

## Determination of dynamic and qualimetric parameters of mobile agricultural units in operation

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**The purpose.** Elaboration of methodology of determination of dynamic and qualimetric parameters for provision of dynamic stability of mobile agricultural assembly units (MAAU). **Methods.** Systemic approach to analysis of mechanic systems is used, at determination of research problems — hypothetical method, at analysis of operation of the previous contributors — informational-analytical. **Results.** Measuring-registration complex with the use of 3-coordinate sensors by means of which are carried out probes of MAAU on stream is developed. Scientific, methodical fundamentals for carrying out tests of MAAU while in service are offered. **Conclusions.** Measuring-registration complex and method of simulation of partial speedups which allow conducting dynamic and qualimetric tests of MAAU during exploitation without interference in construction of the assembly unit is created.

**Key words:** *mobile measuring-registration complex, method of partial speedups, dynamic and qualimetric parameters.*

**Introduction.** The main restriction when carrying out field works were and there are squeezed agrotechnical terms which demand use of high-performance agricultural units on the basis of tractors of a high traction class with the effective power of 200... 350 h.p. By increase of profitability of agricultural production there can be an increase in productivity of cultures together with reduction of costs of their cultivation. One of the directions of reduction of operational costs is increase of efficiency of use of means of mechanization of technological processes - decrease in time for completing, decrease in dynamic loadings, ensuring necessary controllability and stability of the movement of units.

**Analysis of recent researches and publications.** A big problem at the present stages of operation of agricultural units in definition their dynamic and qualimetric characteristics in use. The modern tractor of the traction concept is characterized rigid parametrical dependence between its weight and engine capacity. The severity of this dependence is caused by need of realization of engine capacity only with a great effort of draft and in limited (agrotechnical requirements) the range of speeds. If engine capacity exceeds the value of weight of a tractor corresponding to it, it won't be realized on the majority of agricultural operations because of restrictions on technological speeds [1]. At a power deviation in other party the tractor will work with the lowered speeds due to the lack of draft, and the unit you won't have potentially possible productivity. The theory of a tractor which is used for design of power means is proved for tractors of the traction concept. Chudakov D. A. suggested taking traction effort for the parameter establishing a tractor class. Further this direction was developed Trepenenkovi.I., Sudakov A.N., Medvedev M. I., Guskov V. V., Kutkov G.M., Nadikto V. T., Lebedev A.T., Adamchuk V. V., Bulgakov V. M. in these works the materials allowing to develop are stated and rationally to use tractors of various classes and appointments, they developed in the direction of increase of operational and technological indicators due to increase of power and weight, a technological level and universality. Meanwhile it should be noted that the theory of a tractor of the traction concept is effective if engine capacity is realized through draft [2, 3, 4, 5, 6]. Increase of power of a tractor in the traction concept involves increase in its weight, usually can't constantly proceed, and has the rational limits caused by technological need and to ecological criteria. Considering that measuring systems on the basis of multicoordinate sensors of accelerations which allow improving and accelerating qualitatively carrying out dynamic tests of mobile cars in recent years gained development, there was an idea of representation of the active and jet forces operating on the mobile car because of acceleration (considering the principle of superposition in mechanics). In this case there is a replacement of the mixed vector sum of forces and accelerations in dynamics equations in the uniform vector sum of accelerations. It gives the chance of preservation of physical sense of the received vector equation [7].

Use of sensors of inertia, so-called accelerometers, plays a significant role in the solution of the specified problems. Application options, the principles of action and development of production technologies of accelerometers which are used in world automotive industry [8, 9] now are analysed. Performance of technological operations on processing of the soil is connected with big expenses of energy, both for performance of the most technological operation, and for dynamic processes in system a tractor - soil-cultivating tools. Dynamic stability of implementation of agro requirements is influenced by controllability,

stability of the movement, external loadings, promotes change of quality of their performance [5]. Thus, researches on increase of efficiency of operation of soil-cultivating units and interrelation of dynamic processes with decrease in energy consumption are the actual scientific and applied direction of development of agricultural production of Ukraine.

