MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL AVIATION UNIVERSITY
FACULTY OF AIR NAVIGATION, ELECTRONICS AND TELECOMMUNICATIONS

Abstracts of
the XXth International
conference of higher education students
and young scientists

POLIT.
CHALLENGES OF SCIENCE TODAY

AIR NAVIGATION. ELECTRONICS.
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CONTENT

AUTOMATED CONTROL SYSTEMS FOR TECHNOLOGICAL PROCESSES AND MOVABLE OBJECTS

LASER BEAM AUTOMATED DRONE CONTROL SYSTEM

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Aircraft in structural design can be divided into pilot-controlled and unmanned aerial vehicles. In turn, they are divided into symmetrical relative to the longitudinal vertical plane and symmetric to the longitudinal vertical and horizontal planes. Unmanned aerial vehicles - drones that are symmetrical about the longitudinal vertical and horizontal planes can rotate around or along the longitudinal axis.

Analysis of the literature showed that the most studied, described and researched symmetrical pilot-controlled aircraft are by far the most studied. The study of symmetrical drones rotating about an axis has received less attention.

The efficiency of the use of drones depends largely on the quality of operation of their control systems.

In the general case, the quality of the control systems is determined by the accuracy of the drone retention on the flight line, ie their ability to maintain an adjustable value at a given level.

The transmission of information to the drone can be done by wire, radio or laser beam.

During the work the author was:

- a mathematical model of symmetric in two planes of the drone was created as an object of control, and a structural diagram of its automated control system was constructed;
- it is proposed to use a single-channel system for transmitting information when controlling the drone;
- Functional diagram of the onboard drone equipment has been defined;synthesized devices for generating laser beam commands and a program for generating control pulse-width modulated pulses;
- it is proposed to introduce into the control system a parallel correction device, which leads to the improvement of the control system in terms of quality and stability;
- software for automated synthesis using standard transient response methods has been developed.

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HELICOPTER ACTIVE CONTROL SYSTEM

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The questions of contour construction of helicopter automated control based on the principles of active control systems with compensation of cross influence of separate control channels are considered.

Introduction. In a helicopter single-screw scheme, the main control is a helicopter rotor. It creates lift and thrust for forward movement, as well as all the steering forces and moments except the yaw. The helicopter rotor causes the helicopter to have, in contrast to the aircraft, strong interrelationships between lateral and longitudinal movements, as well as between angular motions and center of gravity movements.

Formulation on the problem. In order to improve the operating conditions of the pilot in the control circuit, it is proposed to build a system of automatic control of the helicopter based on the principles of active control systems, ie systems that improve the pilot characteristics of the control object. Such approaches to the construction of circuits for automatic control of aircraft, in particular, using the ideas of direct control of aerodynamic forces are now intensively put into practice when creating models of pilot-navigation equipment of perspective aircraft. But for helicopters this task was not stated.

Problem solving. In order to decide whether cross-links between control channels are appropriate, it is necessary to examine the effect of the individual components of the helicopter's mathematical model on the processes of working out the specified flight parameters when operating and off stabilization circuits. For the helicopter, some flight modes may be investigated on the basis of isolated longitudinal and lateral motion models, from which the vertical velocity channel, the longitudinal and lateral channels and the yaw channel can be further separated.

The procedure for the synthesis of cross-link compensation circuits involves a preliminary analysis of the usefulness and harmfulness of these links. In particular, the effect of changes in flight velocity Vx and vertical velocity Vu on the pitch stabilization contour is undesirable; For example, an increase in flight speed naturally causes an increase in vertical speed, sometimes used in piloting.

The proposed system of active control of the helicopter with compensation for the relationship between lateral and longitudinal motion, as well as between angular motions and movement of the center of mass dramatically changes the operating conditions of the pilot in the control circuit. The work of the pilot in the synthesized circuit of automated control is greatly facilitated and reduced to the control of isolated aperiodic units..

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NON-LINEAR SPACECRAFT STABILIZATION SYSTEM

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Stabilization and control systems play an important role in the automation of complexes of inertial object control. Currently, there is a whole class of automatic systems for stabilization and control of inertial objects, such as aircraft, spacecraft, ships, submarines. A detailed study of these systems allows us to conclude that they are not linear.

During the development of the theory of automatic control different mathematical methods of analysis and synthesis of nonlinear systems have been developed, each of which can be applied only to a certain class of systems and tasks. Therefore, there are no universal analytical ametodes for the study of nonlinear systems.

Feature of nonlinear systems is the possibility of occurrence of boundary cycles in them - non-attenuating oscillations whose amplitude does not depend on external influence and initial conditions, and their frequency is subharmonic or harmonic of the input signal.

In the work a mathematical model of a nonlinear system of stabilization and control of the spacecraft was developed. It made it possible to set the parameters of a possible limit cycle of the system and to synthesize the proportional part of the controller to eliminate the likelihood of such cycles occurring.

Descriptive function method is used as a method of research in the work.

Descriptive function method is used as a method of research in the work. The simulation of the stabilization and control system with different types of regulators made it possible to carry out a comparative evaluation of industrial regulators. To improve the properties of the subregulator, it is proposed to introduce a nonlinear correction system.

