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Proposals physicochemical mehanycheskaya model lokalyzovannыh violations conformation of membrane cell plants High society. Ustanovlenы occurrence dissipative terms solytonov sverhvыsokochastotnoho (SHF) and krajne vыsokochastotnoho (EHF) dyapazonov existence at hypersonic akustoэlektro-mahnytnыh resonances klasternыh High society structures cell plants.

Physical and mehanycheskoe Modeling, lokalyzovannыe violations, conformation, and membranes, cells, plants vыsshye, dissipative solitons, sverhvыsoko-chastotnыy (SHF) and krajne vыsokochastotnыy (EHF) dyapazonы, hyperzvukovыe acousto-electromagnetic rezonansы, klasternыe cell structure of plants.

The paper has proposed a physical-mechanical model of localized disturbances of conformation of the cell membranes in high plants, as well as the conditions for the formation of dissipative solitons, ultra-high frequency (UHF) and extremely high frequency (EHF) range with the existence of hypersonic acoustic and electromagnetic resonances cluster structures of the cells of higher plants.

Physico-mechanical modeling, localized disorders, conformation, membrane, cells, high plants, dissipative solitons, ultra high frequency (UHF) range, extremely high frequency (EHF) range, hypersonic acoustic and electromagnetic resonances, cluster structures of plant cells.

UDC 621.87

IMPROVING ENERGY MOVEMENT MODE Swing mechanism boom cranes VIBRATIONS IN VIEW OF CARGO

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In the article the way the fluctuations of cargo during the rotation mechanism jib cranes. Optimization mode starting mechanism for turning the tap is performed using methods of variations. This paper uses an integrated complex criterion as a linear convolution of two individual criteria, reflecting the effect of energy loss and dynamic loads.

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Fluctuations load optimization, transition regime movement.

Problem. During the boom of the crane rotation mechanism [5] Appear undesirable fluctuations of individual units, including cargo. This is particularly evident phenomenon during transients (starting, braking). The presence of fluctuations leads to lower quality and productivity performance of assembly operations, reducing the reliability of the crane boom and increasing energy costs. Excessive consumption steering tap leads, in addition to the fatigue of individual elements and the crane as a whole. Therefore, minimizing energy costs while working mechanism for turning the tap is a very topical issue.

Analysis of recent research. The problem of the fluctuations of cargo on a flexible suspension for several decades. Recent studies on this issue are based on the use of mathematical theory of optimal processes (maximum principle, variational calculus). Note that modern methods of eliminating vibrations offered to sell the goods through certain steps to control steering during transient states of motion (acceleration, braking).

In [1,2,8] Option is selected by managing power to the drive mechanism of action: to eliminate the need to manage fluctuations in load torque on the motor shaft rotation mechanism. Management action has a relay character, resulting in increased dynamic loads on the valve. This approach is unacceptable in terms of the emergence of large dynamic loads.

By using the theory of the calculus of variations, as is done in [6,7], We can ensure a smooth change of kinematic characteristics of the mechanism of rotation and eliminate vibrations load on flexible suspension.

The purpose of research. Objective is to minimize energy costs and fluctuations in load on flexible suspension during transients mechanism for turning the crane boom. To achieve this goal it is necessary to solve the following problems: 1) choose a dynamic model of the mechanism of rotation of the crane boom and its construct a mathematical model; 2) choose the basis for optimization mode turn the tap and conditions set its minimum; 3) identify the optimal mode of dispersal mechanism and turn to analyze the results.

Results. One way to eliminate fluctuations in load when working mechanism for turning the crane boom is the choice of mode of motion in which energy consumption would be minimal. To select the movement mechanism for turning the tap must formulate a criterion that reflects the energy costs for the move. This criterion may be the average of the kinetic energy of rotation mechanism with flexible suspension for the movement of goods, which is represented as a functional integral [6]:

$$T_{cp} = \frac{1}{t_1}\int_0^{t_1} T dt, \qquad (1)$$

where t - time; t1 - the duration of the movement mechanism of rotation; T - kinematic energy mechanism for turning the tap.

