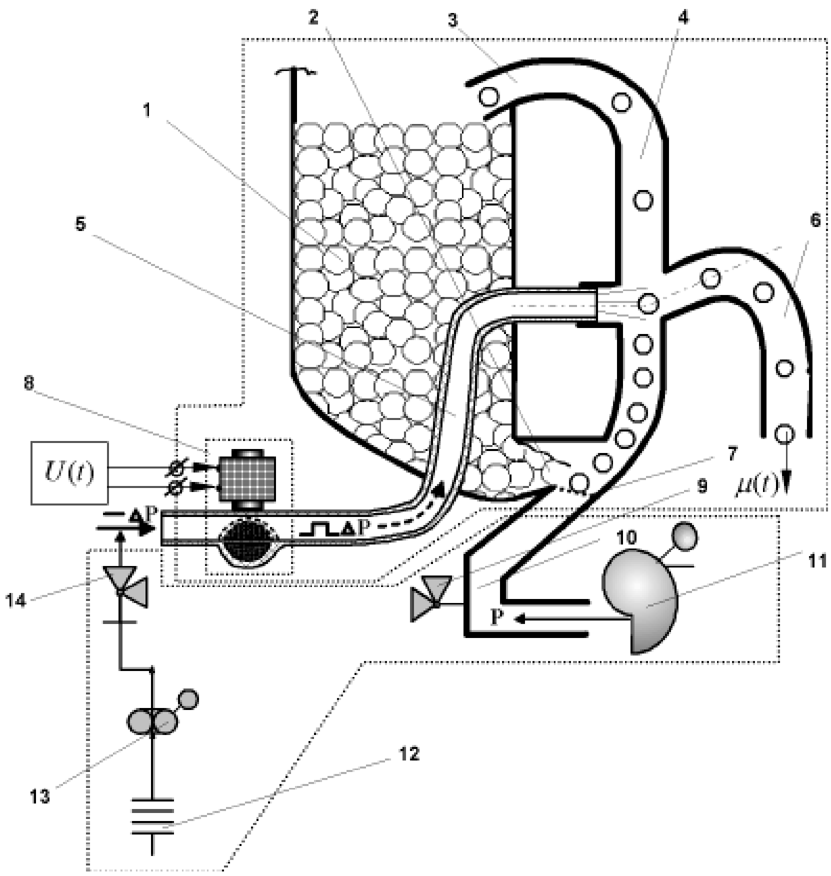

Fig. 1. Air Drills seed drill system for vehicle technology.

Drills system consists of a hopper for seeds 1, 2 intake chamber; excess return pipe 3 seed; 4 working chamber; ejector pipe 5; nasinnyeprovodu 6; 7 grid; magnetic valve control seeding 8, 9 pressure regulator mounted in the duct 10; Fan 11; filter 12; motor-compressor 13; adjustable throttle 14.

Mode variable seeding rules, specially shaped pulses of electric current fed to the magnetic valve 8. This leads to the formation of a controlled pulsed air flow ΔP. required air pressure provided by the motor-compressor 13 which sucks air through the filter 12. At the same time, the fan 11 delivers a constant flow of air into the cooking chamber 4 tangentially to its inner surface. At the same camera with 2 intake chamber by gravity and by the energy flow of air passing over the net 7, served in the cooking chamber 4 seed, which is captured by the air flow and moving up the vertical part of the working chamber 4. With ejector pipe 5 goes pulse stream air ΔP and make seeds from the working chamber 4 to 6 nasinnyeprovid, axes lie in the same vertical plane. Then moves to place the seeds in the soil earnings traditional means. Seeds that do not fall into nasinnyeprovid, in pipe 3 is returned to the tank 1.

Results. Flowchart optimal control intensity output stream seed in one of the channels described pneumatic sowing system is shown in Fig. 2.