The conducted studies have concluded that the optimal regulator for the nonlinear stabilization and control system of the spacecraft in terms of the quality of control and exclusion of the probability of occurrence of the apparatus in terms of control quality and exclusion of the probability of occurrence of self-oscillations is the PD-controller with the proposed system of nonlinear roots.

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SYSTEM OF AUTOMATIC EVALUATION OF PARAMETERS OF LED LAMPS

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LEDs everywhere are replaced by incandescent bulbs because they are energy efficient and durable. But often buyers bypass these "LEDs" side, because they can not understand their marking. Technical characteristics of LED lamps are more varied - earlier it was enough to choose power in Watts, and with new sources of artificial light it is somewhat more complicated. There are a number of parameters to consider in order to find the best option.

According to many sources of information in the world is constantly increasing energy consumption. At the same time, its share due to lighting continues to be high and is at the level of 14-20%. In this regard, the problem of energy conservation remains relevant in lighting. Great opportunities for reducing energy consumption lie in the use of LED lighting. However, their quality control is still not high enough. Usually it is carried out on separate parameters, while complex analysis with the involvement of the appropriate measuring complex will allow to give an objective assessment of the quality of lighting products.

To speed up and improve the accuracy of the LED lamp quality assessment process, a measurement complex was developed that includes meters of power consumption, color temperature, luminous flux, ripple ratio, and color transmittance (CRI). After making the necessary measurements, the complex allows for a general assessment of the quality of the lamp or an automatic comparison of its real characteristics with the declared manufacturer.

The final assessment speaks first of all about quality of light. The idea behind the formula is: Excellent (grade 5) lamp should have a CRI of at least 90 and a ripple of not more than 5%. A good (grade 4.5) lamp should have a CRI of at least 80 and a ripple of not more than 20%. The average (grade 3.5) lamp must have a CRI of at least 70 and a ripple of not more than 35%. Due to the discrepancy between the measured light flux and the declared color temperature of the declared, the final score is reduced, but in general, a lamp with CRI 70 will not be able to have a higher rating than a lamp with CRI 80.

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TUNING AND CALIBRATION OF A MICROMECHANICAL STRAPDOWN INERTIAL NAVIGATION SYSTEM

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The algorithms of tuning, calibration and information processing of the block of micromechanical inertial sensors for unmanned aerial vehicles with catapult start are considered.

Introduction. Setting mode is one of the main modes of operation of any inertial system. In azimuth, an accelerated SINS setting must be made according to the course sensor information. The process of tuning SINS in the horizon is usually performed by the UAV body or accelerometer signals. However, tuning the SINS on signals not calibrated with coarse MEMS accelerometers can lead to large errors in the horizontal procedure.

Formulation on the problem. The article proposes to configure the UAV SINS to perform according to the information from the launch catapult equipment, based on the magnetometer and the SNA UAV receiver. A specialized start control module installed on the catapult, in addition to calculating the starting parameters and checking all UAV systems, also provides the process of pre-launch setup BINS UAV. The apparatus providing the tuning process must include: satellite satellite navigation systems with spaced antennas and a vertical standard constructed on high-precision gyroscopes or accelerometers.

Problem solving. In contrast to the SINS setting in flight, the setting on the start catapult is much simplified because there is no movement of the base and there is accurate information about the UAV's position relative to the start catapult. In the initial tuning process, the parameters characterizing the mutual orientation of the U-axis triangular and the triangular navigation in the initial tuning process must be calculated. As a navigation, it is convenient to choose a trihedron whose axes are directed along the axes of a geographical triangular. In the initial setup process, the guide cosine matrix between the connected axes and the axes of the navigation triangles is calculated.

The adjustment procedure in the horizon is to transfer the information about the angles of roll and pitch of the base of the catapult (taking into account the angle of inclination of the starting strip to the horizon) in the SINS calculator. For azimuthal tuning, information is used on the position of the catapult, which is formed by the multi-antenna catapult receiving apparatus and the SINS magnetometer.**».**

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DIGITAL CONTROL SYSTEM OF THE COURSE OF A SHIP

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In the current context the persist trends that grow the part of digital methods of transformation, processing, transmit and saving information in all spheres of human activity, there are change generation of technical means of Information processing and information transmit.

Control automation system(CAS) in structure where using digital devices, controllers, microprocessor, ECM are discrete.

The development of discrete system due to growing construct, operational and metrological requirements to control. Discrete system allow to ensure high control accuracy there is no zero drift and it have highest interference protection and stability to disturbance and also have less dimensions and weights. The control law in discrete systems realized by program, that gives rebuild regulator parameters quickly and structure if it need to be.

The control modern theory has universal method that discover discrete systems at the disposal, founded by using special mathematic apparat that names – Laplase discrete transformation. At the same time calculation and projection discrete systems are require more carefully development of control algorithm and correct selection of hardware for their implementation, creating own command system and architecture of calculation devices, programming software development.

Projection and calculation of discrete control system include the mathematic creation model of self-driving system, analysis quality and resistance of system functioning and their synthesize. This could be based on a linear model of self-driving system. Since the value of the discrete system is not defined at the time points, the correct transition to discrete form include selection of quantum interval according to the Nyquist–Shannon theorem. For transitioning to z-transformation usually used special tables. Not usually can use tables according to difficult some transfer functions, so Modern systems and process numerical modellingprogrammes helping.

