

UDC 629.735.017.1.083(045)

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## **SCIENTIFIC RESEARCH ON THE ANTI-STRESS PREPARATION OF SPECIALISTS IN A QUARTER CENTURY**

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**Abstract.** *This article provides an analytical overview of the work on training of human operator counteract the simultaneous action of negative factors, carried out by experts from the Avionics Department. The focus is on the method of training of operators by removing the negative effects of the flight, which are associated with the phenomenon of amplification of the dynamic stereotype in aviation specialists. It should be noted that the author does not fully cover all the anti-stress training methods that have been developed by our experts.*

**Keywords:** anti-stress training; human factor; means of prevention; operations; piloting technique.

### **1. Introduction**

Currently, the proportion of accidents falling at Human Factors (HF) is 80-90%.

However, such events have unlikely character.

Historically the transition from one state to dozens of private companies has not led to their commitment to solve this problem.

Despite these difficulties, the research on the reduction of the share of accidents on the HF continues.

### **2. Analysis of the research**

In 1986, in the content of the theme number 536-V85 the quality of the functioning of the System "the pilot-simulator" CSA (complex simulator of aircraft) Tu-154 were assessed.

There were developed procedures of quality assessment of functioning of the ergatic system.

Also, the recommendations on the organization of pilots' and crew members' counteraction from "Superposition Factors" (SF) and unexpected stimuli in special flight situations were implemented.

Experimental data was processed by the Phenomenon of Amplification of the Dynamic Stereotype (PADS) proof (flight handwriting) under the action of complex failures [10].

In Scientific Research (SR) number 563-B86, methods were developed to improve the ergonomic portrait of airlines, the need and practical levels of recoverability of flight personnel were determined.

In this SR historical background of development of the theory of humans' working movements and outlined priority areas for work was presented.

As a result of analyzed statistics in SRs the denial of opinion that during the special flight situations pilot often has "breaking" in dynamic stereotype of action

was justified. It was proved that instead of "breaking" a phenomenon of amplitude PADS occurs.

If operator has any PADS, he enters in the zone of so-called enhanced reflected movements when acts unconsciously, but the "face" of movements is maintained.

However, there may be illogical actions. It is shown that by teaching pilots to fly without PADS, we teach them not to commit wrong actions [10].

The necessity of automatization of instructor's workplace for analyzing PADS is shown. The analysis of the operating pressure on the crew of the Tu-154B2 by the action of complex failures on CSA that mimic the SF in real-world missions is held [5].

In the SR number 623 B88 guidelines for the preparation of the flight personnel at the STT to the effects of SF were developed.

There is developed a System of Objective Control (SOC) "Anti-stress" and methods of its use in the simulator training of pilots.

During the research it was also found that about 70% of the pilots need anti-stress preparation. There were highlighted the main types of pilot's differentiated dynamic stereotypes (flight handwriting) [16].

I received an act on introduction in to algorithm and a program to record the pilots counteractions for methodology of assessing the effectiveness of their training as a result of implementation of SR number 733-V89 which were concluded with the Department of flying service [7, 11].

In the research the recommendations to improve the level of anti-SF were developed.

SR number 782-B90 was devoted to the organization of pilots' anti-stress training by SF counteraction in Tatar United Squadron (TUS). I had received an act of implementation into the

recommendations of the operator training against SF, taking into account [1, 6] PADS.

The Act on the implementation of guidance taking into account PADS, while decision making in SR number 808-B91 "Development of the initial training of engineer-pilot Tu-204 KSTSPNO" with JSC Boryspil was also received.

Further the studies on a topical issue of the principle of invariance during the analysis of processes in man-machine systems by non-classical methods (Fig. 1) were carried out.

The possibility of determining of counteraction of a pilot from negative superposition factors on modern aircraft flight parameters, evaluating the effectiveness of its work was shown.

In the course of further investigation it was established that the invariance of the "man-machine" allows to determine the invariant properties and characteristics of the human operator for the engine output without placing a contact and contactless psychophysiological sensors which basically carry the information about characteristics of the human-operator that is mathematically described by the general theory of oscillations.