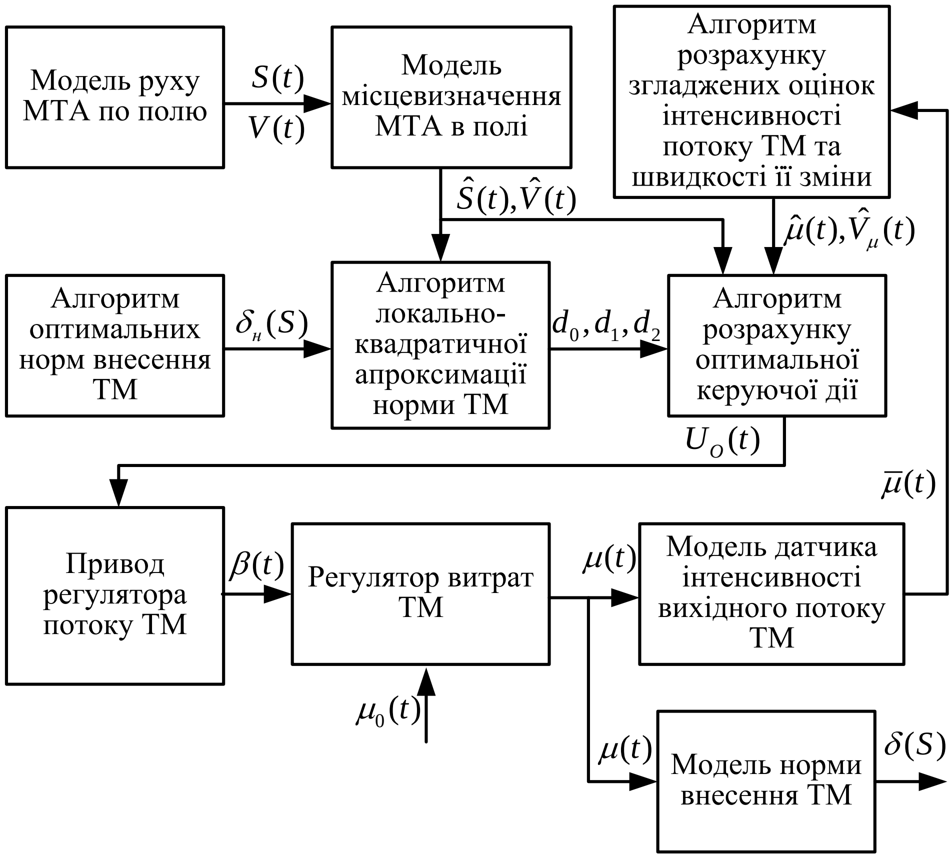

Fig. 2. Block diagram of the optimal control of the intensity of the original seed flow in a channel sowing system.

Model dynamics of seed flow control intensity described by a vector differential equation of the form:

$$\bar{x}' = A\bar{x} + BU(t), \qquad (2)$$

where $A = \begin{vmatrix} a_{11} & a_{12} \\ a_{21} & 0 \end{vmatrix}$; $B = \begin{vmatrix} b_{11} \\ 0 \end{vmatrix}$; $\bar{x}(t) = \begin{vmatrix} V_\mu(t) \\ \mu(t) \end{vmatrix}$; $a_{11} = -\frac{2\xi}{T}$; $a_{12} = -\frac{1}{T^2}$; $a_{21} = 1$; $b_{11} = \frac{K}{T^2}$;

ξ - Damping;

T - Time constant;

K - The gain;

$\mu(t)$ - The average intensity modulated output seed flow

$V_\mu(t) = \mu'(t)$; $U(t)$ - Control action applied to the input control valve 8 seeding rate (Fig. 1).

Model TM sensor stream intensity described by the equations:

$$\begin{cases} \bar{\mu}(t) = \tilde{\mu}(t)\left[1 + \Delta_{\mu}(t) + \Delta_{\xi_{\mu}}(t)\right]; \\ \tilde{\mu}'(t) = -\frac{1}{T_D}[\tilde{\mu}(t) - \mu(t)], \end{cases} \tag{3}$$

where $\bar{\mu}(t)$ - The output signal of the sensor;

$\tilde{\mu}(t)$ - Intermediate variable;

$\Delta_{\mu}(t)$ and $\Delta_{\xi_{\mu}}(t)$ - Systematic and noise components relative measurement error;

T_D - Sensor time constant characterizing its inertia;

To solve the problem of optimal tracking staged Krasovskii functional should be considered with a sliding interval optimization ΔT type:

$$\mathrm{I}_K = \frac{1}{2}\int_{t}^{t+\Delta T}\left[\Delta\bar{x}^T(\vartheta)\hat{Q}\Delta\bar{x}(\vartheta) + \bar{U}^T C^{-1}\bar{U} + \bar{U}_O^T C^{-1} U_O\right]d\vartheta, \tag{4}$$

where $\Delta\bar{x}(\vartheta) = \bar{x}(\vartheta) - \bar{x}_3(\vartheta)$; $\bar{x}_3(\vartheta)$ - Need a vector object state management;

Q - Positive definite matrix;

C - symmetric positive definite matrix;

$\bar{U}_O$ - Vector of optimal control actions.

In the case of stationary linear regulator model rules introduced TM-car salesperson precise optimal algorithm for tracking riposte functional (4) corresponds to the formula:

$$\bar{U}_O(t) = -CB^T\left\{\int_0^{\Delta T} W^T(\tau)\hat{Q}\left[W(\tau)\bar{x}(t) - \hat{\bar{x}}_3(\tau)\right]d\tau\right\}, \tag{5}$$

where $W(\tau)$ - Transition matrix model dynamics controller HA TM;

$\hat{\bar{x}}_3(\tau) = \bar{x}_3(t+\tau)$.