Author was advised design and research apparatus of self-driving system based on software packages Matlab + Simulink i Mathcad. Shown the methodic analysis and synthesis the discrete control system of the course of a ship.

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AEROSPACE CONTROL SYSTEMS AND ROBOTICS

MULTIFUNCTIONAL MULTICOPTER DESIGN

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Recently unmanned aerial vehicles (UAV) are very popular and used in many different areas. Especially, application of multicopoter type UAVs is very actual nowdays. Multicopters are used for soil study, rescue operations, military intelligence. Also, they can be used to deliver small loads or to shoot landscapes and architecture. The purpose of this work is multifunctional multicopter design, which is capable to perform the following basic flight modes:

1. Stabilize.The roll and pitch axis are stabilized with the help of gyroscope and accelerometer.
2. AltHold (Altitude Hold Mode). A barometer, which helps to maintain altitude by air pressure, is added in this mode.
3. Land is an automatic landing mode in the current position. A barometer is used to control altitude in this mode.
4. Loiter holds altitude and position with help of barometer and GPS module.
5. RTL (Return To Launch) returns to the take-off point. The controller remembers the point where Arming was produced and allows multicopter to return to this point.
6. Auto executes pre-defined mission. It allows UAV to follow waypointsthat are program defined.
7. Failsafe-rescue mode returns the UAV to the take-off position. For example, in the case if transmitter signal is lost [1].

To solve this problem we need to choice right flight controller. Not every controller can work in these modes. Relatively inexpensive open source module is ArduCopter (APM 2.6) controller, which supports all the specified flight modes. Flight controller is presented in Fig 1.1.

Fig 1.1 ArduCopter flight controller

Open source is very important, because we can change source code if we need to use additional modules or if we need to change flights modes algorithms. APM includes:

1. MPU-6000 – MEMS 3 axis gyroscope/accelerometer.
2. Microcontroller ATmega32U2 to perform functions of PPM encoder and USB interface.
3. Barometric sensor MS5611 for holding the height.
4. 4 MB of flash memory for recording of flight data (flight logs maintaining).
5. ATmega2560 microcontroller for flight control.

Also multicopter is equipped with four electric motors for provision of flight thrust. The speed of rotation of each individual motor is regulated with the help of ESC (Electronic Speed Controller). APM regulates ESCs with the help of pulse-width modulation. To command the motor to rotate at maximum speed, the controller must send pulses of 2 milliseconds duration, alternating with a logical zero of 10 to 20 milliseconds duration. Pulse duration in 1 millisecond corresponds to a motor stop, 1.1 ms - 10% of the maximum speed, 1.2 ms - 20% [2].

As a result, we have multifunctional multicopter for a wide range of tasks. Also, it always can be upgraded if we need some additional modules or specific flight modes.The multicopter is presented in Fig. 1.2.

Fig. 1.2. Multicopter based on APM 2.6

Like a slight improvement,telemetry module will be added to this model. With the help of which it will be possible to create flight missions on the go, right during the flight using just a smartphone.

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SOME WAY HOW TO IMPROVE THE ACCURACY OF THE FIBER-OPTICAL GYROSCOPE (FOG)

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Naukovy kerivnik - Yurchenko O.M., Assistant

The prospect of a cheap optical wraparound sensor in the United Kingdom, such a healthy solution without the need for mercy at the international control system, is one of the main reasons for the special interest in VOG. The interests of the right and wrong way to VOG are based on the potentialities of capturing the sensitive element of the wrapping in the navigation systems, control and stability. You can find the accessories at the front of the house in order to replace the folding electrical and rotary gyroscopes and three-dimensionally stable platforms. A fiber-optic gyroscope can be sewn up so that it is tightly fastened to the nose housing a sensitive element (sensor) wrapped in the internal control and stability systems. Mechanical gyroscopes may be so called bribes, which especially show up strongly when maneuvering a nose (a small device, a rocket, a space device, and a skinny).

he task is represented by robots є analysis of VOG robots, identification of the causes and reasons for the errors and instabilities of the VOG robots, as well as vibration and functionality, I will attach. For the visualization of Jerel Vinnikenny noise and the instability of VOG, having carried out a detailed analysis of all the elements of the system. The robot accentuates respect for the Jerel of the noise of the electronic part of the VOG, as well as for the noblemen of compensation. On the electronic part of the VOG, as a jerel noise, the photo detectors and the front cascade of the electrical signal are clearly visible. Having analyzed the characteristics of the noise in the podsilyuyuchy cascade of the bulo, the boundary sensitivity of the VOG yak dorivnyu (10 (-4) degrees / year.) Is calculated. to compensate for noise in the cascade of noise, to analyze more clearly the methods of compensating for such noise.

As a rule, it is possible to say that the protected hats are compensated for noise and instability in the VOG robot, the element base for the active part of the VOG is also protected, there are more than two possible variations in the accuracy of this system.

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TWO COMPONENT LASER DOPPLER VELOCIMETER

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Laser Doppler velocimeters (LDV) [1] have the wide application for measurement of aerodynamic flows/

Using the laser diode, photodiode, and optic elements with small dimensions and mass in LDV structure gives the possibility to apply LDV.LDV can be applied also for experimental tests of aircraft constructions in the wind tunnel.