The oscillatory nature of the output characteristics of the human operator allows to make a conclusion for tracking systems, that the engine outputs systems are invariant with respect to the input characteristics of the system, if the input of such a system works by a human operator.

From the general theory of automatization and automatic control systems it is well known, that in relation to all types of oscillations (sinusoidal, modulated, with a random spectrum, etc.), existing

systems are invariant under the scheme "input-process-output" [9, 14].

The questions of maintenance of "Antipult" systems which are regarded as the means and methods of analysis processing for the anti-stress training and assessing the ability of pilots and air traffic controllers to counteract the SF during complex avionics failures. On the basis of given statistical data and graphical dependences the assessing of readiness of the operators to act in specific situations was maintained [13].

It was established that during the tests of operators it makes sense to use the primary and secondary resources of grouping.

Herewith, the primary grouping is held with using of the laws of multivariate normal distributions taking into account the interaction between the individual indicators of grouping by the nature of change in the maximum entropy distribution.

Secondary grouping can be carried out according to standard logical tests or psychophysiological methods with the problem statement on logical transitions.

It makes sense to develop anti-stress training program for traffic controllers.

Medical surveillance should be provided in this program.

During pilots and traffic controllers' training it's necessary to take into account psycho-physiological factor both qualitatively and quantitatively.

The main aims of anti-stress training are: decreasing of risks concerned with operators' "opposition to SF" training; establishing ergonomically optimal flight control systems.

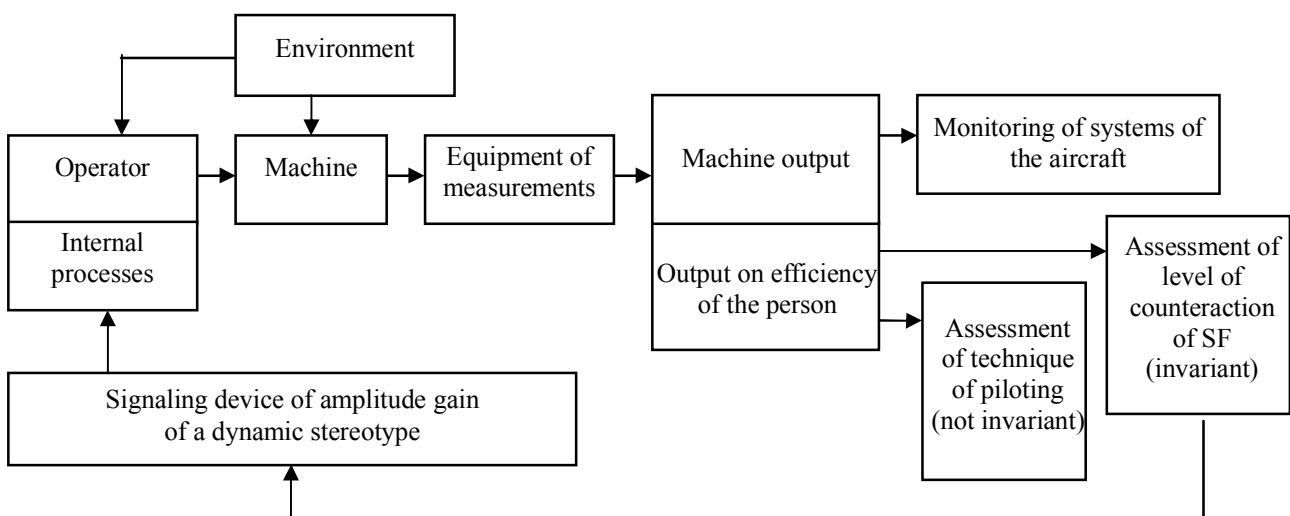


Fig. 1. Method of pilot's characteristics determination through machine approach

In accordance with factor Model of Action and Counter-action in Flight (MACF) and taking into account nature of Sechenov's intensified reflexes (SIR), flights are considered as extremely complex processes and their moments when risks can be caused by expected processes, uncertainties and occasions, external errors (Fig.2).

The most complex flight uncertainties are SF.

SF is an interaction between factors [23, 24].

There was no scientific works before, which consider training of SIR saving under SF action.

