MODEL OF MACHINES AND MECHANISMS WITH DELAYED FEEDBAC

ИССЛЕДОВАНИЕ МОДЕЛИ МАШИН И МЕХАНИЗМОВ С ЗАПАЗДЫВАЮЩЕЙ ОБРАТНОЙ СВЯЗЬЮ

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Abstract: *A number of agricultural, land reclamation and road construction machinery bearings (wheels, rollers, skis, etc.) are located behind the working bodies and move across the surface generated by their working bodies during the execution of processes. These machines and mechanisms relating to machines and mechanisms with delayed feedback.*

We were first investigated by transient planar and spatial models of machines and mechanisms with delayed feedback, a feedback coefficient is greater than one, when exposed to a single step of the relief support surface. When the model coefficient k>1 (this machines and tools to the schemes similar to the bulldozer) transition process from a single push - h_0 has the form of a circle with radius r.

KEYWORDS*: MECHANISM, LONG WHEELBASE PLANNER, MODEL TOOLS, SUPPORTS, WORKING BODY*

1. *Introduction*

World and domestic practice of agriculture proved that the layout or the alignment of the earth's surface is the main reclamation measures designed to eliminate existing irregularities on the field in a variety of increases and decreases. Most clearly manifest the effectiveness of planning, in paddy fields, from micro relief which depends primarily on the yield of rice and other crops of rice crop rotation.

Among tillage, sowing and other machines, tools and separate mechanisms for agricultural purposes, as well as land reclamation and road construction Excavation works are those in which various types of support (wheels, rollers, skis, etc.) are located behind the working bodies and move on surfaces created by these working bodies during the execution of processes.

Such mechanisms and machines have in their kinematic schemes closed contours transmission effects: Yaw bearings located behind the working body is transmitted through the frame to the working body, and from the latter through the surface formed by them to support the motion. Pass-by-frame support chain-working body forms a direct connection, and from the working body through the surface of the newly formed by them to the support - the reverse. In this case, the feedback of these machines is delayed: as deviations supports located behind the working body causes displacement of the latter, but in relation to them occur with a lag time [1,2,3].

After leveling land in the capital section remain inconspicuous irregularities. Some irregularities remain on the cutting sites and mounds of substandard processing sites Earthmovers, others due to the fact that they were not included in the draft plan. All microscopic irregularities must be addressed long-base scheduler. Long-base planners eliminate unevenness of up to 10-12 cm and a length in the range of leveling base machine, that is to 18-20m [5,6,7].

2. Physical models of machines and mechanisms with delayed feedback, machines for planning field surface

The effectiveness of planning of irrigated land in the first place depends on the quality of performance. Deviations from the marks on the planned project area should not exceed ± 0,05 m [4,5]. Aged single natural slope should not lead to soil erosion. When planning should be kept fertile layer thickness of not less than 0.15 m and for a number of crops at least 0.18-0.20 m [6,7].

The planning capacity planner monotonic grows with increasing length L of the machine base and decrease distance (Figure 1). However, for small values (approximation of the knife to the rear wheel), the influence of disturbances by the rear wheels, and a reduced ability to follow planners midline profile. With the increase of the same base L increases dramatically reduced metal consumption and maneuverability, which is a serious obstacle in the way of improving the ability of planning long-base trailer planners.

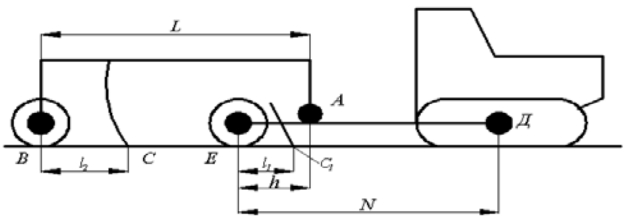

Figure 1 *- The structural layout of long-base scheduler*

It should be noted that the high-precision planning rice paddies have a special role. For example, according to Velichko EB and Shumakova BB rice yield with fluctuations marks checks planned with increased accuracy of ± 3 cm, 1.5 times higher, and the cost of irrigation water is 1.6 times lower than the deviation marks checks within ± 5cm. Thus, the plan to increase the accuracy of ± 2 cm gives an increase rice yields by 19.9 t / ha (47%) and cost of irrigation water 1621 m3 per tonne of raw rice (36%).