Since power consumption is undesirable, the criterion (1) should be minimized. To optimize the motion mode mechanism for turning the tap should dress dynamic model in a way that took into account the coordinates of links that carry the main motion and coordinate fluctuations cargo. Such dynamic model can be dynamic model mechanism for turning the tap [4] With two degrees of freedom (Fig. 1).

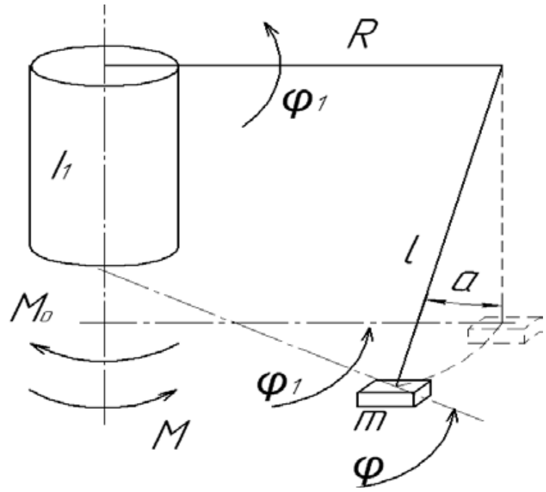


Fig. 1. Design model of the "column-load."

Present design model (Fig. 1) is described by a system of differential equations:

$$\begin{cases} I_1\ddot{\varphi}_1 + \dfrac{mR^2}{l} g\left(\varphi_1 - \varphi\right) = M - M_0; \\ \ddot{\varphi} - \dfrac{g}{l}\left(\varphi_1 - \varphi\right) = 0, \end{cases} \qquad (2)$$

where I_1 - Moment of inertia rotary drive mechanism columns and arrows, reduced to the axis of rotation of the crane; φ and φ_1 - Generalized angular coordinates aggregate weight of the goods and columns; m - Bulk cargo; R - Boom; l - The length of the flexible suspension of cargo; g - Acceleration of gravity; M_0 - Static torque resistance, elevated to the axis of rotation of the column; M - Driving time on the motor shaft, built to the axis of rotation of the column; α - angle from vertical cargo rope.

Given the influence of oscillatory movement of goods on the main motion arrows, which is determined by the differential equations of motion adopted dynamic model are:

$$\varphi_1 = \varphi + \frac{l}{g}\ddot{\varphi};\ \dot{\varphi}_1 = \dot{\varphi} + \frac{l}{g}\dddot{\varphi};\ \ddot{\varphi}_1 = \ddot{\varphi} + \frac{l}{g}\overset{IV}{\varphi}. \tag{3}$$

Then kinematic energy of the considered system based on expression (3) can be written in the following form:

$$T = \frac{1}{2}I_1(\dot{\varphi} + \frac{l}{g}\dddot{\varphi})^2 + \frac{1}{2}mR^2\dot{\varphi}^2. \tag{4}$$

The condition of a minimum criterion (1) is the Euler-Lagrange [9] That for kinematic energy expression (4) is:

$$\overset{VI}{\varphi} + 2k^2\overset{IV}{\varphi} + \left(1 + \frac{mR^2}{I_1}\right)k^4\ddot{\varphi} = 0, \tag{5}$$

where $k = \sqrt{l/g}$ - Frequency of oscillation load on flexible suspension.

The equation (5) is a homogeneous differential equation of the sixth order with constant coefficients, which has an analytical solution. For its interpretation enough six boundary conditions of the system "arrow-load." However, for a real moving arrows with flexible suspension of cargo from the initial position to the final eight is necessary to provide boundary conditions:

$$t = 0 : \varphi_1 = \varphi = 0, \dot{\varphi}_1 = \dot{\varphi} = 0;\ t = t_1 : \varphi = \Delta\varphi, \dot{\varphi}_1 = \ddot{\varphi} = \dddot{\varphi} = 0. \tag{6}$$

Given the dependence (3), these boundary conditions are written as follows:

$$t = 0 : \varphi = \dot{\varphi} = \ddot{\varphi} = \dddot{\varphi} = 0;\ t = t_1 : \dot{\varphi} = \Delta\varphi, \ddot{\varphi} = 0, \dot{\varphi} = \ddot{\varphi} = \dddot{\varphi} = 0. \tag{7}$$

Thus, in a staged optimization problem angular displacement arrows with flexible suspension load can not solved, as this problem with the necessary eight regional traffic conditions can be secured only six conditions.

