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V.I. Morzhov, Dr. Sci. (Eng.)

I.A. Zhukov, Dr. Sci. (Eng.)

MAIN DIRECTIONS IN THE DEVELOPMENT OF MODERN TECHNICAL MEANS OF INSTRUCTION FOR AIRCRAFT PILOT TRAINING

Institute of Information Science, NAU, e-mail: iit@nau.edu.ua

The analysis of main directions in the development and improvement of modern technical means of instruction for aircraft pilot training on the ground, presented in this paper, shows that computerization of the training process of aircraft pilots on the ground will provide: a reduction in the number of flight accidents and the causes of them in flight training, a greater safety guarantee for pilots in training, a reduction in training costs per crew member, crew members' full knowledge of aircraft piloting technology in both standard and emergency modes of flight, a reduction in aerodrome training flight load, etc. The paper shows that computerization of both the theoretical and practical aspects of ground pilot training plays an especially important role in resolving this problem. Concrete technological solutions for a computerized system for theoretical training, which allows the use of data touch input into an aircraft system model, the use of automated teaching systems are given in the paper.

Introduction

The increasing number of aircraft in Ukraine, both civil and military, having complex onboard equipment - that provides the quality of flight and flight safety, the conditions and modes of flight becoming more complicated, shorter time periods for decision making in emergencies - all these create extremely unfavorable conditions for pilots' activity and set forth new higher requirements to the training of aircraft crew members.

This is because crew functions in controlling modern aircraft constitute a complex process of receiving information about the aircraft's attitude in space, power plant and on-board equipment performance, outside visual and radar situation, as well as, the processing and transformation of the information received into correct motor actions to manipulate aircraft controls in accordance with decisions made in a coordinated manner, - all of this is to be performed in seconds, or even in fractions of a second.

Thus, the level of accountability of each aircraft crew member for actions undertaken increases considerably, as an error on the part of a crew member when performing even a simple operation can result in disrupting the steady operation of the whole "Crew - Aircraft" system and create an emergency that might jeopardize the safety of those on board.

The growing complexity of pilot activity onboard aircraft is also due to the recent persistent tendency pursued by designers of new aircraft to bring down the number of crew members to two.

All this results in sensory, emotional and intellectual stress.

The solution of this problem is seen by specialists to lie in both refining the process of appropriate se-

lection of future aircraft pilots from among the candidates, and in the improvement of the system of training of aircraft crews for working in both standard and emergency situations.

Recognized technical means of instruction, which provide solutions to the mentioned-above problems of aircraft pilot training on the ground, include different computerized pilot training systems.

On the whole, these means of training may be roughly divided into two groups:

- computerized systems for teaching theory to aircraft pilots, in particular - various electronic multimedia teaching aids, courseware, etc.;

- computerized teaching systems for practical pilot training, in particular - aviation simulators of various designs.

Computerized systems for teaching theory to aircraft pilots

While in the early days of aviation only physical flying was used to train pilots, as well as to maintain their skills in order, in present-day conditions, when aircraft are becoming more and more complex and the cost of an hour of in-flight training is on the rise, special emphasis is made on training pilots on the ground. This allows:

- reducing the number of flight accidents and the causes of them;

- guaranteeing the safety of pilots in training;

- reducing the cost of training per crew member;

- mastering the technology of aircraft piloting by crew members both in standard and emergency modes of flight;

- reducing the aerodrome training flight load.

Advances in the field of computer technology, computerization of advanced sectors of the country's na-

tional economy have resulted in radical changes in the methods of training of operators of various complex engineering systems (aircraft, atomic power plants, thermal power stations, etc.). The basis for such training methods is the concept of computerizing the training of operators of complex engineering systems.

This concept is based on the introduction of different computerized systems on a large scale. These means are used in the educational process for training and re-training aircraft pilots in both theory and practical skills.

Computerization of aircraft pilot training allows intensifying the teaching process through enhanced student activity, adapting the process of training to the student's individual abilities, visualization of information presented.

All this allows the teaching of what is really required in the practical work of every particular pilot.

However, it is possible to claim, that the problem of complex computerization of training, using high-performance computers, can not be resolved without achieving an organic conformity of the process of learning and training to the natural patterns of cognitive and sensor-motor activity of the human operator.

Modern computerized means for theoretical training of aircraft pilots are designed on the basis of high-performance computers with large random-access memory and external storage and are integrated in local area networks that make the basis of the computer-controlled system of training.