In the functional (4) the value of C expresses a positive weight, and the matrix $\hat{Q}$ That is included in this expression for this case is:

$$\hat{Q} = \begin{vmatrix} q_{11} & 0 \\ 0 & q_{22} \end{vmatrix}; \; q_{11} > 0; \; q_{22} > 0.$$

Preferably tracking algorithm (5) in the integrand on the right side is predictable given action $\hat{\bar{x}}_3(\tau)$ to $\tau \in [0, \Delta T]$:

$$\hat{\bar{x}}_3(\tau) = \begin{pmatrix} \dfrac{\partial \delta_{н}\left[\hat{S}(\tau)\right]}{\partial \hat{S}}\hat{V}^2(t) \\ \delta_{н}\left[\hat{S}(\tau)\right]\hat{V}(t) \end{pmatrix}, \tag{6}$$

where $\delta_{н}\left[\hat{S}(\tau)\right]$ - Required rate of sowing;

$\hat{V}(t)$ - Estimate the speed of the machine;

$\widehat{S}(\tau)=\widehat{V}(t)\tau$ - Predictable movement drills.

It should be noted that the quality of a given mode of the machine by selling some extent depends on how accurately match taken from cartograms-value problem given application rate TM those that really needed at any given moment ITA location in the field. It depends on the step periodization data in electronic digital Cartogram task-specific values and coordinates ITA in the field. It is desirable to specify, through the operation of approximation, numerical data that are selected from e cartograms problem. To apply this procedure locally quadratic approximation to allow receive data from cartograms task exactly those coordinates, which at this moment is the AIT. Then, if the dependence $\delta_{и}\left[\widehat{S}(\tau)\right]$ approximated by a quadratic function of the form:

$$\delta_{и}\left[\widehat{S}(\tau)\right]=d_0+d_1\widehat{S}+d_2\widehat{S}^2, \quad (7)$$

where d_0, d_1, d_2 - Carbon locally quadratic approximation seeding rules, instead of (6) will be:

$$\widehat{\widehat{x}}_3(\tau)=\begin{pmatrix} C_1+C_2\tau \\ C_0+C_3\tau+C_4\tau^2 \end{pmatrix}, \quad (8)$$

where $C_1=d_1\widehat{V}^2(t);\; C_2=2d_2\widehat{V}^3(t);\; C_3=d_1\widehat{V}^2(t); C_4=d_2\widehat{V}^3(t);\; C_0=d_0\widehat{V}(t);$

Holding optimal control intensity output stream TM (or seed flow in a channel sowing system chosen for example) in the machine by selling due to the need to obtain estimates of actual $\widehat{\widehat{\mu}}(t)$ intensity output stream TM and the rate of change of intensity:

$$\widehat{\widehat{\mu}}'(t)=b\left\{\frac{\partial\widehat{\delta}_n[\widehat{x}_T(t)]}{\partial x_T}\widehat{V}(t)+\widehat{\delta}_n[\widehat{x}_T(t)]\widehat{V}'(t)\right\}, \quad (9)$$

where $\widehat{x}_T$ - Assessment of coordinates moving along the center line of the MTA process track.

In the right-hand side of (9) includes assessment components required density gradient along the TM making process track and longitudinal acceleration MTA.

For assessment $\widehat{\widehat{\mu}}(t)$ in analytical form for the initial intensity sensor information, and to smooth the noise components of the error and dynamic error compensation sensor advisable to perform a polynomial approximation sensor on second order sliding time interval $\left[t-\Delta T, t\right]$:

$$\widetilde{\widehat{\mu}}(\tau)=a_{t0}+a_{t1}\tau+a_{t2}\tau^2;\; \tau\in\left[0,\Delta T\right], \quad (10)$$

where a_{t0}, a_{t1}, a_{t2} - Factors of approximation.

If $\widehat{\widehat{\mu}}_j(t), j=1,2,...,m$ - A set of discrete values of the output signal of the sensor that recorded at the times $t-\Delta T+\Delta\tau\left(j-1\right)$ Where

$\Delta\tau = \frac{\Delta T}{m-1},\ j = 1,2,...,m;\ m > 3$, The best in the sense of minimum mean square error of approximation process, estimation of coefficients of approximation determined by the formula:

$$\overline{a}_{ti} = \mathrm{H}^{+}\overline{y}, \tag{11}$$

where $\overline{y} = (\overline{\mu}_1, \overline{\mu}_2, ..., \overline{\mu}_m)^T$;

$$\mathrm{H} = \begin{pmatrix} 1 & 0 & 0 \\ 1 & \Delta\tau & \Delta\tau^2 \\ ... & ... & ... \\ 1 & (m-1)\Delta\tau & \left[(m-1)\Delta\tau\right]^2 \end{pmatrix};$$

"+" - Sign operations pseudoinverse matrix (operation) can be performed using the Greville algorithm [4].