To ensure the eight boundary conditions of the boom with flexible cargo (7) optimization problem should be formulated another criterion as a linear convolution [6]:

$$K = \int_0^{t_1}\left[\delta V/\tilde{I}_V + (1-\delta)\, T/\tilde{I}_T\right]dt, \tag{8}$$

where T, V - respectively the kinetic energy and energy acceleration system "arrow-load"; $\tilde{I}_V, \tilde{I}_T$ - In accordance with the minimum possible value of kinetic energy, time and dynamic component of the power drive mechanism required for angular displacement arrows with flexible suspension of cargo from one extreme position to another; δ - Dimensionless weight, which varies from zero to one share reflects the dynamic component of the power drive.

Kinematic energy system "arrow-load" is defined by the expression (4), and the energy dependence of acceleration is described:

$$V = \frac{1}{2} I_1 (\ddot{\varphi} + \frac{l}{g} \overset{IV}{\varphi})^2 + \frac{1}{2} m R^2 \ddot{\varphi}^2. \quad (9)$$

The lowest possible cost kinetic energy, time and dynamic component of the power drive system "arrow-load" without load fluctuations are determined according dependencies [6]:

$$\tilde{I}_T = \frac{1}{2}\left(I_1 + mR^2\right)\Delta\varphi^2 / t_1 ; \tilde{I}_V = 6\left(I_1 + mR^2\right)\Delta\varphi^2 / t_1^3 . \quad (10)$$

Using relationship (4), (9) and (10), we define the integrand criterion (8):

$$f = \delta V / \tilde{I}_V + (1-\delta)\, T / \tilde{I}_T = \frac{t_1}{12\left(I_1 + mR^2\right)\Delta\varphi^2} \times$$
$$\times \{\delta [I_1 (\ddot{\varphi} + \frac{l}{g} \overset{IV}{\varphi})^2 + mR^2 \ddot{\varphi}^2] t_1^2 + 12(1-\delta)[I_1 (\dot{\varphi} + \frac{l}{g} \dddot{\varphi})^2 + mR^2 \dot{\varphi}^2]\}. \quad (11)$$

The condition of a minimum criterion (8) is the Euler-Poisson [9], Which is based on the integrand expression (11) is:

$$\overset{VIII}{\varphi} + (2k^2 - k_\delta)\overset{VI}{\varphi} + k_I k^2 (k^2 - k_\delta)\overset{IV}{\varphi} - k_I k_\delta k^4 \ddot{\varphi} = 0, \quad (12)$$

where $k_\delta = 12(1-\delta)/(\delta t_1^2)$ - The relative importance weights $k_I = 1 + \frac{mR^2}{I_1}$ - The relative moment of inertia of the system;

Equation (12) is a homogeneous differential equation eighth order with constant coefficients, which is enough to solve the eight boundary conditions of the system "arrow-load" (7). So, in a staged optimization problem angular displacement arrows with flexible suspension load can be solved.

For solving the resulting differential equation (12) subject to the boundary conditions (7) is convenient to use the program Wolfram Mathematica v.8, which lets you search for symbolic solutions of differential equations [3].

Solve this problem the following initial data: *I1*= 7200 kg·*m2*; m = 600kh; R = 2.5 m; l = 4m; g = 9,8m / s2; Mo = 570*Nm*; $\Delta\varphi = \pi$, t_1= 10s. As a result, the solution of the problem of kinematic characteristics of the graphs start column and load (Figure 2), for different values of the coefficient δ = (0.1, 0.9). Dashed line shows the kinematic characteristics at start δ = 0.9, and the solid lines in δ = 0.1.