The structure of LDVis represented in Fig. 1.This LDV uses the diaphragm with two holes instead of the beam splitter to exclude influence of low coherence ratio of the laser diode.

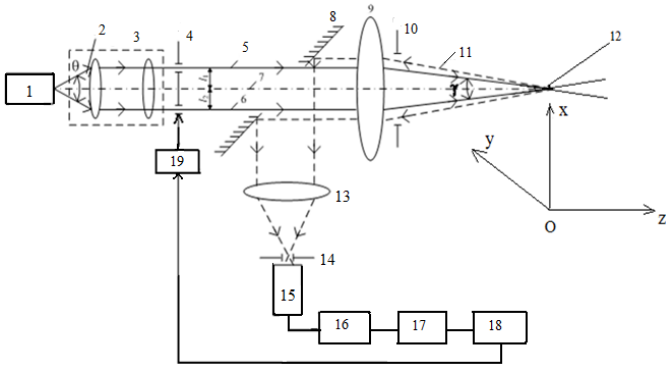

Fig.1. The structure of the airborne LDV.

Structure of LDV, which uses the laser diode with the low degree of coherence, is protected by the patent [2].

Such an instrument for measuring speed operates in the following way. Radiation 2 of the laser diode 1, which diverges under the angle θ, is directed to the collimator 3, where it is converted in the parallel bundle of beams. Further, two laser beams 5 and 6 are picked out by means of diaphragm 4 with two round holes. The holes on the diaphragm 4(Fig.2a) are located at different distances l_1 and l_2 from the optical axis of the device 7. This is done to provide passing different distances by the laser beams 5 and 6. Difference of distances $\Delta = l_1 - l_2$ should not exceed a length of radiation coherence of the laser diode. In this case, they will interfere in the region of their crossing (in the measuring capacity). Diameters of holes in the diaphragm are the same $d = d_1 = d_2$.

Then, the laser beams 5 and 6 by means of the objective 9 are focused in the volume of measuring speed 12. This is explained in the following way. The difference

of distances, through which laser beams 5 and 6 are passing, is low $\Delta L \geq \lambda$, where λ is a length of the wave of laser radiation.

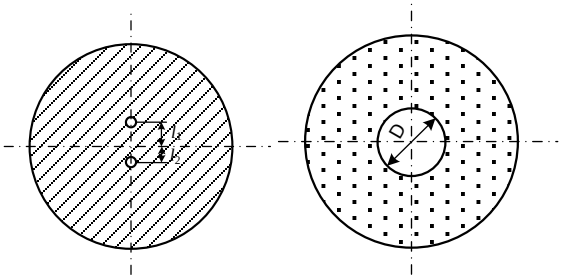

Fig.2 Shapes of the diaphragm 4 (2a) and the mirror 8 (2b).

Radiation 11 scattered by aerosols, which are located in the measuring volume 12, is collecting in the region of the aperture diaphragm 10 by the objective 9. Further, this radiation is reflected from the mirror 8. The mirror 8 has a hole(Fig. 2b) with the diameter $\Delta D > (l_1 + l_2)$.

The scattered radiation 11 reflected from the mirror is collected by the objective 13 and directed to the avalanche photodiode 15. The diaphragm 14 mounted in front of the photodiode decreases influence of the residual radiation on the Doppler signal.

The frequency of the Doppler signal, which is formed on the photodetector output, is proportional to V_x, component of the vector of the flying UAV speed

$$f_{dx} = \frac{2V_x}{\lambda} \sin[arctg(\frac{l_1}{f}) + arctg(\frac{l_2}{f})].$$

where f is the focal distance of the objective 9.

Further, the signal from the photodiode is amplified by the wide-band amplifier16 and enters to Analog-to-Digital Converter (ADC) 17. The output signal of ADC enters to airborne processor 18, which calculates the value V_x of the componenet of the speed vector.

To measure the component of the flight speed vector V_y, the processor produces a command on the execution unit 19. This unit rotates the diapragm 4 on 90^o. Based on radiation of the laser diode 1, the diaphragm forms two new laser beams. These beams will be located in the plane Oyz, which is perpendicular to the plane Oxz. In this case, aerosols will cross the interference fringes parallel to axis Oy. Measuring of speed vector component V_y is implemented in the similar way.

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KEYBOARD SPIES AND THEIR APPLICATION

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A keylogger is a tool designed to intercept all keystrokes on a computer keyboard through a program or through a hardware device. This keyboard recording activity is also called keystroke logging.

The key idea of the keylogger is to be embedded between any two links in the signal chain from the user pressing the keys on the keyboard to the appearance of characters on the screen - it can be video surveillance, hardware "bugs" in the keyboard, on the wire or in the system block computer, interception of I / O requests, replacement of the system driver of the keyboard, driver-filter in the keyboard stack, interception of kernel functions in any way, interception of DLL functions in a custom mode or experience ing a standard keyboard documented way.

However, practice has shown that the more complex the approach, the less likely it is to be used in widespread programs and more likely to be used to steal corporate financial information.

All keyloggers can be divided into hardware and software. The former are small devices that can be attached to a keyboard, a wire, or to a computer system unit. The second is a specially written program designed to keep track of keystrokes on the keyboard and to log keystrokes.

