# COMPUTER MODELING OF DYNAMICS OF ROPE TECHNOLOGICAL SYSTEMS

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Mechanical systems with rope elements, such as rope carriage systems, receive significant dynamic loads that significantly affect the quality of the basic functions of such systems.

Dynamic discrete model of logging wire rope carriage system for transportation of wood in mountainous conditions is considered (Fig. 1).

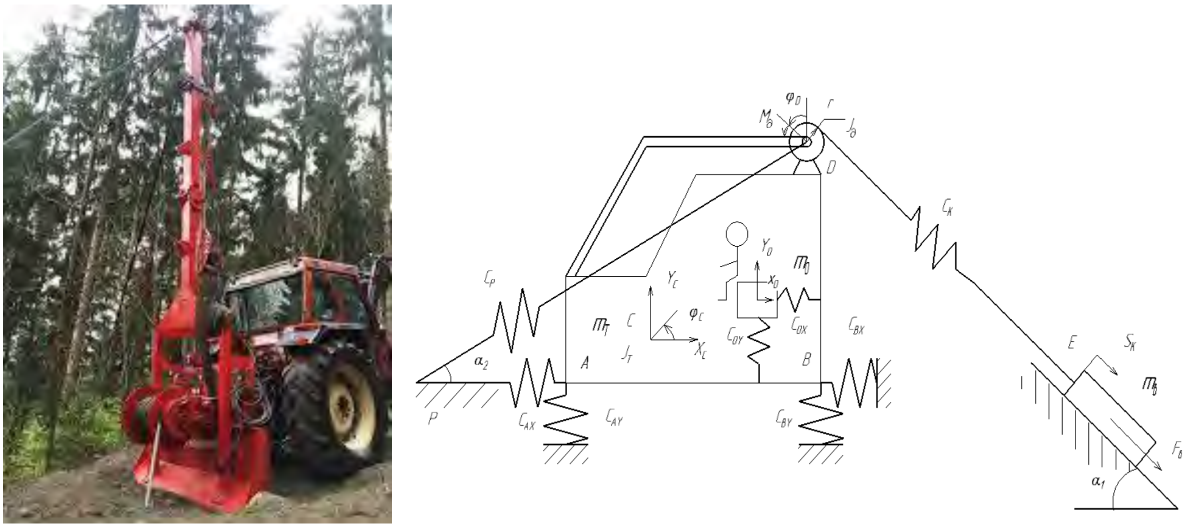

*Fig. 1. Wire rope carriage system for transportation of wood in mountainous conditions*

Ropes are considered as flexible threads that work only for tension. It is admitted that the stretching effort along the length of the rope is constant, and the nodes change only direction. Displacements the nodes causes corresponding changes in the lengths of the rope sections.

In some cases oscillatory processes (vibration) are used to increase the efficiency of technological operations of individual elements. At the same time, oscillatory processes of other elements of the system, such as the operator's place, need to be minimized.

Solving such problems requires the development of adequate dynamic models of such systems. It is important to determine the elements of the inertial and quasi-elastic coefficients and generalized forces matrices and to solve the problem to the developed numerical methods of analysis of small oscillations. The procedure for the exclusion of quasicyclic coordinates is proposed, which facilitates the application of computer methods for determining the eigenfrequencies and forms of oscillation and solving other problems of the dynamics of such systems. The estimation of the error of using traditional simplified approaches in comparison with the exact solution is given.

Nonlinear dissipation of structural damping is represented by viscous frictions based on the equivalence of dissipation energy. An approximate method for determining the damping coefficients as diagonal elements of the dissipation matrix in normal coordinates is presented in the paper. It is shown its efficacy in the process of dynamic calculation of the system by the method of normal coordinates with the help of the proposed computer programs. The developed mathematical models allow solving problems concerning optimum position of damper, providing maximum damping of vibrations.

It is suggested to use additional devices for activating parametric oscillations to provide greater efficiency of transportation by cable systems and to develop mathematical models of such processes.

One of the suggested variants of eccentric vibration activator is shown in Fig. 2. It includes the end block of the rope system with diameter *D*, a piece of toothed transmission and eccentric fastened traction rope, which moves the load mass *m*.

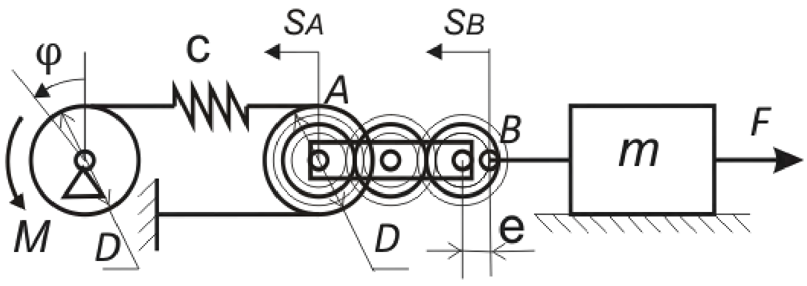


*Fig. 2. Rope system with eccentric vibration activator*

Kinematic vibration is ensured by the difference of displacement point *A* and *B*

$$SB - SA = e \cdot \cos (SA/D \cdot i),$$

where *I* is the gear ratio, e – eccentricity, *D* – block diameter, which affects the frequency of kinematic vibration.

Accepting the generalized coordinates of the cable mechanical system (Fig. 2) The angle of rotation of the winch drum φ and displacement of cargo *SB* will receive the expression of potential energy deformation of the rope rigidity *c*

$$\Pi = c \cdot [\varphi \cdot D/2 - (SB - e \cdot \cos (\varphi \cdot i))/2]2/2.$$

After the substitution in the equation of the Lagrange of the 2nd kind we obtain the differential equations of movement of the system, the analysis of the solution which allows estimate the efficiency of the activator vibration.

***Reference***


*1. Heletiy V. Development of dynamic models of mechanical systems with cable elements / Bulletin of the Lviv Polytechnic National University. «Dynamics, durability and designing of machines and devices» 20 16 № 838, pp. 23-28 (Ukraine)*