Given the expression system (3) can write the following expressions for the smoothed estimates of the output stream TM intensity and rate of change:

$$\hat{\overline{\mu}}(t) = \tilde{\overline{\mu}}(t) + T_D \tilde{\overline{\mu}}'(t); \tag{12}$$

$$\hat{\overline{\mu}}'(t) = \tilde{\overline{\mu}}'(t) + T_D \tilde{\overline{\mu}}''(t); \tag{13}$$

$$\tilde{\overline{\mu}}(t) = \overline{a}_{t0} + \overline{a}_{t1}\Delta T + \overline{a}_{t2}\Delta T^2; \tag{14}$$

$$\tilde{\overline{\mu}}'(t) = \overline{a}_{t1} + 2\overline{a}_{t2}\Delta T; \tag{15}$$

$$\tilde{\overline{\mu}}''(t) = 2\overline{a}_{t2} \tag{16}$$

For dynamic model of object control type (2) expressions for transition matrix elements $W(\tau)$ the expression vector of optimal control actions (5) it is possible to add to the following analytical form:

– case $\xi \neq 1$:

$$\begin{aligned} W_{11}(\tau) &= \frac{1}{\lambda_2 - \lambda_1}\left[-\lambda_1 e^{\lambda_1\tau} + \lambda_2 e^{\lambda_2\tau}\right]; \\ W_{12}(\tau) &= \frac{\lambda_1\lambda_2}{\lambda_2 - \lambda_1}\left[e^{\lambda_1\tau} - e^{\lambda_2\tau}\right]; \\ W_{21}(\tau) &= \frac{1}{\lambda_2 - \lambda_1}\left[-e^{\lambda_1\tau} + e^{\lambda_2\tau}\right]; \\ W_{22}(\tau) &= \frac{1}{\lambda_2 - \lambda_1}\left[\lambda_2 e^{\lambda_1\tau} + \lambda_1 e^{\lambda_2\tau}\right], \end{aligned} \tag{17}$$

where $\lambda_1 = \frac{-\xi + \sqrt{\xi^2 - 1}}{T};\ \lambda_2 = \frac{-\xi - \sqrt{\xi^2 - 1}}{T}$;

for the case 0 < $\xi < 1$:

$$\lambda_1 = -a + ib;\ \lambda_2 = -a - ib; \tag{18}$$

where $a = \frac{\xi}{T};\ b = \frac{\sqrt{1-\xi^2}}{T};\ \lambda_1 + \lambda_2 = -2a = -\frac{2\xi}{T};\ \lambda_1\lambda_2 = a^2 + b^2 = \frac{1}{T^2}$;

$$\lambda_2 - \lambda_1 = -2ib = -\frac{2i\sqrt{1-\xi^2}}{T}; (\lambda_2 - \lambda_1)^2 = -\frac{4(1-\xi^2)}{T^2}; \cos\omega = \frac{1}{2}(e^{i\omega} + e^{-i\omega});$$

$$\sin\omega = \frac{1}{2i}(e^{i\omega} - e^{-i\omega}).$$

– case $\xi = 1$:

$$W_{11}(\tau) = (1 - \frac{\tau}{T})e^{-\frac{\tau}{T}};$$
$$W_{12}(\tau) = -\frac{\tau}{T^2}e^{-\frac{\tau}{T}};$$
$$W_{21}(\tau) = \tau e^{-\frac{\tau}{T}};$$
$$W_{22}(\tau) = (1 + \frac{\tau}{T})e^{-\frac{\tau}{T}}. \quad (19)$$

Analysis of the analytical calculations show that for projecting the interval $[t, t+\Delta T]$ a given application rate $\hat{\hat{x}}_3(\tau), \tau \in [0, \Delta T]$ form (8) and expressions (17), (18) or (19) for the transition matrix elements $W(\tau)$ Integral on the right side (5) may be obtained in an analytical form:

$$U_O(t) = P_1(C,K,\xi,T,\Delta T,q_{11},q_{22})\hat{V}_\mu(t) + P_2(C,K,\xi,T,\Delta T,q_{11},q_{22})\hat{\mu}(t) +$$
$$P_3(C,K,\xi,T,\Delta T,q_{11},q_{22})d_0\hat{V}(t) + P_4(C,K,\xi,T,\Delta T,q_{11},q_{22})d_1\hat{V}^2(t) + \quad (20)$$
$$P_5(C,K,\xi,T,\Delta T,q_{11},q_{22})d_2\hat{V}^3(t).$$