When testing physical models of machines and mechanisms with delayed feedback is not recommended to use the fertile layer of soil for construction pillows channels, rollers and other earthworks. For this purpose, use generally in the subsurface soil. In drafting and execution of work necessary to consider a draft of the proposed surface, especially in the field embankment and repeated passes of cars. Sediment on dry soil less (up to 0.05 m than the wet to 0,10m)

2.1. Theoretical studies of the transition process from the action of a single push

Consider the behavior of the model (Figure 2) with a sharp deviation point linkage on the value 0 h_1 as a single push. Due to the rotation of the model with respect to the pivot point on a working body forms a first step. Depth variations in height [1]

$$K = \frac{l}{L}; \frac{L-l}{L} = 1 - k \qquad (1)$$

When lifting V $\frac{AC}{AB} = \frac{l}{L} = k;$

When lifting A. Sun $\frac{BC}{AB} = \frac{L-l}{L} = 1 - k;$

The height of the first step is:

$$h_1 = h_0 * k;$$

The height of the second step is:

$$h_2 = h_1 * k = h_0 * k^2;$$

The height of the n-th step is:

$$h_n = h_n * (1-k) = h_0 k (1-k)^n; \qquad (2)$$

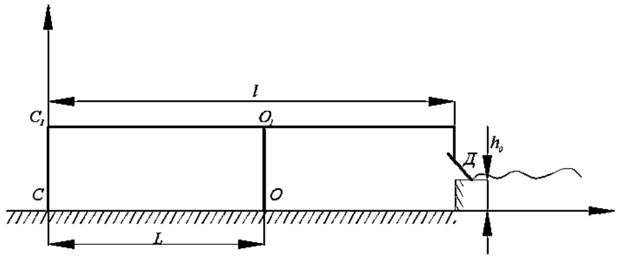

Figure 2 *- Model guns feedback with a single push*

Transients are counting on the assumption that the model (Figure 2) inertial less, the deviation point linkage O_1 and support *C* with small compared with the length *OC* of the operating system frame, $OO_1 \leq CC_1$ the speed $v = const$ and support OO_1 is given by a rigid stand [1.2].

Consider the behavior of the model at running about support on the step height h0 deviation point *D* of the working body of the value of h_1 as a single push. Due to the rotation of the model with respect to the pivot point *C* on a working body forms a first step. Changes in the depth of processing height where ΔY_1

$$\Delta Y_1 = h_0 * k$$

When $k = \frac{l}{L}$

At copy the support *C* from the first stage of the turning point O_1 of the model with respect to the working body forms the next step with height ΔY_2.

$$\Delta Y_2 = h_1(1-k)$$

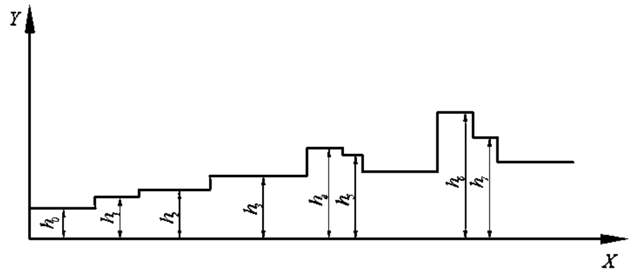

Figure 3 *– Transients*

With the formation of the step have changed to the value:

$$Y_2 = \Delta Y_1 + \Delta Y_2 = h_0 k + h_1(1-k), \qquad (3)$$

Height third step is:

$$\Delta Y_3 = k * \Delta Y_2 = k^2 * h_0 + k h_1 (1-k), \qquad (4)$$

The height of the fourth step is:

$$\Delta Y_4 = k * \Delta Y_3 = k^3 * h_0 + k^2 h_1 (1-k), \qquad (5)$$

and so on. The height of the *n* - th step

$$\Delta Y_n = k * \Delta Y_{n-1} = k * h_0 + k^{n-1}(1-k) h_1, \quad (6)$$

In the formation of *n* - th step change aligned the same site

$$Y_n = \Delta Y_1 + \Delta Y_2 + \Delta Y_3 + \Delta Y_4 + \cdots + \Delta Y_n, \qquad (7)$$