Recently, there has been a tendency for keyloggers to use methods of hiding (masking) their files - so that they cannot be found manually or using an antivirus scanner. Such methods are commonly called rootkit technologies. There are two main types of concealment technologies used by keyloggers:

• using the UserMode mode;

• Using the operating system kernel mode (KernelMode) hiding methods.

Legitimate computer keyboard interception programs can have a key lock function that can be used to call certain software functions using hotkeys or to switch between keyboard layouts. There are many programs designed to allow administrators to track what employees do throughout the day, or to allow users to track the third-party activity on their computers. However, the boundary between justified monitoring and espionage is blurred. Legal software is often used intentionally to steal sensitive user information such as passwords.

In order to minimize the undesirable effects of keyloggers, the following practices can be identified and detected:

1) control of the distribution of resources, processes and data;

2) constant updating of protection against antiviruses and anti-rootkits;

3) use of software against keyloggers;

4) disabling self-running files on external devices;

5) use of password policy.

MATHEMATICAL MODEL OF THE AIRCRAFT

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Mathematical model - a mathematical representation of reality, one of the variants of the model as a system, the study of which allows to obtain information about some other system. The mathematical model is intended to predict the behavior of a real object, but there is always a degree of its idealization.

Where does the mathematical model of the aircraft come from? Not from the theory of control, but from aerodynamics and similar related sciences. Because over many years of design in aviation, a certain formalized basis of mathematical models of aircraft has developed in the form of a certain system of differential equations. This system has proven its worth, and experts in control theory can only "bind" a particular aircraft to this base, with minimal changes, if possible. This method significantly cuts off the subjectivity of designers.

What are the further ways of formalizing the problem situation? Let us turn again to the model aircraft. The differential equation system mentioned above is usually written in the so-called normal Cauchy form:

$$\frac{dx}{dt} = F(x,u), \quad (1.1)$$

where x is the vector of plane states, the vector of controls, F is a function, t is time. The coordinates of the state vector are selected variables that determine the position of the aircraft at the current time, for example, x1 is the flight distance or the first vector coordinate x, x_2 is the horizontal flight speed or the second vector coordinate x, x_3 is the altitude, x_4 is the vertical speed, x_5 - course, x_6 is the slope of the trajectory, x_7 is the angle of inclination of the aircraft relative to its center of mass and other variables. Typically, the coordinates of the control vector are u_1 - the steering angle, u_2 - the steering angle, u_3 - the aileron, u_4 - the thrust and other controls. The system of equations (1) can also be written in scalar form

$$\frac{dx_1}{dt} = F_1(x,u),$$
$$\frac{dx_2}{dt} = F_2(x,u), \quad (1.2)$$
$$\ldots\ldots\ldots\ldots\ldots\ldots$$
$$\frac{dx_n}{dt} = F_n(x,u),$$

where n is the order of the system.

The solution of each equation (1.2) gives some elementary motion. Their totality characterizes the complex dynamics of the entire aircraft. The number n equations can reach 200 when describing not only the motion of the center of mass of the aircraft, but also the movement around the center of mass in three-dimensional

space, the rigidity of the wings of the aircraft, fuel consumption, change of position of the center of mass and other movements.

If we go to the model of inventive problems, the question arises, what can be such elementary movements, the totality of which determines the problem situation?

In my opinion, such elementary movements can be contradictions, and each i-th equation of system (1.2) will describe the development of the i-th contradiction by coordinating xi (t), i = 1,2, .. n. Then the whole system (1.2) should mathematically simulate the initial problem situation of our problem.

We can assume that the mathematical model may be quite complex. For example, it is very difficult to analyze a system of two hundred differential equations, and to develop an autopilot, for example, is simply impossible. Therefore, the system of equations is decomposed. To do this, allocate some trajectory, direction, and consider the movement related only to this direction.

For example, taxiing an airplane along the center line of the runway can in the simplest case be described by just two equations of type (2): one for the speed of movement, and the other for the speed of change of speed, i.e. acceleration.

Flight in three-dimensional space is often divided into two types of movement: longitudinal - in the vertical plane, and transverse - in the horizontal. For example, the trajectory of landing in the longitudinal plane can be described by a system of only 4 equations, etc.

In conclusion, we can say that the construction of mathematical models for aircraft is extremely relevant in our time as aerospace technologies are advancing. Despite all the complexity, describing each factor by an individual equation, using computer systems can significantly simplify the task.

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THE USE OF VARIOUS TYPES OF DYNAMIC SYSTEMS REVERSIBILITY FOR DATA PROTECTION IN INFORMATION SYSTEMS

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In the last decade in information processing tasks, in particular of its cryptographic protection, ideas and methods of the theory of dynamic systems are increasingly used. The authors proposed an approach to constructing ciphers based on reversible dynamic systems with complex behavior with a transition, when they are computerized, to finite dynamic systems - automaton analogues of the above systems. The latter are described by systems of equations over finite rings or fields. In the report various types of reversibility of such systems and their possible application in information security problems are considered.