**The purpose of researches** is increase of efficiency of operation of MAU by development of the theory of dynamic stability, creation on the basis of the received scientific provisions of new methods and ways of management, calculation of stabilization of dynamic processes.

Achievement of a goal assumes the solution of the following tasks: - Creation of methodology of determination of dynamic stability of MAU at variable parameters of a state for justification of the resource-saving modes of their work;

- Theoretically to prove a method the partial accelerations and its application for monitoring and a parametrical assessment of dynamic characteristics of MAU;

- To carry out the theoretical analysis and justification of application of the developed measuring and registration complex on control, an assessment of traction and power, power characteristics of MAU at their unsteady movement;

**Results of researches.** Dynamic tests of agricultural units is one of the most widespread and reliable ways of an assessment of their operational properties. Researchers meet when carrying out such tests many difficulties which are caused by imperfection of the existing methods of their carrying out. When carrying out such tests of agricultural machinery there are certain difficulties with measurement and registration of change in time of such parameters as traction effort, the valid speed of the movement, effort on a hook, the engine capacity, traction efficiency. The particular interest causes determination of the specified parameters in real time. Determination of these parameters will allow specifying the equations of traction dynamics of mobile agricultural units, expenses of power and fuel on performance of technological operations. There are unresolved problems of justification of universal methods of an assessment in operation of traction properties of a tractor and traction resistance of agricultural cars, on the basis of which perhaps rational aggregations of agricultural units for various operating conditions.

One way to solve this urgent problem is to develop models and methods of theoretical and experimental studies with determination the necessary parameters for effective use and exploitation tillage units.

D'Alembert idea was to bring the dynamic equation to a simple equation of statics. This means bringing the mixed system of vectors (acceleration and force) in homogeneous vector space forces. Such an approach would in engineering practice greatly simplify the analysis of complex power mechanisms (Figure 1).