The essence of the problems of practical application of (20) is that the algorithm optimizing control action based on the calculation of the optimal values of coefficients P_1, P_2, P_3, P_4, P_5. Performing these calculations and procedures for identifying and adapting system parameters in real conditions of agricultural fields require some time - to several seconds - and this leads to poor performance of a given process. To reduce execution time optimization of operations necessary to use more powerful onboard processor computing system, which results in an increase in financial expenses. This fact requires finding original ways to optimize system parameters. One of these ways is that each of the coefficients P_1, P_2, P_3, P_4, P_5 depends on the system parameters and the parameters of certain functionals, namely:

$$P_i = f(\xi, K, T, C, \Delta T, q_{11}, q_{22}), \quad (21)$$

where ξ, K, T just act as dynamic characteristics of the system that can unexpectedly change in the process.

It follows that the adaptation behavior of dynamic systems control variable application rate TM engines distributors may hold not only on analytical formulas determining factors P_1, P_2, P_3, P_4, P_5 But also because of their search for optimal values by means of numerical approximations to the value space ξ, K, T (Fig. 3).

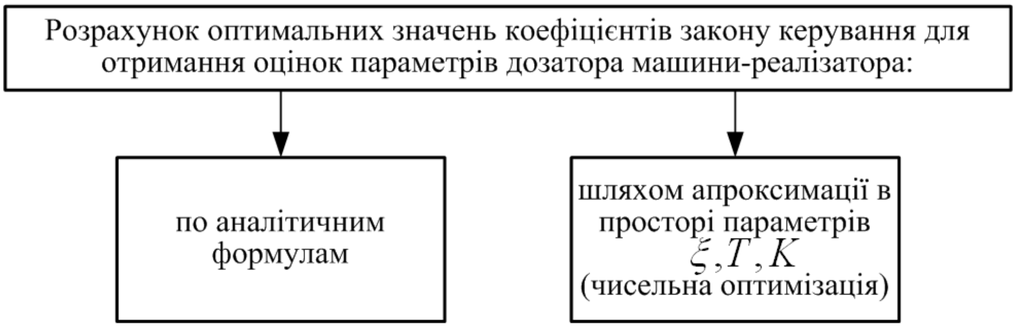

Fig. 3. Options for calculating coefficients P_1, P_2, P_3, P_4, P_5

Were calculated coefficients P_1, P_2, P_3, P_4, P_5 for the case discussed above example operation of pneumatic sowing system and RMS values and deviations SD values of actual norms of a given seed sowing standards using the procedure of dynamic optimization of system parameters and in a situation where the lower, main and upper levels for each of the actual parameters ξ_{fact}; T_{fact} and K_{fact} is respectively: 0.1, 0.3, 0.5; 0.4 s, 0.7 s, 1.0 s and 0.002, 0.004, 0.006.

The optimal values of the coefficients P_1, P_2, P_3, P_4, P_5 depending on the parameter values $\xi, T\ i\ K$ calculated using the analytical expressions (17-20) and reduced in tabular form.

Fig. 4 - Fig. 6 shows the dependence of the standard deviation SD difference in actual seeding rules and regulations set by the actual values of the dynamic characteristics of the system ξ_{fact}, T_{fact} and K_{fact}.

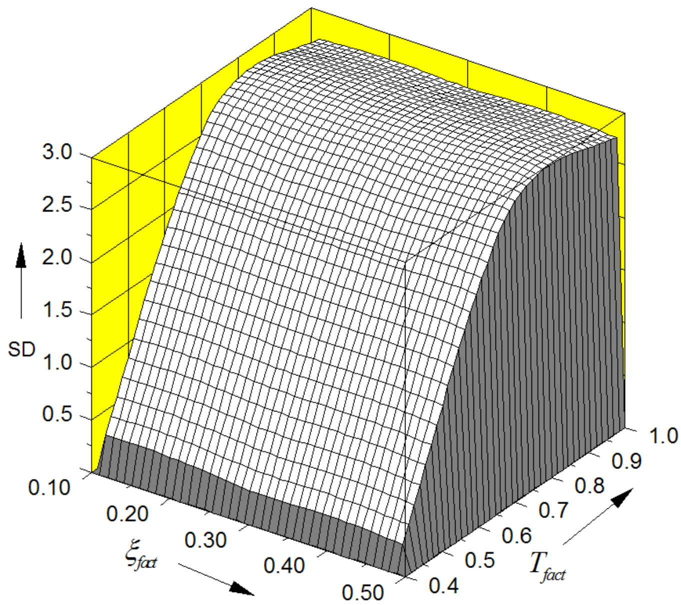

Fig. 4. Dependence of standard deviation SD values of the dynamic characteristics of the system ξ_{fact} and T_{fact}