Personal computer (PC) application in theoretical training of pilots allows the use of automated teaching systems, multimedia manuals, systems of objective efficiency control of acquiring theoretical knowledge, and individual methods of aircraft pilot training.

All this should facilitate more efficient mastering of theory.

Computerization of theoretical training of aircraft pilots allows reducing the period of training significantly.

However, complex high-performance computerization of pilot training requires large financial expenditures and is intellectual labor intensive.

To solve this problem, it is necessary to use the principles of modular design in presenting aircraft system models to be used in the entire complex of information technology used in pilot training on the ground, based on unitized hardware and software.

A vivid example of such an instructional informational technologies (IT) means designed for teaching theory to aircraft pilots in the on-the-ground environment, which, nowadays, airlines are beginning to use on a large scale in their training centers, could be the general-purpose system of individual pilot training in theory using touch input of data, the design of which is shown in figure.

The hardware consists of:

- a high-performance PC with information tanks;
- a flat color video display (monitor) with a screen no smaller than 19 inches;
- a touch panel;
- an audio unit.

The software contains:

- an operating system;
- application programs dedicated to on-board equipment system models of a particular aircraft.

Such a system supplements the process of pilot training with multimedia information by particular aircraft system studied.

All necessary information relating to a particular aircraft system represented in the form of models (static and dynamic), video models of boards and panels of the system studied is copied from a compact disk onto the hard disk, where it is stored.

Video models of boards and panels of particular aircraft systems (for example, the fuel system) with instruments, indicators and controls are displayed on the screen of a color video display just the way they appear on physical panels in the cockpit.

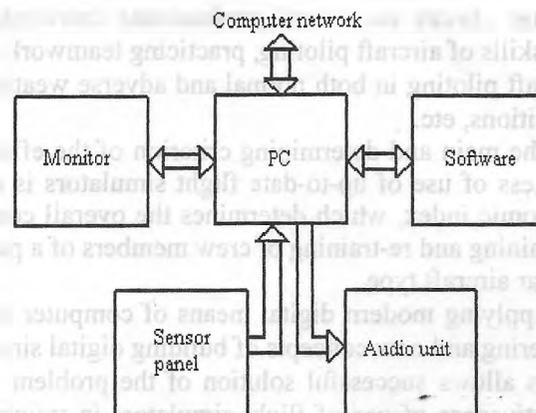
For a pilot, to input information about the state of an operating control into the PC, it is sufficient to touch the touch (lucid) panel where that control is shown on the screen.

Following that, the information of the control's state is fed into the PC, and, at the same time, the image of the control on the screen changes (a toggle switch changes its position, or a button lights up, etc.).

System function dynamics is monitored by changes in the reading of appropriate instruments (for example, fuel consumption indication, etc.).

If the operation of a real system is accompanied by an acoustic noise, a noise simulation can be put through the audio unit (loudspeakers with amplifiers).

Such a general-purpose system may be supplemented with a system of objective control to monitor the pilot's progress, which significantly improves the methodological capability of the system.



The structure of individual pilots' training

The modular principle of building such systems makes it possible to simplify their modernization as well as to raise their simulation capability, reduce the time required to develop new models of aircraft systems, improve their reliability, lower the training equipment operating costs, and lower the training equipment unit cost, when in serial production.

Due to the fact that system hardware is of serial computer production, and mathematical models of these systems, represented in the software, describe the on-board system operation, there appears an opportunity for the designers of these systems to license the functioning models, which would preclude any changes to system models without their permission.

Thus, information about physical properties and processes of a particular on-board aircraft system could be protected by software means, which would exclude unauthorized access to the system and facilitate, on the one hand, official distribution of such models and, on the other hand, provide the function of monitoring pilots' progress in training in accordance with the operating requirements of the on-board system, as defined by the aircraft flight manual.

Computerized systems for practical training of aircraft pilots

Computerized systems for practical training of aircraft pilots on the ground are intended for the development of operator skills in controlling an aircraft and its on-board systems. While being engaged in the operator activity, the aircraft pilot, by processing in-coming information, develops motor responses and, using the controls of appropriate systems, exercises the controlling effect.

At present, flight simulators of various designs are widely used in Ukraine's civil aviation.

A flight simulator is a technical means of instruction, by means of which actual aircraft flight conditions and the operation of aircraft on-board systems are simulated on the ground. Simulators are used for pilot training, improvement of piloting skills, training crew members to operate other types of aircraft, regular checks on crews' professional knowledge and skills of aircraft piloting, practicing teamwork in aircraft piloting in both normal and adverse weather conditions, etc.