Substituting in (7) value $\Delta Y_1, \Delta Y_2, \Delta Y_3, \Delta Y_4, \dots, \Delta Y_n$ we obtain the following expression changes aligned site[1]

$$Y_n = h_0 k + h_0 k + h_1(1-k) + k^2 h_0 + k h_1 (1-k) + k^2 h_0 + k^2 h_1 (1-k) + .. \\ .. + k^n h_0 + k^{n-1} h_1 (1-k) \qquad (8)$$

Equation (8) is the sum of a geometric progression with ratio *k*. That Is Why

$$Y_n = h_0 \sum_{i=0}^{n-1} k^i + (1-k) h_1 \sum_{i=0}^{n-1} k^i = h_0 \frac{k^n}{k} + (1-k) h_1 \frac{(1-k^n)}{1-k} = h_0 + h_1(1-k^n), \qquad (9)$$

The transition process, calculated according to the equation (9) is shown in Figure 2

The final change aligned sites determined from (9) by setting n → ∞, and considering that $0 < k < 1$

$$Y = \lim_{n\to\infty} [h_0 + h_1(1-k^n)] = h_0 + h_1; \qquad (10)$$

From (10) it follows that the final change aligned digging equal to the deflection point linkage.

Consider the behavior of the model with the modified surface of the field formed a support *C* to a constant value h_2 as a single push

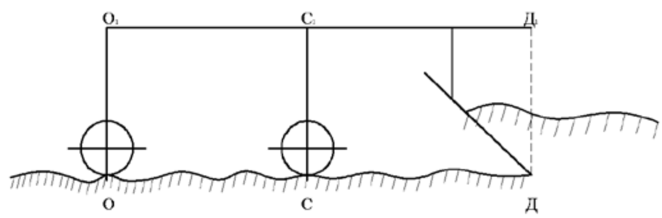

Figure 4 *- Model guns feedback to the front working body*

When leveling the field surface changes due to the rotation of the model relative to the point hitch 0 working body forms a step height in $\Delta Y_1 = k * h_2 + h_1$. When you copy a mainstay of the first step working body forms a second step, the height of $\Delta Y_2 = k * \Delta Y_1 = k^2 * h_2 + k * h_1$ and so on.

The height of the *n* - th step is

$$\Delta Y_n = k^n * h_2 + k^{n-1} * h_1, \quad (11)$$

The amount of change aligned site Y_n the formation of *n* - th step is the sum of the heights of all the steps.

$$Y_n = \Delta Y_1 + \Delta Y_2 + \Delta Y_3 + \Delta Y_4 + \cdots + \Delta Y_n, \qquad (12)$$

From Where

$$Y_n = \frac{k^{n-1}(1-k^n)}{k(1-k)} k * h_2 + h_1 = \frac{k^{n-1}(1-k^n)}{1-k} h_2 + h_1, \qquad (13)$$

The final amount of change aligned area determined from the equation (13) by putting $n \to \infty$.

$$Y = k^{n-1}(h_2 + h_1) \lim_{n\to\infty} \frac{1-k^n}{1-k} = \frac{k^{n-1}}{1-k}(h_2 + h_1), \quad (14)$$

From (14) it follows that in the depth of the treated section ΔY times greater than the change in $\frac{k^{n-1}}{1-k}$ the depth of ruts formed support.

For example, when $k = 1.05$

$$Y = 1{,}05(h_2 + h_1)$$

That is, the amount of change in the treated area 1.05 times the value of the ruts formed a support C. Calculate the duration of the transients. Since the theoretical processes are long, then we assume that the real transition process ends when leveling the field surface in the (100 - a)% of the total of its theoretical value [2]:

$$Y_i = \frac{(100 - a)}{100} Y, \qquad (15)$$

where Y_i - change leveling the field surface, above which the real transition process is considered over Y - of course theoretical change in the surface of the field, a - a percentage that depends on the required accuracy of determining the duration of the transition process:

$$a = \left(1 - \frac{Y_i}{Y}\right) 100\ \%$$

Substitute in the formula Y_i change leveling the field surface (9), and in place Y - the final theoretical change of the surface field (10):

$$h_0 + h_1(1 - k^i) = \frac{100 - a}{100}\left(h_0 + h_1\right).$$

After conversion, the following relation

$$1 + k\left(1 - k^i\right) = \frac{100 - a}{100}\left(1 - k\right) \text{or } k^i = \frac{2a}{100} = \frac{a}{50}. \quad (16)$$