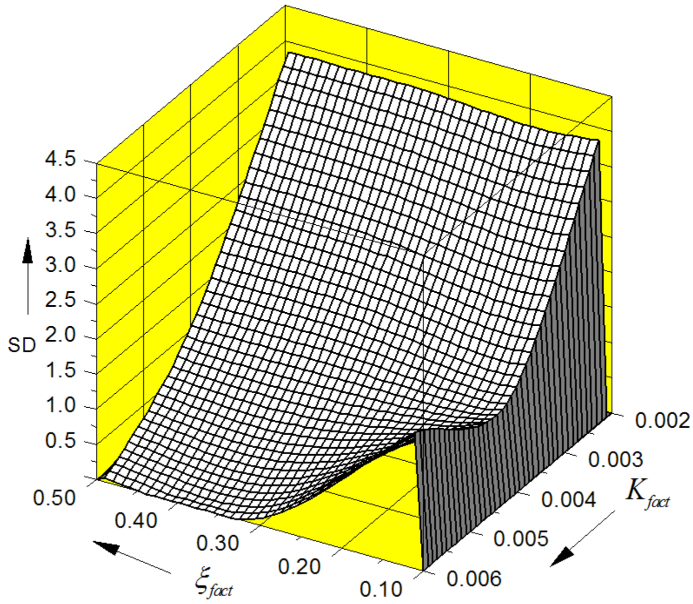

Fig. 5. Dependence of standard deviation SD values of the dynamic characteristics of the system ξ_{fact} and K_{fact}.

In particular, Fig. 3 shows that the decrease in SD greatly affects the value of the parameter T_{fact}, While ξ_{fact} in this case almost no effect on the level of SD. However, when considering the option of simultaneous parameter changes ξ_{fact} and K_{fact} (Fig. 4), the ξ_{fact} affects the level of SD largely as same as the value K_{fact}. At the same time, the joint change settings K_{fact} and T_{fact} (Fig. 5), the change in the gain coefficient K_{fact} little effect on the value of SD, and T_{fact} - Hard.

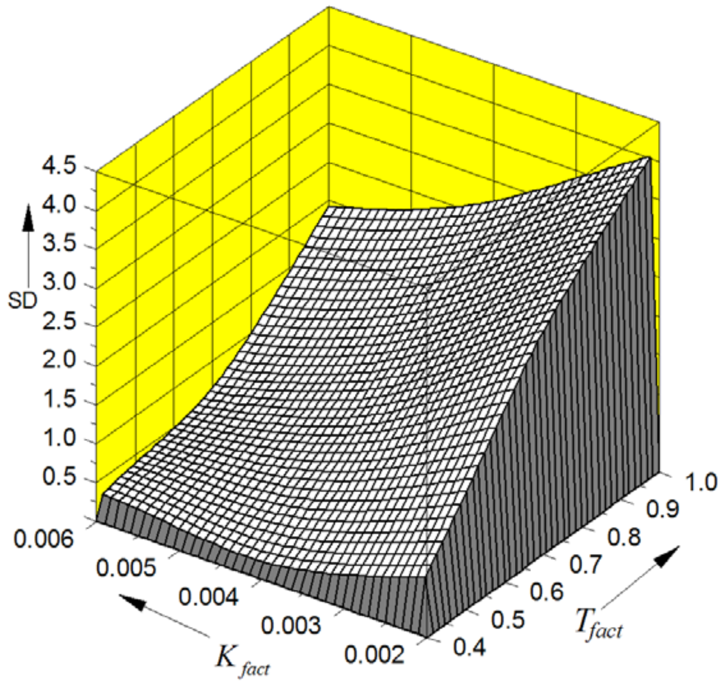

Fig. 6. The dependence of standard deviation SD values of the dynamic characteristics of the system K_{fact} and T_{fact}.

Analysis of the data set at the rate coefficients P_1, P_2, P_3, P_4, P_5 And the value of mean square error values SD actual rules from a given seed sowing rules of procedure optimization using dynamic parameters of the system shows that the nature of the change may be appointed dependencies analytical equations describe, for example, a second or higher order. This approach has significant practical importance, since the procedure approximation coefficient control law metering system vendors engines has a simple algorithm (unlike optimization algorithm) and can be performed in the field of machine-controller board implementer of relatively low computing power (and therefore price). This will be a high level of adaptation modes of the controlled dosing when unforeseen changes the dynamic parameters of produce through the use of simple and cheap (in the financial sense) solutions.

