Crane, truck, dynamic loading, dynamic model, mathematical model, reduced weight, beam crane, optimization.

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ANALYSIS METHODS controls lifting machinery

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The article analyzes modern control systems of hoisting machines. Described intelligent control algorithms lifting devices, based on the solution of inverse problem of dynamics and application of fuzzy logic. Control algorithm reduces the qualifications of operators of lifting mechanisms and allow you to move the "intelligence" of trained personnel in the control system.

Daily motion sensor, control valve, drive, feedback.

Formulation of the problem. Cranes are increasingly used in transport and construction. They are also becoming bigger, faster and higher, requiring effective management to ensure a smooth movement of goods and to meet the safety requirements. Working movement when moving the crane trolley characterized by transient modes, that is systematic accelerator and brake. At such speeds as short-term changes in the details of the mechanisms and sites to dynamic loads occurring metal that can be detected using the chosen calculation model.

In operation crane trolley with flexible suspension hanging on a load continuously moving the carrier along farms and consoles. The process of moving the trolley includes acceleration,

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moving from nominal speed and braking. Such transient conditions cause significant dynamic loading mechanism to drive the trolley and crane generally affecting the reliability and durability, and rocking load performance and ergonomic operation.

Also known [1] that are observed when using cranes load pendulum oscillation, which cause irregular movement of hoisting machinery, trolley, additional load on the power elements, creating inconvenience for their operation and increase the risk of accidents.

The purpose of research. The main purpose of this study is to analyze ways to manage lifting machinery in which adverse events (dynamic load fluctuations cargo) will be absent or minimal impact, as desired (reliability, robustness, performance, ergonomics) improved.

Results. Conveying machinery used in virtually all areas of industry. To transport goods in industry, construction sites, warehouses and ports commonly used cranes. Cranes differ in the configuration of the working area, the type of goods transported and precision positioning. Depending on the requirements, according to the characteristics of different types of structures are cranes. To move heavy loads frequently used portal (gantry) cranes. The design of the gantry crane presupposes the existence of a special trolley with rectilinear movement along the guide rails and cable, through which the payload is attached to the cart. Gantry crane can move on rails, it allows for the transportation of cargo to any point in three-dimensional space within the working area of the crane. Gantry-cranes are often used in ports for loading ships, as well as loading cranes on railways. The advantages of gantry-cranes are a relatively large working area with a smaller footprint. Rotary cranes are characterized by considerable height and are often used in such circumstances where the goods should primarily move vertically.

Control systems, lifting and transport mechanisms are usually multitask. They must be robust, high-speed, accurate, and essentially replace the action of trained personnel, ie they must own "intelligence". The control system must move the load as fast as possible, while minimizing vibrations cargo transportation and fully extinguish their place in the stop. Also to be taken into account possible changes in system parameters such as length of rope and weight of cargo. In developing control algorithms should be considered and practical implementation, the power control action, maximum acceleration and speed and so on. To eliminate the possibility of collisions with obstacles load shall not exceed the transport outside a specified band.

The system process control movement of goods can be both open and closed. Rozimknute management is characterized by greater sensitivity to parameter changes and disturbances. When you create a closed-loop control system is necessary in appropriate sensors. Information about the position and speed of the trolley is usually obtained from control systems for electric carts. Harder to get information about the angle of the load. You can use a vision sensor, but the disadvantages of video services is the complexity and high cost [2]. With the known length of the rope can estimate the angle by electromagnetic torque and angular speed of the motor cart, in other words, the structure of the management system should include observer dynamic loads.

The mechanism of interaction between motion and suspended load leads to a buildup of the latter. If the amplitude exceeds a given limit, they must fade or operation must be stopped until the vibrations do not cease. In any case, it will degrade system performance. These problems have led many researchers to develop control algorithms that automate transactions crane. However, most existing schemes are not suitable for practical use. Therefore, a large number of industrial cranes is not automated and still depends on human action. At the same time provide adequate compensation for fluctuations can only highly skilled operator (crane).

There are various ways to control crane, based on both open system and the control system with feedback. Automation crane can be divided into two approaches. In the first approach, the operator remains in the chain of control, and the forces that move cargo in some way changed to facilitate the work of the operator. One way is to drive a damper feedback deflection cargo and its angular velocity or feedback delay deflection angle [3, 4]. This feedback provides additional trajectory that provides operator. The next way is to establish a mechanical damper valve design [5]. The implementation of this method involves spending significant amounts of energy, making it impractical.