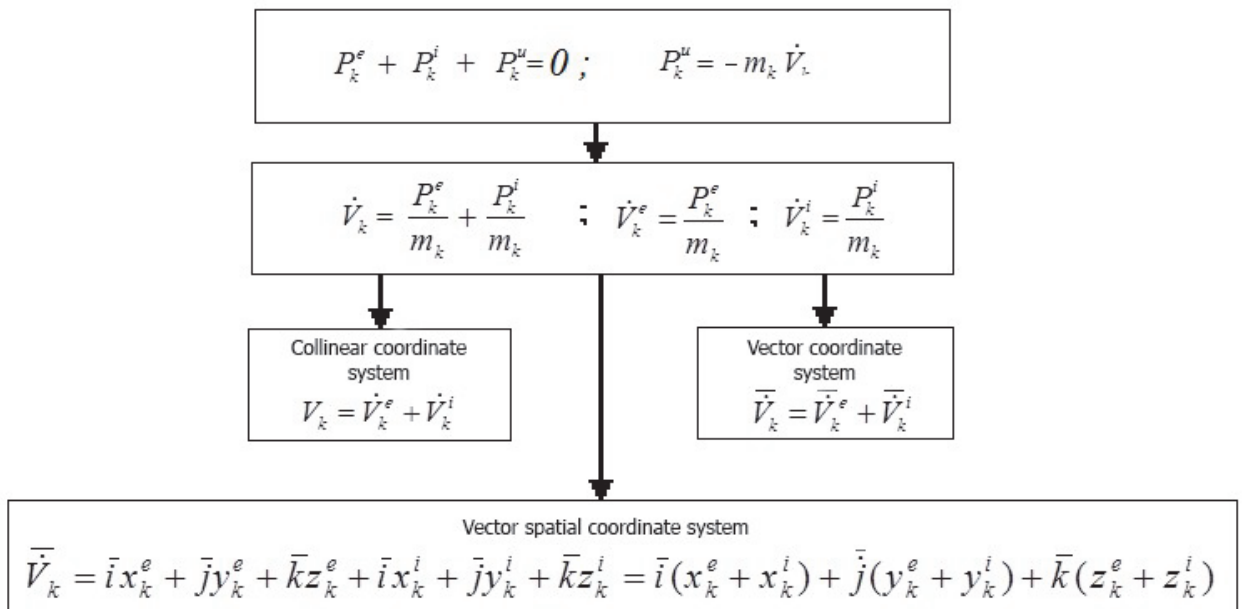


Fig.1. Model transition to acceleration space

Between acceleration and power factor is its appearance, there is a linear relationship (defined axiom speakers). However, the relationship between acceleration and nonlinear control action because the system there are different forces of resistance (dry and viscous, elastic, etc.). In a mobile machine control system inputs are: turning the steering wheel, turning clutch, gear, increasing fuel supply, the change effort on the brake pedal, and others. In addition, the input signal for this system is any external influence: changing the resistance weapons of relief bearing surface, the effect of external forces and others. Monitoring the dynamics of mobile agricultural units is possible with the help of modern devices - accelerometers, which are widely used

in many sectors of the economy and modern computer software. The accelerometer measures acceleration or according to Newton's second law, force that is accelerating the inertial mass [8,9]. Today is urgent the establishment of mobile registration and measurement systems to estimate the parameters of movement of mobile machines in dynamic and qualimetric trials. One of these complexes (Figure

2), for testing MAU developed at the Department of tractors and automobiles of P. VasilenkoKharkov National Technical University of Agriculture.



Fig. 2. Mobile measuring and registration complex: 1 - RS with an author's software package; 2, 3 - sensors of accelerations of MMA 7260QT; 4 - analog-digital converter of a signal of a tenzounit.

Carrying out qualimetric tests demands use of mobile computer systems which will allow carrying out determination of its kinematic and dynamic parameters without intervention in a design. We will note that it is necessary to provide higher level of tests, to use new devices and devices with wide functionality.

It is known that each mobile car does three progress of rather coordinate axes connected with the mobile car, systems of coordinates from the beginning in the center of masses and three rotary motions round these axes. Influencing governing bodies, the machine operator can change the movement MAU only along longitudinal and side axes of system of coordinates. The movement in the direction of a vertical axis doesn't give in to management and depends only on a profile of a surface and vertical fluctuations of the unit. From three angular movements only the angle of rotation of a longitudinal axis can change as a result of the operating influences of the machine operator or a control system. Thus, are operated only parameters characterizing the plane-parallel movement. Linear communication between input and output parameters of mechanical system is the best from the point of view of controllability. For its receiving it is necessary to provide the appropriate technological level and stability of parameters of system.

In order to determine the parameters of planar motion unit requires installation of two triple-grid acceleration sensors. The algorithm of the sensors, accelerometers consisting of measurement and registration are set in Figure 3. Accuracy of measurement error is only direct measurements that measure linear acceleration (accelerometers for MMA7260QT - 1%), and the coordinates of the location on the longitudinal axis accelerometers ISA [10].