The first type is reversible output systems. Here, an autonomous chaotic system is taken, which is converted into a reversible controlled system by introducing input variables and functions from them into the equations, as well as synthesizing new equations that describe the outputs of the system. Thus, a class of systems that are invertible in behavior and defined by parametrized equations is constructed. Any such system from this family forms a stream symmetric cipher - a converter of the input (open) information that goes to the input of the system to the output (closed, encrypted). The system key and its initial state are used as the secret key. Its recipient converts the received ciphertext to the original using the reverse system.

The second type is system state reversible. The above-mentioned automaton analogues are considered as systems without an output and are selected so that they are group, i.e. those for which, from the final state into which the system went under the influence of a known input sequence, it is possible to restore the initial state. In this case, the system is not parameterized, the secret key is a pre-selected input sequence, and encryption is carried out by blocks that specify the state of the system. The data block is considered as the initial state of the system, which is converted into encrypted text - the state that the system will go into under the influence of the key. The system is reversible and, thus, can be considered as a block cipher.

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MODERN PROBLEMS OF USE OF UAV IN THE LAND

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Now, scientific and technological progress constantly gives new methods of solving geodetic problems. Therefore, to facilitate your work, improve the quality and accuracy of the data obtained, you need to know the capabilities of the latest developments in the field of modern devices. One of the best and most innovative tools used in geodetic surveys is drones. Drones allow you to get data faster and with fewer resources [1].

Areas of UAV use are quite broad - emergency forecasting, border control, road monitoring, atmospheric and meteorological observations, prevention of unauthorized deforestation, land management and topographic surveys.

The use of drones in surveys, cadastre and land management offers great prospects. Drones can be used in the dark, at some distances, in automatic shooting mode or under human control. The time spent on camel processing has decreased due to full software processing.

Flying along a given route, you can get accurate and reliable photos and videos about the terrain features that the study needs. Obtained data from the drone is processed in specialized software. Thanks to the data obtained, you can develop topographic, digital and orthophotos. It is possible to study the terrain of interest, and to develop the design of construction with consideration of rational use and environmental protection, to predict changes in the natural environment of the site under the influence of construction and operation of enterprises. To fulfill these tasks qualitatively, it is necessary to optimize the technological schemes of UAV applications in aerial photography.

Conducting land surveys using UAVs are cost-effective due to the speed of collecting geodetic data from a large surface area, up to 200 hectares per working day. Modern software in the presence of appropriate computing equipment in 24 hours processes the collected data 100 ha using UAV. We get an actual orthophoto plan of the terrain [2].

One of the problems with the use of UAVs in the field of land management is an imperfect legal framework. UAVs are subject to the regulation of the following regulations: Air Code of Ukraine, Rules for the registration of civil aircraft in Ukraine, Regulations on the use of Ukrainian airspace, Aircraft flight rules, and air traffic services in Ukraine's classified airspace. "Unmanned aerial vehicle" designed to be operated without a pilot on board, the operation of which is controlled by a dedicated control station located outside the aircraft [3].

Such UAVs must be on the Civil Aviation Register of Ukraine. However, UAVs whose maximum take-off weight does not exceed 20 kilograms and which are used for entertainment and sports activities do not require registration. There is no

restriction on the use of drones in cities for personal needs, except in strategically important state-restricted areas.

Registered UAVs are prohibited from flying in certain areas, such as protected (government buildings, industrial facilities), restricted access (military, border control, research stations, etc.) or reserved for other aircraft. Users interested in specific areas should submit a request to the State Air Traffic Services Enterprise of Ukraine.

The inherent problems and aspects when regulating drones are used. Today, flying over cars, people and during mass events is not prohibited. Moreover, drones are considered dual-use items. Any imported drones or locally produced; drones will be tested for military capabilities.

The next problem is privacy. Nowadays, privacy has a low level of certainty and security, given state security cameras, mobile photos and videos, online streaming, but drones have even more power [4].

Data collection and processing leads to the conclusion that the boundary between surveillance and privacy is currently unclear. Accordingly, at least from the technical and legal side, special rules of regulation should be adopted for the storage and deletion of information processed by drones. Public authorities should provide request and removal programs that respond to citizens' messages and retain information for no longer than is usually necessary.

Based on the analysis of trends in the use of UAVs and directions of their further development, it can be argued that the use of unmanned aerial vehicles is promising for land surveying. Their implementation is rapidly developing and they occupy a worthy place in aerial lifting processes.

But besides the positive sides, some factors hold back the prospect of using UAVs to accomplish tasks; The issues of registration, technical requirements and operating conditions of the equipment remain unresolved.

Given the above, it is possible to identify the main areas of improvement of land surveying using UAV:

-legislative regulation of land surveying using UAV;

-improvement of structures and technical equipment of UAVs;

- synchronization of the processed data with electronic inventories.

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AIR NAVIGATION

RISK ASSESSMENT CRITERIA IN SAFETY MANAGEMENT SYSTEM

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According to the statistics for the last decade on aviation events, the issues of ensuring the guaranteed level of flight safety are the most urgent, since the shortcomings and problems in the functioning of aviation activity are explained by the lack of a theoretical basis and generally accepted scientifically-grounded approaches to flight safety management. , which stipulates that no region should have more than twice the frequency of aviation events worldwide. These are the main directions:

- introduction of an acceptable level of flight safety in the country;
- mandatory procedures for the development and implementation of a flight safety management system;

Mandatory procedures to ensure the immediate management of the level of flight safety within an acceptable or established level (continuous monitoring and regular assessment of flight safety, corrective actions necessary to maintain agreed flight safety indicators, oversight of flight safety indicators, analysis of flight information, risk management of aviation events, etc.)

