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METHODICS FOR STRUCTURAL IDENTIFICATION OF DYNAMIC MODEL OF OPERATOR PILOT OPTIC CANAL IN THE DYNAMIC CONDITIONS OF FLIGHT, CLOSE TO REAL

There had been developed the methodic for structural identification of model of dynamics of pilot-operator during execution of stochastic signal of command system in part manual mode. The operator is under influence of external disturbance – three dimensional stochastic oscillation of work place. Experimental conditions are dynamically close to real. The suggested methodic will enable sampling the most appropriate candidature for pilot, which will significantly improve quality control in part manual mode.

Key words: *structural identification, optic canal , execution of stochastic signal, control in part manual mode.*

General task setting

Modern conditions make higher demand to accuracy of part manual mode motion of transport facilities [1]. It is strongly believed that the best accuracy is achieved in full automatic systems, optimal criteria as for accuracy. This accuracy may serve as the standard to be approached in part manual mode of control [5]. Therefore it is necessary to learn the model of operator dynamic in control loop in details, find new approach to identification of this model in conditions, close to real. The number of dynamic factors, related to the character of movement, influence biological properties of operator in conditions of real movement of the object. Each of these factors can significantly change the model of operator dynamic in part manual mode control loop. During the composition of such models there appear difficulties, since the content, specifics, influencing mechanisms of these factors, their changeableness caused by specific conditions of the flight mode under research are not studied enough. In other words, there are no strict conception about influencing the above disturbance on pilot, specific person's response to them in specific flight. Sufficiently full and reliable conceptions about pilot's behavior in the specified circumstanced require pretty complicated and expensive movement simulation facilities, when possible – specified movement. It is necessary to have latest technologies for structural identification of interested models of pilot dynamics, corresponding physical and mathematical tasks setting for identification, algorithms for their solution.

That is, there is the necessity in setting and efficient execution of range of scientific, research, technical and organizational works aimed at studying pilot's properties in movable object control loop.

Research task setting

As is known, for example [4, 5], dynamic models of candidate to pilot-operator in the loop of in part manual control over movable object had successfully been researched in static conditions. Apart from that it is known [4, 5], that in the real imitator of flight aerodynamics there had been studied the peculiarities of acceleration channel of model of the pilot dynamic. The existing simulation facilities and methodology for task solution allow to solve tasks, evaluating changeableness of pilot dynamic models in the loop of *part manual control under the influence of three dimensional angle stochastic oscillations of the movable object's base during the execution by the operator of the known program signal of object's control loop deviation (aircraft for example). These signals, appearing on the output of the command system aboard the movable* object, enter the input of the optic canal of the pilot-operator, and are usually of stochastic character.

It is commonly accepted that optic canal of control includes human visual sensitive element, some part of brains and human motor reaction, which is fixed during manual moving the controls.

Though the man as the complex self-adjusting system has the arbitrary dynamics, it may be described [4, 5] for example by apparatuses of transfer function and accompanying noise during the execution of monotonous actions in the specific part manual control mode by the pilot. Range of factors, such as base movement character the operator works on, operator qualification, his skills, age, sex, peculiarities of performance with the left or the right hand etc. influence the dynamic peculiarities of the operator in this mode.

Thus, there is a task to research the changeableness of pilot's dynamic models due to such factors as stochastic character of angle movement of movable base, housing operator's work place, number of training actions, dynamic peculiarities of transport facilities.

Essence of the methodic and description of the experimental plant

As the work place for conducting the experimental researches it had been suggested to use three-degree-of-freedom dynamic stand-generator of base spatial motion [3] of submarine-based real object, received by multiphase natural testing in different conditions, computer calculating environment with display, showing error signal in *part manual mode.*

During the experiment it had been suggested to use the reproduced on display error signal between program and real movement of the researched controlled object as the input signal on the model of pilot optic canal dynamics, and operator's manual control movements (in this case - joystick) – as the output signal. As the required algorithm of structural identification of the dynamic model of optic canal there had been suggested to use the known [1] algorithm of structural identification. With changes of dynamic conditions of movement for each operator under research there is the possibility to determine the changeableness of his model dynamics on specific peculiarities of the influencing factor.

Tests, like those described, are possible to be conducted on the selected group of pilots, specified as for characteristics: age, sex, peculiarities of mechanisms of operator activities, trained or not trained, and make corresponding statistic conclusions on character and changeableness of operator dynamic model under specific dynamic conditions of his operation.