In the second approach, the work of the operator is eliminated and the operation is fully automated. This can be realized by several methods. The first method is based on the trajectory passing movement of goods to their destination with minimal fluctuations. This trajectory emerging best practices for management. The second method is based on feedback trolley position and angle of deviation. The third method is based on the design of the controller of two parts: the controller, eliminating the fluctuations and controller tracking the position of the cart. Each is individually and then combined to provide the performance and stability of the system as a whole.

Use as an optimal time open-loop control system crane [6] and open-loop control system in which the input signal is formed so that when moving the cart in the default position does not cause excessive fluctuations goods [7], gives poor results because management without feedback sensitive to changes in system parameters (such as length of the rope) and can not offset the impact of the wind. These methods also avoid residual vibrations cargo.

Feedback control is known to be less sensitive to parameter changes and disturbances. Therefore, in most studies in recent years prompted a closed control algorithms, from conventional PID controller (proportional integral differential regulator) to intelligent approaches. In particular, Omar suggested that PD-controller (proportional-differential regulators) for positioning as well as to eliminate vibrations [8]. But we

know that control using PD-regulator is not effective in removing static error. Therefore, as has been proposed, and PID controller to control the system gantry cranes [9]. However, the work of the regulator worse when saturation is about power.

To build a traditional regulators must have the "exact" mathematical model of control object, and then synthesize the controller, which implements the required control algorithm. Since the mathematical description of the crane is a system of nonlinear differential equations unsteady, perform the controller synthesis analytically difficult this task can be solved only for small angles of deviation of the goods by the relevant equations and linearization "freeze" their rates. For such systems mainly use non-traditional regulators. As you know, to manage complex processes where there is a simple mathematical model, you can use the system with fuzzy control. In [2] described a system in which applied fuzzy logic control device as the provisions of the cart, and to damping vibrations. The above control methods would lead to good work when using the exact model and its parameters in the controller.

But we know that modeling is complex and time consuming process. In addition, identification of parameters required crane that can not be measured. Identification of parameters - it is also a complex and laborious process. In addition, advanced controls tend to be more complex and therefore problematic in terms of their realization in real time. Very often, these regulators should adjust engineers who have experience in working with similar systems management. So simple design and structure of the regulator is very important from a practical point of view. The disadvantage of closed systems is the need for position sensors cart deflection and load. In addition, the creation of sensor measuring fluctuations in the real system gantry crane is not an easy task because there are parallel lifting mechanism for flexible suspension. Some studies have focused on schemes of video system management, which in practice has found increasing application in view of the fact that we should not place the sensor on the side of the cargo. Disadvantages feedback control based on CCD-camera (vision sensor) is the complexity and high maintenance cost.

In the above cases seems appropriate to use methods based on the measurement of electromagnetic torque, the angular velocity of the engine and applying observer dynamic load [10]. This method allows to estimate the angle of the load at an affordable Driveline information and does not require the use of expensive and technically complex sensors. Task prevent fluctuations in cargo handling mechanisms can be solved in two ways. The first way is damping vibrations closed control system using the measuring or evaluating device angular velocity and / or angle suspension. The second way is to prevent fluctuations by setting a chain

of open governance shaping filter (shaping filter) tuned to the frequency of oscillation cargo.

Closed management system dampens vibrations of all goods, including from wind and other disturbances, but is in need of installing special sensors. Rozimknute Administration shaping filter, in principle, can not extinguish any hesitation, it only reduces the effect of fluctuations in the excitation control, no additional sensors is not required. The most common system without feedback angle deviation load controllers were shaping (shaping control, shaper). The algorithm is based on the work of the temporary redistribution of force on a cart at the stages of acceleration and deceleration, while maintaining a stable amount of cumulative effects. Due to the extension of the transitional regime of movement or trolley hoists from one speed to another provided imposing load fluctuations, and the shift control action for the period and / or half-life calculated load fluctuations ensures a perfect case of complete extinction.

There are many varieties shaping algorithms. Common: ZV-shaper (Zero-Vibration shaper), ZVD-shaper (Zero-Vibration and Derivative shaper), ZVDDshaper (Zero-Vibration and Derivative-Derivative shaper), ZVDDD-shaper (Zero-Vibration and Derivative-Derivative-Derivative shaper), varieties of one, two and three curves - EI-shaper (Extra-Insensitive shaper), inverse compared to EI - SI-shaper (Specified-Insensitivity shaper).

Analysis of different control algorithms lifting and transport mechanisms leads to the following conclusions. Shaping filters lead to a decrease in the amplitude faster than standard filters [11]. Shaping filters have a duration of oscillation in the range of 0.7 to 2.0 periods and standard filters from one to more than 10 periods of oscillation. Most filters must measure 3 times more. Shaping filters have a high speed compared to traditional digital filters is due to the peculiarities of their construction and initial (as opposed to the standard filters) focus on solving these problems.