The similarity of the nature of the occurrence of risks and the increased relevance of their reduction to an acceptable level for various critical applications necessitates the creation of appropriate risk assessment criteria to ensure and maintain a guaranteed level of flight safety. The purpose of the methodology is to integrate into a single set of tasks the evaluation, maintenance and verification of the safety of AD, as a complex hierarchical structure with independent critical elements, as well as hardware, software, network and ergatic components, which are both a means and a security object. .

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PROCEDURE OF IMPLEMENTATION OF ARRIVAL AND DEPARTURE MANAGER SYSTEMS IN UKRAINIAN AIRSPACE

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1. Introduction

Nowadays, with continuous growing of air traffic, it is necessary to find solutions how to control the big air flow in more effective way. One of the solutions is the “Arrival Manager” (AMAN) and “Departure Manager” (DMAN), systemswhich arrange arrivals and departures more safely and effectively.

2. AMAN

The AMAN helps to air traffic controllers to create sequence of arrival flights at a given portion of airspace. AMAN distributes the workload by improving coordination between Area Control Center (ACC) and Approach Control Center (APP) and between sectors in ACC and between APP and Tower (TWR). AMAN provides a list of sequenced arrivals (Arrival Sequencing List - ASL) in order to ensure a safe separation between two successive landings on a constraint point (Initial Approach Fix (IAF), aerodrome or runway) and ensures optimum runways utilization and the quickest landing time for aircraft [1].

AMAN benefits:

- Approach planning for defining the approach sequence for the entire area of responsibility of an airport;
- Arrival management for calculating precisely timed approach paths based on the definitions generated by approach planning, from the point where aircraft enter the planning area to the runway threshold;
- Approach monitoring for continuous monitoring of separation between all aircraft in the terminal control area and compliance with the planned 4D approach paths;

3. DMAN

The DMAN tool takes into account the scheduled departure time, slot constraints, runway constraints and airport factors [2]. In such a way, it improves traffic predictability, cost efficiency and environmental protection, as well as safety. By taking into consideration information such as the aircraft’s preparedness to leave its parking position, runway capacity and slot constraints, tower controllers can optimize the pre-departure sequence.In order to build sequences, DMAN needs access to accurate information about the status of individual flights and airport units work done from different systems. Integration of DMAN with AMAN enables the mutual coordination of departure and arrival flows. In such a way, traffic flows smoothly directed to the runways and en-route phase of flight [3].

DMAN benefits:

- Improved predictability and stability of departure sequence, start-up approval time and off-time blocks;
- Enhanced tactical runway scheduling;
- Significant reduction in fuel burn and CO_2 emissions [4].

4. AMAN and DMAN implementation status in Ukraine

As Ukraine is the member of European organization of safety of air navigation EUROCONTROL, it should meet the requirements of this organization. EUROCONTROL implements the Single European Sky ATM Research (SESAR) program, which foresees the advanced use of European airspace and implementation of different systems and procedures, which will support this program. Therefore, installation of AMAN and DMAN systems in Ukrainian airspace is obligatory requirement within the framework of European ATM Master Plan, which will bring the following advantages:

- increased airspace and airport capacity;
- reduced time of holding procedures and number of holdings in terminal control areas;

In the near future, Ukraine expects an increase of traffic volumes, and these systems will help to manage traffic demands quite efficiently and flexibly.

5. Conclusions

Decisions of DMAN and AMAN are not compulsory for ATCU. They may be omitted by ATCU in case of emergency traffic and unusual situations. Therefore, AMAN and DMAN systems are such supplementary tool which helps to ATCU provide runway and airspace capacity through the creation of departure and arrival sequence.Installation of AMAN and DMAN systems is nowadays requirement for all modern ANSs thoughout the world. Therefore, implementation of these systems is a big necessity for Ukraine in order to correspond to progressive States in the field of air navigation.

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THE USAGE OF UAVS FOR THE DELIVERY OF GOODS IN AN URBAN ENVIRONMENT FOR CIVIL PURPOSES DUE TO THE CORONAVIRUS PANDEMIC

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The idea of using drones for the commercial delivery of goods has been waiting for its implementation for a long time.

Despite the existing administrative barriers, enthusiasts and corporations invest millions of dollars in the development of this idea and it pays off.

A several years ago, online PR was the only one benefit from developing of such projects, when videos with the logo "first-ever drone delivery in the world" gained millions of views, now we can see a sophisticated projects with real working examples.

According to new rules, it is forbidden to conduct flights:

- Above thedencely built-up areas of cities, towns or settlements or above an open-air assembly of people;

- Above the objects and zones, which are determined by Ministry of Defence, Ministry of infrastructure, Ministry of Interior, State Border Service, Security Service of Ukraine, National Police, National Guard, Foreign Intelligence Service, State Security Department, all other military units and law enforcement agencies.

Note. "Dencely built-up areas" – is a territory which is selected with special markings.