For the case of quadratic approximation, analytical equations describing the surface variations $\Delta P_1, \Delta P_2, \Delta P_3, \Delta P_4, \Delta P_5$ appropriate coefficients law regulating the intensity of the process flow and surface variations values mean square error of implementing a given application rate TM (ΔP_6) As a function of variations of scale values of generalized parameters of the object $\Delta\hat{a}_1, \Delta\hat{a}_2, \Delta\hat{a}_3$ are as follows:

$$\Delta P_l = c_{l1}\Delta\hat{a}_1 + c_{l2}\Delta\hat{a}_2 + c_{l3}\Delta\hat{a}_3 + c_{l4}\Delta\hat{a}_1^2 + c_{l5}\Delta\hat{a}_2^2 + c_{l6}\Delta\hat{a}_3^2 + \\ + c_{l7}\Delta\hat{a}_1\Delta\hat{a}_2 + c_{l8}\Delta\hat{a}_1\Delta\hat{a}_3 + c_{l9}\Delta\hat{a}_2\Delta\hat{a}_3, \qquad (22)$$

$l = 1, ..., 6,$

where $\Delta P_l = P_l(\Delta\hat{a}_1, \Delta\hat{a}_2, \Delta\hat{a}_3) - P_{lop}$, $l = 1, ..., 6$ - Limits of deviation from the actual setting its reference value during the factorial experiment;

$\Delta\hat{a}_i = (a_i - a_{iop})d_i$, $i = 1, 2, 3;$

$d_i (i = 1, 2, 3)$ - Scale factors.

The value of the generalized parameters of the object $\Delta\hat{a}_1, \Delta\hat{a}_2, \Delta\hat{a}_3$ anchor point to be written as follows:

$$a_{1op} = \frac{K_{op}}{T_{op}^2},\ a_{2op} = -\frac{2\xi_{op}}{T_{op}},\ a_{3op} = -\frac{1}{T_{op}^2}. \qquad (23)$$

where ξ_{op}, K_{op}, T_{op} - System parameters in the reference point.

As initial data for solving approximation should use the results of solving the optimization problem of multiple control law in accordance with the above algorithm. Data format for the analysis of the dependence of optimal coefficients $P_1, P_2, P_3, P_4, P_5, P_6$ parameter values of the object $\xi, T\, i\, K$ can be presented in tabular form (Table. 1). This table row table data to the central values of the parameters ξ, T and K corresponds to the anchor point of the operation of approximation.

Column vector of coefficients of approximation $\hat{c}_l = (c_{l1}, c_{l2}, ..., c_{l9})^T$, $l = 1,...,6$ calculated by the formula:

$$\hat{c}_l = A^+ \Delta \bar{P}_l,\ l = 1,...,6, \tag{24}$$

where A^+ - Pseudoinverse matrix size (in this case) 9h26 values of coordinate functions table settings;

$\Delta P_l = (\Delta P_{l1}, \Delta P_{l2}, ..., \Delta P_{l26})^T$, - Vector-column variations optimum values $P_1,...,P_6$ nodes in tabular parameter values $\xi, T\ i\ K$ relatively optimal values anchor point.

1. The format of data to analyze values ΔP_l.

Number of calculation	ξ	T	K	P_1	P_2	P_l	P_6
1	ξ_1	T_1	K_1	P_{11}	P_{21}	...	P_{61}
2	ξ_2	T_2	K_2	P_{12}	P_{22}	...	P_{62}
...	...	...	...	...	...	...	...
26	ξ_{26}	T_{26}	K_{26}	P_{126}	P_{226}	...	P_{626}

To calculate the pseudoinverse matrix used Greville algorithm, and an example for calculating the data used in accordance with the selected object - pneumatic pulse seed feeder.

Results for solving the problem mentioned included pseudoinverse matrix A^+, Matrix approximation coefficients estimates $c = (\hat{c}_1^T, \hat{c}_2^T, ..., \hat{c}_6^T)^T$, Matrix output variations and calculation of optimal coefficients $P_1, P_2, P_3, P_4, P_5, P_6$ relative to the reference value, matrix approximation errors in 26 knots table output data, and RMS deviation value ratios approximating to 26 nodes. For example, in Fig. 7 and Fig. 8 graphics changes are analytical and factual optimal coefficients P_2 and P_3.