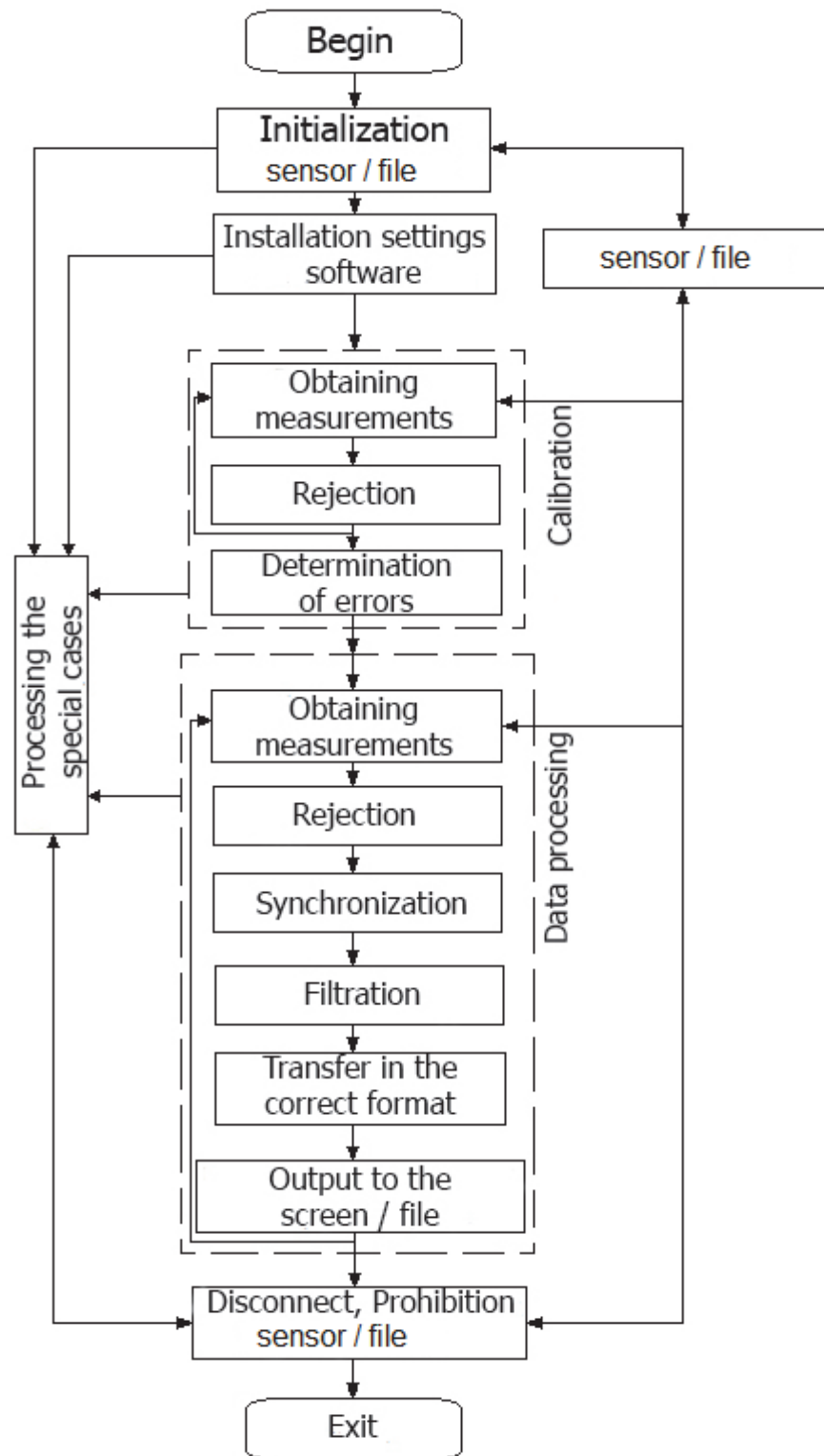


Fig. 3. The algorithm of the measurement and registration complex.

Observing the behavior of the unit in real time, a measuring system makes it possible to predict with great accuracy that will be changes in management at the change of engine power, strength of agricultural tools, change the weight, center of gravity and the redistribution of others.

Through the use of new techniques to study the dynamics of units based on scientifically based theoretical and experimental results by reducing costs for equipment, reduce dynamic loads on the machine, improving handling and stability of may provide reduced costs of fuel and lubricants, increase productivity and reduce the cost of agricultural products.

### Conclusions.

The developed measurement and registration and modeling of complex partial acceleration and allows for dynamic testing qualimetricalMAU during operation without interfering with the design of the unit.

Technological and energy of MAU can be improved to meet the needs offered for each of them, avoiding conflict, and improving the overall performance of the tractor and implement.

This solved important for the theory and practice of the problem of improving the efficiency of agricultural units.

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