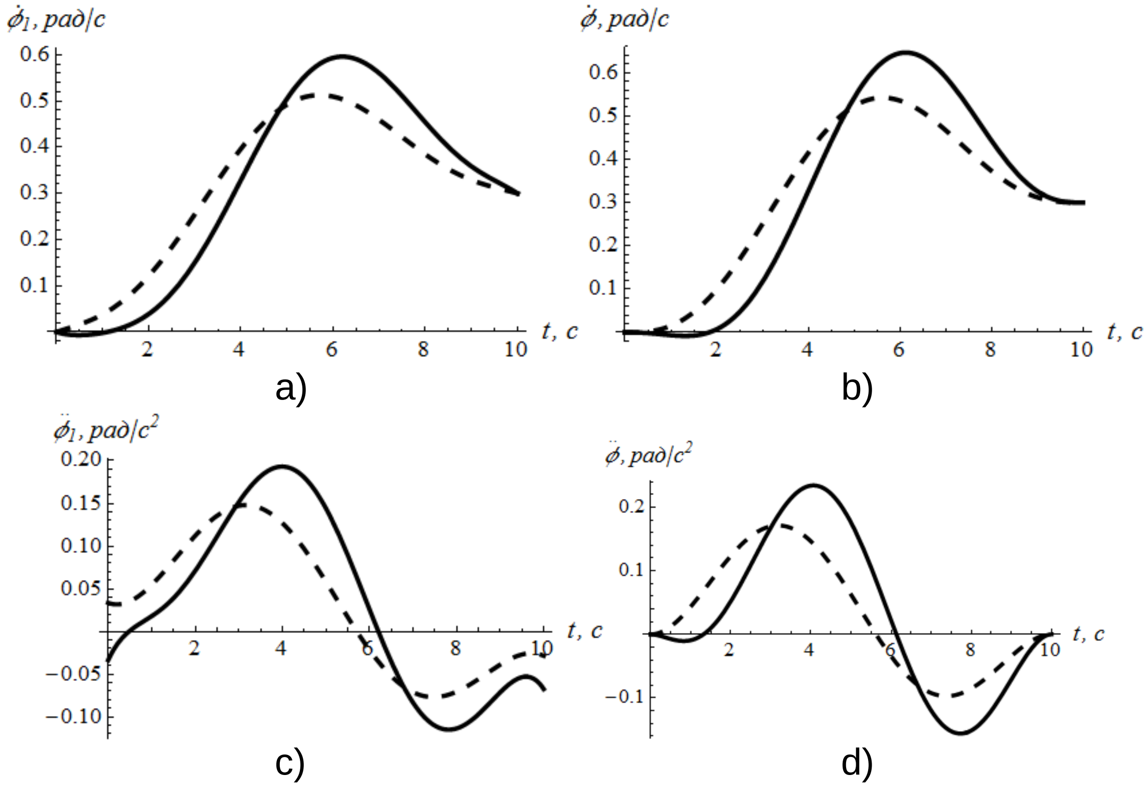
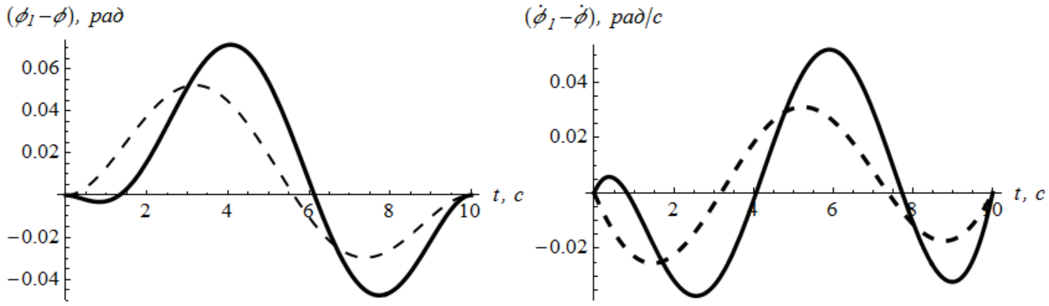


Fig. 2. Graphs of the functions of the angular velocity of the column (a) and cargo (b) and angular acceleration columns (c) and transportation (d) for different values of the coefficient δ.