Our model allows to take into account this training.

A variant of aftereffect is more earlier prevention of accident and it is more distinctive feature of our model from the west one. MACF also

allows to prevent accident thanks to SIR (even during negative flight or at presence additional error).

Difficulty of solving this problem is that we consider a lot of interacted factors.

Our scientists distinguished more than 1500 of these factors.

So, problem of aircrew error prevention is very difficult (even when causes are known) [8].

Features of applying of current methods of extra small probabilities analysis were considered. It was also considered the appearance of "tail effects" [2].

The analysis of aviation accidents appearance while determining the aircraft position based on selection and processing of V.D. Gulenko's experimental data were analyzed [3].

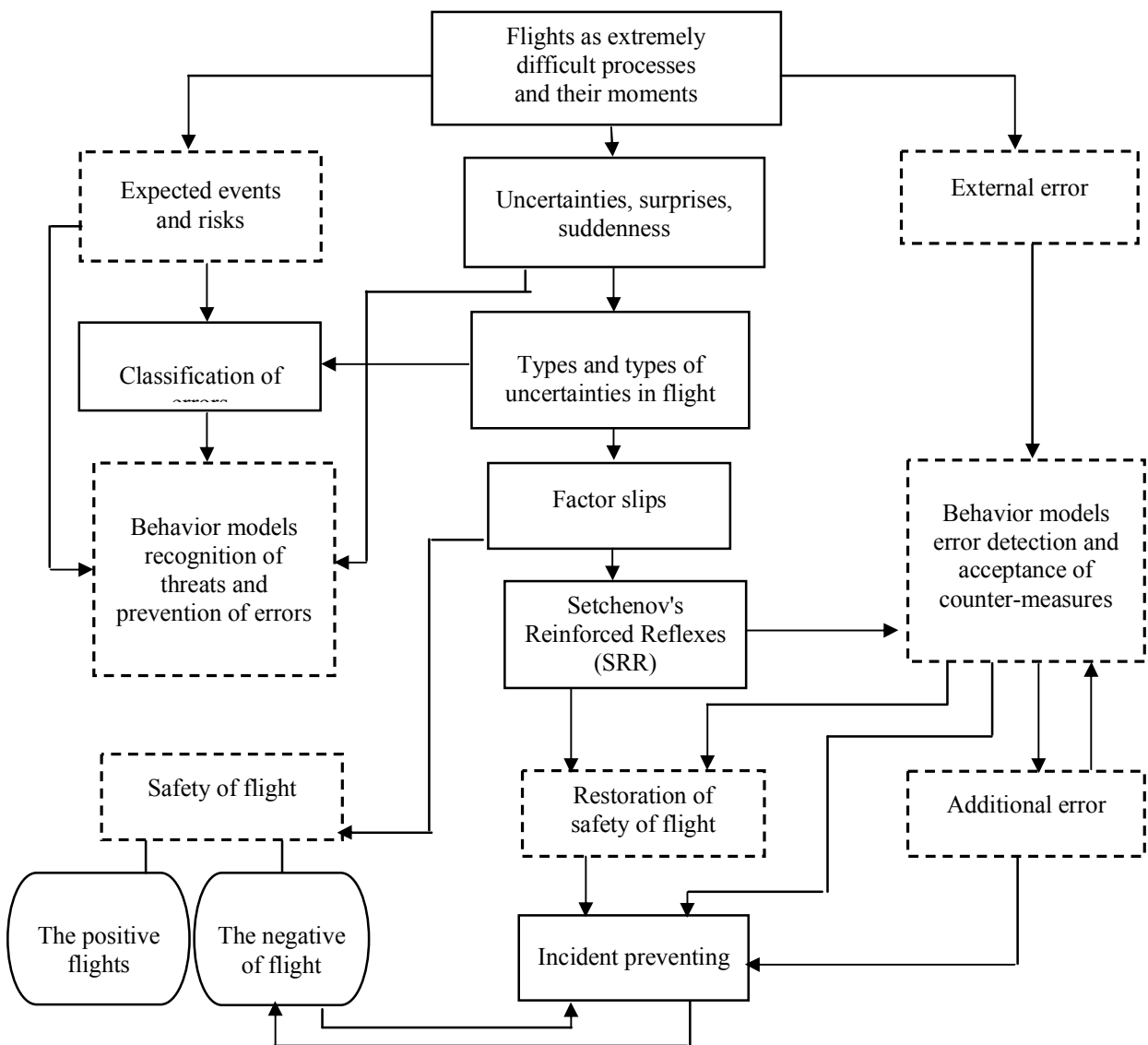


Fig. 2. Factor model of flight, considering nature

A number of conclusions were made based on analysis of random values.