Hence we define the number $i = n$ of anew copied passes required to complete a real transition.

$$i = \frac{\lg a - 2}{\lg k}. \qquad (17)$$

The path S_i of transition determined by multiplying (17) by the distance $CA = l$ between the working and the support body (Figure 4)

$$S_i = l\frac{\lg a - 2}{\lg k}, \qquad (18)$$

(18) that the path of the transition process is directly proportional to the distance between the working body and the support and inversely proportional to the logarithm k of feedback tools. When $a = 5$% is equal to the duration of the transition process

$$S_i = l\frac{\lg 5 - 2}{\lg k}. \qquad (19)$$

Similarly, the transient path changing surface define the field values Y_i and Y by substituting (13) and (14) to (15):

$$\frac{k^{i-1}\left(1 - k^i\right)}{1 - k} h_2 + h_1 = \frac{100 - a}{100}\left[\frac{k^{i-1}}{1 - k}\left(h_2 + h_1\right)\right]$$

Hence, for $h_2 = h_1 k$

$$1 - k^i = 1 + \frac{2a}{100} \text{ or } k = \frac{a}{50}. \qquad (20)$$

Since (20) is similar to equation (16), the transition path also exists from the equation (18).

The analysis is valid for support in the form of a rigid stand up and instant support *B* in the vertical front steps. In the real world in the course of transients are various deviations due to the influence of various kinds of factors.

3 Results Discussion

Were first investigated by transient planar and spatial patterns of machines with a delayed feedback, a feedback coefficient is greater than one, when subjected to a single step bearing surface topography. For example, if the model coefficient k> 1 (this machines and tools to the schemes similar to the bulldozer) transition process from a single push - h_0 has the form of a circle with radius *r*.

The proposed methods of theoretical research model of machinery allows us to study their properties and the impact of design parameters and operating modes. The foundations of the theory of the study of mechanisms and machines different from the existing approaches to the study of the problem and the application of this theory in the calculations make it possible to justify the optimal parameters and modes of operation of real machines and tools with delayed feedback.

4 Conclusions

Finishing area rice fields produced long-base scheduler. Planning work can be carried out with the following limits of soil moisture,% absolutely dry soil: clay soils of 20-24%; loamy 19-22%; loamy 13-15%; sand and silt 10-14%. Before you start the scheduler on a flat plot surface correctly set knife height. On the loose soil at the first track layout knife set at 3-5 cm above the base plane wheels. After the first trace of the knife assembly is lowered to the reference plane of the wheels.

After a major leveling land in the area remain subtle irregularities. Some irregularities remain on the cutting sites and embankments due to defective processing sites Earthmovers, others due to the fact that they were not included in the draft plan.

All microscopic irregularities must be addressed long-base scheduler.

5. Literature

1 Zhunisbekov PJ Transients tillage machines and implements feedback. // In: Nauch.trudy KazSKHI - Almaty-Ata: 1972 - C.29.

2 Ksendzov VA Introduction to the mechanics of machines and mechanisms with delayed feedback. Moscow: Sputnik, 2005.

3 Samsonov NP activities on irrigated lands. - M .: Selkhozgiz, 1955. - 127s.

4 Paramonov EG On the accuracy stakeout vertical layout // Improvement aerogeodesic technology research for the purposes of agriculture. - M. - 1991 - S.58-61.

5 Shumakov BA, Petrunin VP Disposition of the surface irrigated areas for irrigation furrows and long strips: Sat. scientific. tr. / YuzhNIIGiM, 1964. - Vol. 10. - S.5-13.

6 Smets VI Reclamation and rehabilitation of disturbed land. - M .: Kolos, 2000. - 95c.

7 Tsyvinski GV determining the direction and distance carriage ground when planning irrigated areas // Irrigation and Water Management. - 1970 - Vol. 12. - S.38-47.