Let us consider in detail the main stages of experiment, peculiarities and importance of the obtained results. With this in view we schematically depict the testing process (fig.1). With the help of block diagram fig.1 shows principle of submitting and taking off necessary information for the experiment, disturbing factors, influencing operator, and the measuring process.

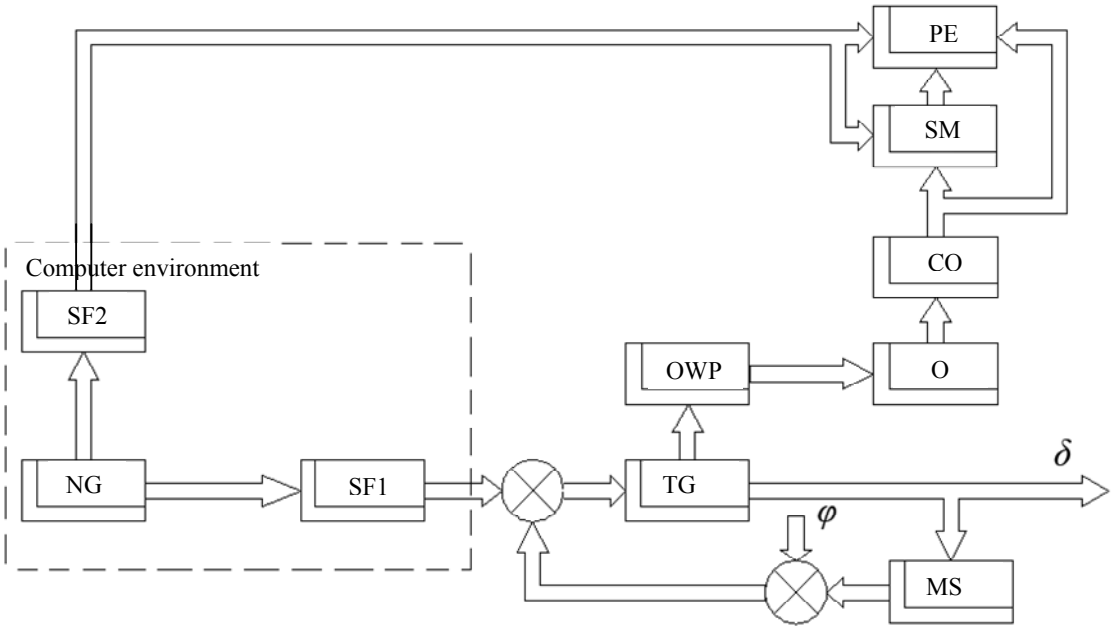

Fig.1. Block diagram of the experiment.

Here we have the following marking: NG – noise generator; SF – shaping filter; CE – computer environment; TG – table generator; MS – measuring system; OWP – operator work place; O – operator; CO – controls; SM – monitor screen; PE – environment for processing the received information; φ – measuring interference.

In the experiment the under research channel is the model of dynamics of optic canal. With the help of noise generator and shaping filter the error signal between program and real movement of the controlled object is submitted from computer environment to the screen of the monitor. This signal is the input influence in the model of dynamics of optic canal. At the same time, from computer environment with the help of other shaping filter and noise generator, the signal is submitted to the several-stage dynamic stand-generator, in the result of which the spatial angle rolling on three coordinates: angle of bank, pitch and swerving is being simulated. Under the above conditions, the operator is influenced by the disturbing factor: rolling imitation, and pilot is trying to "catch up" the signal which he observes on the screen with the help of controls. The output is the shift of controls, made by operator. The processing system receives program signal, which is displayed on the screen, the signal of input of dynamic object, signal created by the controls (joystick), signal of output of dynamic object and difference between them.

After processing of input and output information on the object, obtaining corresponding spectral characteristics and building with the help of algorithm of structural identification [1] model of dynamics of optic canal, it is possible to make a conclusion which of the candidates to pilot will answer all the requirements. For the research it will be necessary to choose candidates of different age, sex, different training level etc, which will enable to evaluate quantitatively the influence of biological and physiological state of a man on the result of the experiment.

Conclusions

The result of the application of the methodic [1] of structural identification to the dynamic model of pilot –operator optic canal in dynamic conditions of flight, close to real, is the quantitative evaluation of candidates influenced by rolling movable base. The suggested methodic for experiment allows to get information on how the influence of disturbing factors on the human is reflected in the obtained results. In future, after research of the interested canals of perception of navigation information, it will become possible to select the most appropriate candidature to pilot

which will significantly improve the control quality in *part manual mode.*

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