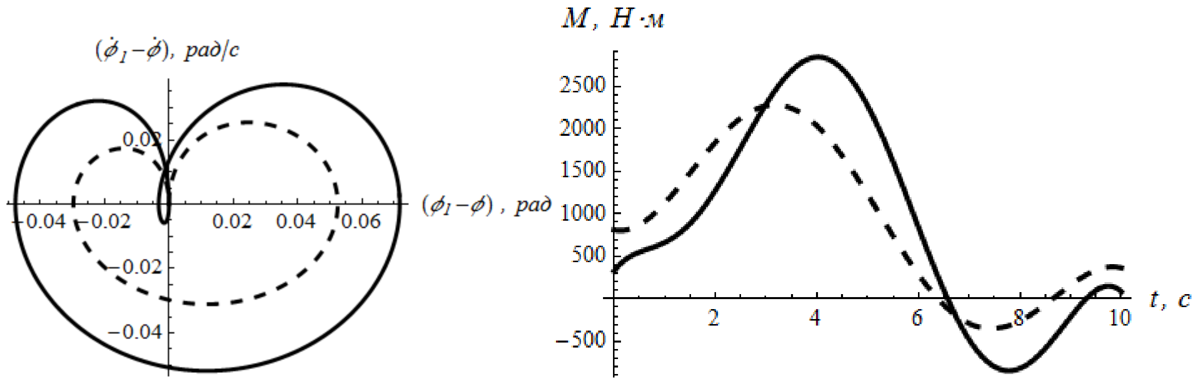
Analyze graphs obtained kinematic characteristics for different values of the coefficient δ. From the graphs of functions of the angular velocity of the column and load (Fig. 2 A and 2 B) shows that the value of the coefficient δ 0.1 = speed of rotation of the column is greater than the maximum values than the values of the coefficients δ = 0.9. In this case, the maximum deviation of the coordinates φ1-φ (Fig. 3, a) at δ = 0.1 is 0.07 councils, while δ = 0.9 respectively 0.05 rad. Changing difference in angular velocity (Fig. 3, b) also indicates the preference coefficient δ = 0.9.

Changing angular acceleration (Fig. 2, and 2 g) adopt a positive and negative values (there is a process of inhibition columns), a value of coefficient δ = 0.9 the maximum acceleration and lower columns is 0.15 rad / s2, while at δ = 0.1, the figure rises to 0.2 rad / s2. This made it possible to reduce the maximum value of the driving point (Figure 4, b) Mmah = 2300 Nm at δ = 0.9 compared with δ = 0.1, where Mmah = 2700 nm. In both cases, driving time is oscillating nature of the change, which complicates the implementation of mechatronic products.



a) b)

Fig. 3. Charts flexible suspension deflection from vertical load (a) and the change in angular velocity difference (b) at different values of the coefficient δ.



a) b)

Fig. 4. The phase portrait of the dynamic system "column-load" (a) and a graph of the driving (b) at different values of the coefficient δ.

From the phase portrait (Figure 4 a) shows that the different values of the coefficient δ, Before the steady traffic load fluctuations are eliminated. However, in the first case (δ = 0.1) occur much greater velocity and acceleration deviation turn columns and load compared to the value of the coefficient δ = 0.9.

Conclusions

The obtained results allow the following conclusions:

– The simulation mechanism for turning the crane boom and based mathematical model;

– elected complex integrated optimization criterion that minimizes unwanted Movement Swing mechanism;

– analyzed the effect of weight coefficient which is part of the optimization criteria, the dynamics of movement mechanism for turning the optimal control.

– Optimum laws are implemented through the use of automated control system steering.

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In Article rassmotrenы Elimination Methods fluctuations in the work of cargo hoisting and transportnыh machines. Optimization mode start-up mechanism turns the tap proyzvodytsya with pomoshchju varyatsyonnoho yschyslenyya. In the work yspolzovan yntehralnыy Kompleksnye criterion in linear video svertky two edynychnыh kryteryev, otrazhayuschyh эnerhetycheskye the loss and Dynamic Action nahruzok ..

Fluctuations of cargo, optimization, perehodnыy mode motion.

The method of cargo oscillation reduction, during the lifting machines operation, has been considered in the article. The start-up mode of the crane swinging mechanism optimization has been carried out by means of variation calculation. This paper uses an integrated complex criterion as a linear convolution of two single criterion that show on the energy loss and effect of dynamic loads.

Fluctuations of the cargo, optimization, connecting mode of motion.