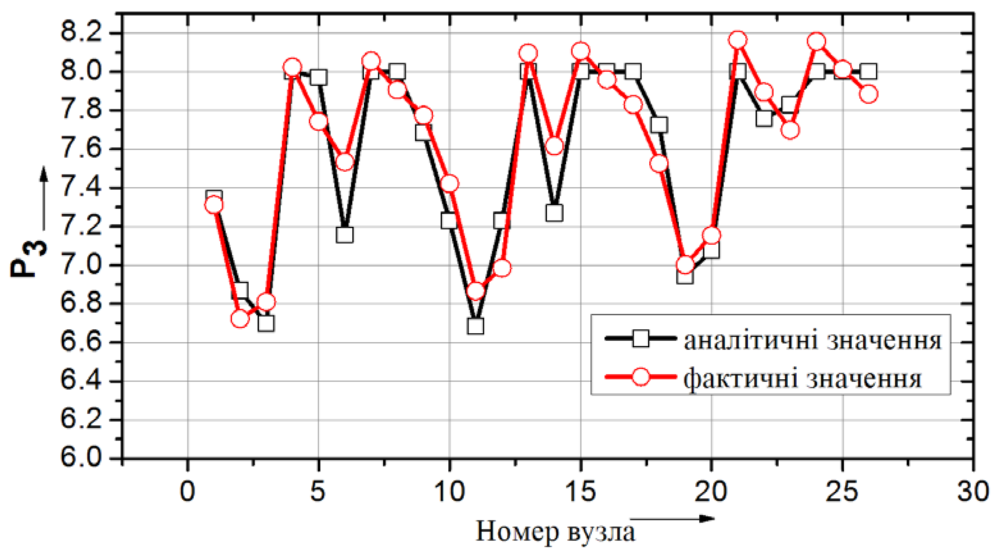

Fig. 7. The value of output and the estimated optimal values of coefficient P_2.

Analysis of these graphs shows that the actual values of the coefficients P_2 and P_3 to think about are the optimal values of this ratio. The relative value of standard deviation of the actual values of the coefficients think is 2.2% and 1.7% respectively for P_2 and P_3. The relative error expectation of actual values for all factors ($P_1 \div P_5$) Does not exceed 2.7%. The value of the residual standard deviation approximation to 26 nodes for any of the coefficients of the control law is less than 0.21 g / m, and the expectation of approximation errors for each of the coefficients for all 26 nodes is less than 0.05 g / g.

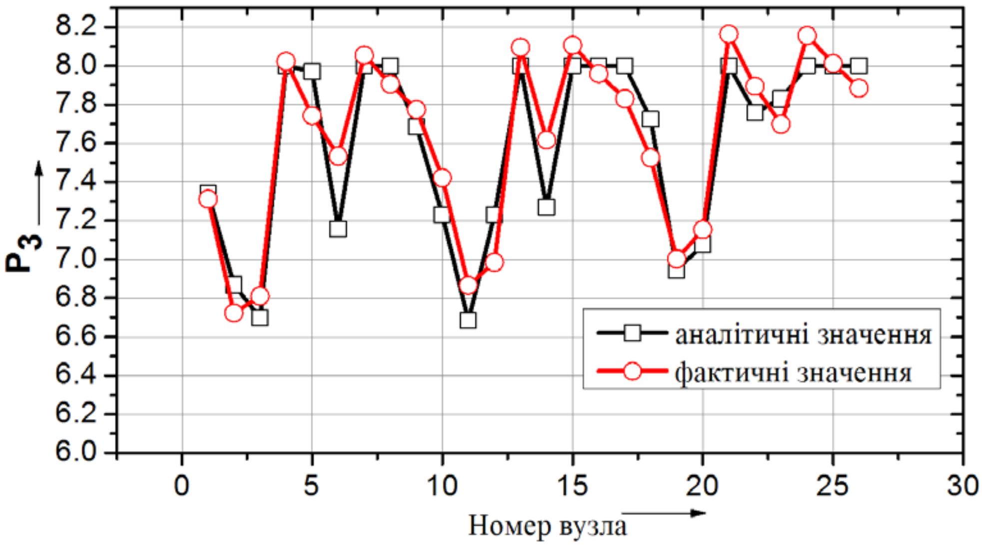

Fig. 8. The value of output and the estimated optimal values of coefficient P_3.

The studies give rise to the following conclusions:

1. Formation control law regulating systems for metering technologies HA TM engines distributors depending on the values of dynamic parameters of executive bodies, as well as unanticipated changes in these parameters in production (field) conditions effectively carry out by finding optimal coefficients of the control law through numerical approximation in space ξ, K, T.

2. The method of determining the optimal coefficients of the control law can recommend to the practical application of basic interpolation methods for the nodal points of optimal control law coefficients for the variables values of the parameters of dynamic system parameters. In this case, the first stage interpolation values of optimal coefficients for the two input parameters (eg, ξ i K), And the next - one more parameter (eg on T). Interpolation operations may be conducted at

high speed with minimal requirements for computing power processor systems specialized equipment for variable application rate TM.

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Conducted analysis of opportunities vыsokotochnoho dozyrovanyya of technological materials in cases nepredvydennыh Modified values Dynamic parameters dozyruyuschyh systems technology with precision zemledelyya Using methods of optimal control systems tehnycheskymy.

Dozyrovanye, tehnolohychnыy Material, optymalnoe management.

The analysis of possibilities of high-fidelity proportioning of technological materials in cases of unforeseen changes of values of dynamic parameters of batching systems in precision agriculture with use of methods of optimum management technical systems is conducted.

Proportioning,technological material,optimum management.