

Study of Functional human performance at work in the extreme conditions

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Human activities in terms of space flight is a specific kind of work performed in unusual and complex conditions requiring high active, ready to respond to sudden unspecified situations and the capacity to bear loads, weightless, isolation, and control of a system of knowledge, habits and skills. In this context, the aim of the project was to study the functional performance of people at work in extreme conditions and determining the requirements and activities for the selection, training and supervision of operators of complex technical systems.

Synthesised is an algorithmic model of man as control system (MaCS), which is considered as a complex hierarchically organized management system at three levels: mechanic control, intelligence.

Described is organizational and technical system of an unmanned aviation complex as sophisticated ergatic system. Performed a computer realization of the modules of the algorithmic model of human beings as control system and developed software for processing and analysis of data, including:

- 1) Model an unmanned complex to train operators and formation of the mental models of emergency realized in "Simulink". This model reflects the specific features of the unmanned aircraft (UAV) and have the capacity to model the different types of failures in the control system;
- 2) Model the flight. The basis of the development of the model stand subsystems of lateral and longitudinal movement and the connections between them, a model management system with autopilot and manual mode adjustments (ie combined mode "). Modeling has been done to specifically adopted characteristics of small (UAV);
- 3) Models of the pilot. As a unit of the control loop, the pilot (operator) is viewed as a simple automatic control consisting of a three interconnected subsystems: sensitive organs (sensors), central nervous system; executive organs (muscles of the arms, legs, back). Presents a detailed model of the system-operator-plane autopilot for different modes of operation.

Modeling is work in the pilot loop on takeoff and landing "matlab-simulink" environment. Recorded the results of modeling of flight departure, level flight and landing. It reflects the typical stages subject to the safety flight conditions.

To simulate the activity of the operator attention is given to the creation of a virtual reality based on different software flight simulators and virtual elements of the system itself.

Described are the composition and elements of the system chosen for virtual reality software and the mode of action. It includes: PPJoyZ800 is a program manufacture of RakudaSoft, which works with PPJoy driver emulation Emagin Z800 3D visor like a joystick. This allows the sensor to move with six free degrees to be used in every setting with a virtual reality that supports joystick, for example "MS Flight Simulator 2004" or "X-Plane".

Proposed a theoretical data model to predict the level of information load operator ergatic systems that allows to assess and predict efficiency of actually running operator.

Synthesised is an information model for simulating the activity operator based on Petri nets.

The sequence of the actions of human operator (HO) are given by the algorithm of activity, including consistent implementation of elementary operations to solve a given task. Evaluated the behavior of the human operator is in terms of reliability and safety of the man-machine complex. Created graph model based on Markov chains, which allows to obtain analytical expressions for the establishment of the quantitative factors affecting the reliability and safety.

Created research complex "BeOn-1 (Fig. 1) to explore the human operator for the impact of factors in the operating environment includes an assessment of: Situational alertness (consciousness), Decision making, Ability to deal with scarce and contradictory information; Aadaptability to changes in medium preferences; Ability to perform simultaneous ongoing activities; Stress management – flexibility, emotional stability and management of stressors; Pphysiological costs of dealing with stress.

Accomplished a testing laboratory research complex in applied science center for military medical expertise, aviation and maritime medicine - Military Medical Academy, Sofia.



Figure 1. Used sensor types and place of putting on the respondent

1.Headphones - giving acoustic and speech stimulus 2.Sensor galvanic skin response (CGW), 3.Senzor for pulse wave (SW), 4.Sensor ECG right arm, 5.Sensor ECG left arm, 6.Temperature sensor right arm, 7.Temperature sensor left arm, 8.Temperature sensor left foot, 9.Temperature sensor right foot