The main and determining criterion of the effectiveness of use of up-to-date flight simulators is an economic index, which determines the overall costs of training and re-training of crew members of a particular aircraft type.

Applying modern digital means of computer engineering and new concepts of building digital simulators allows successful solution of the problem of effectiveness of use of flight simulators in training aircraft pilots on the ground.

New tendencies in creating and refining training IT, used by aviation enterprisers in Ukraine, which include the module principle of design, the conceptual unity of all links of the computerized aircraft pilot training, new information technologies for creating databases, knowledge, etc., provide high effectiveness of their use.

All this, as well as the lowering of the cost of pilot training and reducing the time needed for training, makes for the transfer of practicing interaction between pilot and aircraft on-board systems, envisaged in pilot training programs for a particular aircraft, from physical flights to training on the ground, i.e. to flight simulators.

In this connection, requirements to the accuracy of simulations of aircraft system physical processes, which are reproduced on the simulator, as well as - to the quality of simulation of all possible physical factors of flight (acoustic noise, visual situation in the outer space, etc.) are becoming more stringent.

In this connection, leading flight simulator firms are constantly improving not only the design, but also the dynamic and information characteristics of flight simulator imitators, which are to be adequate to the appropriate characteristics of the physical aircraft systems being simulated. The main directions along which present-day flight simulator technology is being improved are as follows.

1. Improvements in the module technology of building hardware and software for flight simulators of different types.

The development of flight simulator modules of multiple use allows significantly lower prime cost of flight simulators, shorter time for the development of flight simulators for aircraft of new types, better operating indicators, early putting flight simulators into operation.

In addition to this, the module design allows simple modernization of the existing flight simulators.

Adding-on to the equipment of such flight simulators, with the aim of extending their capabilities to simulate individual aircraft systems, is easily achieved.

Unification and standardization of modular flight simulator equipment require essentially lower costs of operation in working conditions.

2. The introduction of a unified technology of pilot training systems, in accordance with which - for one type of aircraft a uniform theoretical and practical pilot training system should be developed. This includes flight simulators (complex, specialized, etc.), electronic multimedia teaching aids, teaching programs, a system of individual theoretical pilot training with data touch input, etc. All these engi-

neering means are developed on the basis of unified module technology.

3. Improvement of simulation of physical factors of aircraft flight, which play an important role in creating the psycho-physiological mood of a pilot in the aircraft cockpit. Essential flight simulator imitators include:

- the imitator of visual situation of the space outside the aircraft;
- the imitator of aircraft overloads.

4. Improvement of methodological capabilities of training systems for theoretical and practical aircraft pilot training, which include systems of objective control of the process of pilot training using flight simulators, different teaching programs, an electronic instructor, which is necessary for independent training sessions on flight simulators, etc.

Thus, computerization of aircraft pilot training on the ground allows achieving not only better educational process outcomes, but also securing safer training at different stages, as well as bringing down the costs of training.

В.І. Моржов, І.А. Жуков

Основні напрями розвитку сучасних технічних засобів підготовки пілотів повітряних суден

Показано, що вдосконалення методів і технічних засобів для навчання і тренування пілотів у наземних умовах не тільки буде сприяти забезпеченню безпеки процесу навчання, але й суттєво знизить вартість підготовки кожного члена екіпажу повітряного судна. Установлено, що важливу роль у вирішенні цієї проблеми відіграє комп'ютеризація технічних засобів як для теоретичної, так і для практичної наземної підготовки пілотів, що суттєво поліпшує якість навчального процесу. Розглянуто конкретні технічні рішення комп'ютеризованих технічних засобів для теоретичної підготовки пілотів повітряних суден.

В.И. Моржов, И.А. Жуков

Основные направления развития современных технических средств для подготовки пилотов воздушных судов

Показано, что совершенствование методов и технических средств для обучения и тренировки пилотов в наземных условиях будет не только способствовать обеспечению безопасности процесса обучения, но и существенно снизит стоимость подготовки каждого члена экипажа воздушного судна. Установлено, что особую роль в решении этой проблемы играет компьютеризация технических средств как для теоретической, так и для практической наземной подготовки пилотов, что существенно улучшает качество учебного процесса. Рассмотрены конкретные технические решения компьютеризованных технических средств для теоретической подготовки пилотов воздушных судов.

It is these factors that explain the steady tendency to computerize the theoretical and practical training of aircraft pilots in all units of civil aviation of Ukraine that are engaged in the training and qualifications control of aircraft pilots.

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