Despite the fact that today the most common method of vibration load in the absence of any information about the angle of deviation is shaping-control, this method has several disadvantages: it is difficult to consider limiting electric lifting mechanisms to accelerate and discrete imposing fluctuations leads to the need abrupt changes in speed, which adversely affects the power section. The use of asking the intensity of the input leads to increased system response time and speed preset smoothing the output shaping filter degrades its quality indicators.

To calculate the open systems commonly asked desirable output coordinate law changes crane and transfer them to input coordinates. This National solves the inverse problem of dynamics mathematical

model of the crane and can be considered as a universal basis for calculating signal forming filter.

Effective in this case is the use of control with fuzzy logic operation (fuzzy-control), as a system of fuzzy logic control may consider a set of a large number of conflicting factors that affect both the accuracy of positioning and the degree of wear elements of the system, arising in the fluctuations in cargo movement and bearing parts handling mechanisms (tower and gantry cranes), wind speed gusts and his (true for cranes) changing load weight (with an inability to accurately measure).

Using fuzzy logic to eliminate vibrations on flexible load suspension proposed in [12]. It is considered dvomasova oscillating system in which the algorithm controls two terms. First, if the load weight deviates from the vertical with some speed, then the mass of the trolley must exert force that will move this mass in the same direction and about the same rate. Second, if the load is rejected at an angle and its rate is close to zero, then the weight of the trolley should be in the same direction to make efforts that would give weight trolley about the same acceleration.

The use of fuzzy logic of operation enables setting coefficients management system based on integrated criterion by which to adapt with minimal control algorithm to the case.

Conclusions

Comparison of shaping-management algorithms developed leads to the conclusion that the shaping filters are not as effective for the formation of the control action compared with continuous controls. The algorithms are significant advantages of: requiring less time and provide low rivnen residual vibrations. The quality of work is determined by the precision of the oscillation frequency identification cargo (if noisy even information about any parameter associated with the oscillation frequency).

In the absence of any information system can be realized only through shaping filter. However, its construction should be treated by turning the regulator developed for closed systems. In this case, the quality of the regulator will depend on the accuracy of matching models real property management, and therefore there is the issue of the two conflicting requirements: high performance and weak sensitivity to changes in the parameters of control object.

Application system with fuzzy logic operation allows by simulating the process of human thought (procedures for acceptance of the decision) to setting coefficients management system based on complex criteria, taking into account the time displacement, precision positioning, the degree of damping vibrations, the degree of deterioration of power components, restrictions on reverse engine at switching from one speed

to another and another. The use of fuzzy logic allows you to shorten the design of intelligent systems and enables component (modular) design.

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In Article wires sovremennыh analysis systems control lifting machines. Opysanы yntellektualnыe algorithms hruzopodъemnыmy control mechanism, osnovannыe decision on obratnoy problem dynamics and Application nechetkoy logic. Control algorithms snyzhayut Requirements for qualifications operators and lifting mechanisms pozvoljajut move "Intelligence" in obuchennoho personnel management system.

Daily motion sensor, control valve, drive, Customer feedback

The paper analyzes modern control systems of load machines. Described intelligent control algorithms lifting devices, based on the solution of dynamics inverse problem and application of fuzzy logic. Control algorithms reduce the qualifications of lifting mechanisms operators and can move "intelligence" of trained personnel in the control system.

Mode of motion, sensor, control crane, drive, feedback.

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SETTING GROUND improvements TECHNOLOGY transhipment for sugar beet

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The method for determining rational parameters of advanced technologies for shipments of sugar beet.

Sugar beet, harvesting, carriageEfficiency, productivity.

Formulation of the problem. An important way to increase the efficiency of harvesting and transport processes for sugar beet is the use of powerful combine harvester with large capacity bins combined with heavy vehicles and powerful loading and sewage treatment equipment. This trend must be seen in close connection with the problem of soil compaction during transport Root off.

It shows the direction of a foreign experience farm with a large volume of production [1], which is widely spread transhipment technology that improved use of specialized heavy-trailers perevanta zhuvachiv and highly-loader-cleaners.

Therefore, the actual development of methods substantiation of rational parameters of advanced technologies for shipments of sugar beet.

Analysis of recent research. For the first time in Ukraine reloading option shipments technology for sugar beet in the 70s of the last century was proposed by the All-Union Research Institute of sugar beet (m. Kyiv), but manufacturing application improved alternative technologies did not happen due to insufficiently high technical level of development as trailers and combine harvesters.IN recently in the EUWhen there are more sophisticated BC bunkers with high capacity - 40 m3 (company combines Ropa,Vervaet Beet Eater 625 and other) and