Obtained method of module transformations got wide application in one of flight squad.

V.D. Gulenko found that model parameters distribution for modern aircrafts' flight parameters are logarithmic-normal laws, with defined asymmetry and logarithmic "tails".

Asymmetry of model distributions allows to distinguish canonical (normal) part of distribution and "tail" of distribution.

Logarithmic "tail" of distribution carries information about high deflections of flight parameters, such as High Roll Angle (HRA).

So, it's possible to measure risks of HRA from relation between canonical and "tail" parts of distribution. It's necessary to use complex variational approaches during analysis of new causality errors model: mathematical analyzing apparatus of maximal parameter deviations through SIR zones.

Risks measurement of HRA through module distributions during prevention of accidents is an important aspect of solving such problem as losing space orientation.

Taking into account that the aircrew lose direction of roll change at high angles of attack, it's necessary to use module transformations as mathematical model.

Module values allow to enter uncertainty in estimation of HRA direction.

Module distributions (static and probability) of flights during operating aircrafts of different generations lead to necessity of considering two types of signalization of HAR – symbol-variable and index one.

While symbol-variable signalization the function of HAR direction is conducted by automatically systems.

While index signalization this operation is conducted by aircrew and leads to the increase of aircrew operation loading and the increase of HAR risks.

Current indexes and criterions of operation were analyzed in general stage [17].

Its information ground from a perspective of aviation engineering psychology and ergonomics [22].

Main concepts of perspective programs and methods of pilots' training on complex flight simulator, using process approach, were specified [15].

Process concept of flight operation and its fundamental significance for CIS aviation development was represented [15].

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Integral evaluation of aircraft considering avionics importance was provided [12].

Cyclic statistics of accidents was considered from position of process flight safety conception [19].

Complex calculations for trend algorithms for aircrafts of different types [4] were developed. Limits of dichotomic analysis at investigations of accident precondition during flight training, and methods of complex evaluation, were estimated [21].

The way to determine the first symptoms of aircrew factor resonance, which is a part of PADS [20] was developed.

Complex automatically extrapolator with functions of vertical velocity gradient measuring and steepness of the slope of the mountains with a scanning radio altimeter measuring [25] was developed.

Timely aircrew warning about danger leads to decrease the probability of PADS.

#### 4. Conclusions

Great researches in anti-stress human-operator training were developed by specialists of the Avionics Department of in last 25 years.

Operators training method of removing the negative effects connected with PADS, during flight, takes important place in anti-stress training.

It's necessary to provide further implementation of the above mentioned approaches to aviation training.

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Received 17 February 2014.

**Ю.В. Грищенко. Науково-дослідна робота з антистресової підготовки авіаспеціалістів за чверть віку**

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Виконано аналітичний огляд навчання людини-оператора протидії одночасному впливу негативних факторів. Основну увагу приділено навчання операторів зняття негативних ефектів у польоті, які пов'язані з явищем підсилення динамічного стереотипу у авіаспеціалістів.

**Ключові слова:** антистресова підготовка; виробництво польотів; засоби попередження; техніка пілотування, людський фактор.

**Ю. В. Грищенко. Научно-исследовательская работа по антистрессовой подготовке авиаспециалистов за четверть века**

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Выполнен аналитический обзор обучения человека-оператора противодействию одновременному воздействию негативных факторов. Основное внимание уделено снятию негативных эффектов в полете, которые связаны с явлением усиления динамического стереотипа у авиаспециалистов.

**Ключевые слова:** антистрессовая подготовка; производство полётов; средства предупреждения; техника пилотирования; человеческий фактор.

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