UAV (an unmanned aerial vehicle) the weight of which is less than 20 kg can be launched without submission of applications and permissions to use runways and informing units of Ukrainian armed forces, State Border Service units and ATS, departmental ATC units.

However, there are several restrictions for UAV,

- It is not allowed:
  - to cross the border of Ukraine.
  - To conduct flights in prohibited areas and restrictions of RWY.
- Flights are allowed
  - not closer than 5 km from the outer limits of RWY of aerodromes or not closer than 3 km from the outer limits of RWY of helipad.
  - not closer than 500 m from manned aircraft.
  - within the line-of-sight.

The maximum height of flight should be not higher than:

- 120 m AMSL – beyond the ATC zones, aerodromes, zones and areas of departmental units, specially established zones, reserved airspace;

- 50 m AMSL within the ATC zones, aerodromes, zones and areas of departmental units, specially established zones, reserved airspace or if there is no

information about actual airspace structural elements status at the time of conduction of flight;

- 50 m above static obstacles with the horizontal distance not less than 100 m from such obstacles,

Allowed speed of flight of UAV should not exceed 160 km/h.

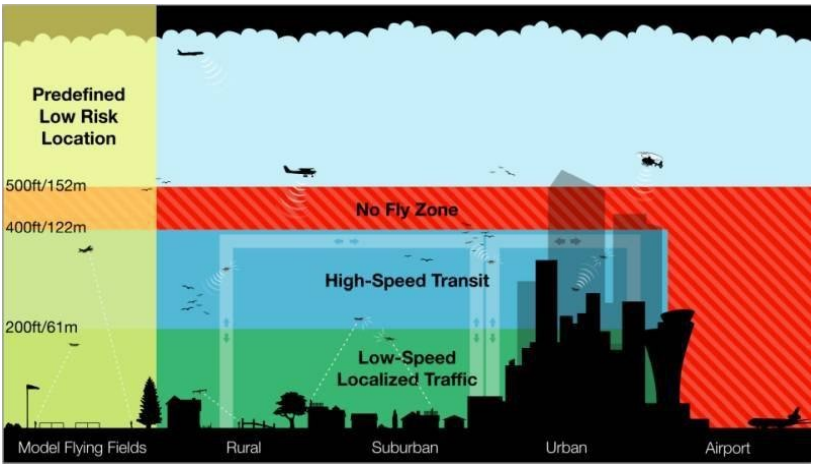

Fig. 1. UAV's flight zones.

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CAPACITY ASSESSMENT METHODOLOGY

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Airport capacity is one the main factors that shows the efficiency of the airport and its prospects for the future. Good airport capacity assessment ensures all relevant factors are taken into account– including environmental impacts, resilience, commercial factors and economic factors – rather than just delay.

To get make capacity more constant and sufficient, is needed to increase capacity in any weather situations. To increase capacity, the airport management must first understand what the current capacity is across various scenarios and where any inefficiencies are.

The two main drivers why an airport needs to measure its capacity are:

1. Current demand is causing delays in good or poor weather conditions, or traffic growth is forecast and both economic and network related drivers will require the demand to be accommodated.

2. Regulation on airport performance monitoring and target achievements related to capacity will continue to expand.

To determine an airport's current airside efficiency, there must be a comparison to its potential performance. This comparison will help determine where inefficiencies lie and how we can fix it. One of the most interesting results we saw from EUROCONTROL's Challenges of Growth 2013 analysis was a decreasing of number of plans to expand airport infrastructure system: an increase of 17% in capacity by 2035 compared to 38% by 2030, that was planned five years earlier. The report found that the decreased demand in last years and weaker growth in the future should give an eight-year head start on meeting the airport capacity. In the most-likely scenario, 12% of total demand (or 1.9 million flights) will not be accommodated by 2035 according to the plans that airports reported in the 2013.

ICAO generally defines capacity as the number of movements per unit of time that can be accepted during different meteorological conditions. However, ICAO identifies that there are a number of variables in this definition that give rise to key performance capacity indicators such as:

a. Maximum hourly number of maneuvers, that can be done in high or low visibility meteorological conditions .

b. Average daily airport capacity measured as a moving average; and so on.

There are 3 main methods of measuring airport capacity:

Hourly or less:

•Usually short enough timeframes to account for the peak and sustainable capacity accounting for effects of fleet mix, runway dependencies, arrival/departure mix and variances in aircraft separations.

Daily:

•The usefulness of this metric reduces for airports that have characteristics that impact hourly capacity such as weather, noise abatement procedures etc. in these cases the capacity could increasingly be overstated.

Annual:

•Primarily used for strategic master planning providing a high level guide for the airports capacity.

•As for the daily figure, airports that see significant changes in capacity characteristics such as winter and summer weather from visibility to wind will find this metric less useful.

Planned capacity should be calculated from approximately 18 months in advance to the week prior to the day of operation when more detailed constraints are able to be forecast with reasonable accuracy. To icrease capacity airport management has a wide range of options to choose from depending on the nature of the inefficiency, that exist in the airport.

1**. Infrastructure and Airspace**: improvements, such as new exits (standard and rapid), also taxiways and runways are usually helpful, if we talking about less expenses priority and consuming action effect.

2. **ATM systems** improvements help us to perform major infrastructure and airspace changes, where higher levels of integration and collaboration are necessary

3**. Improvinghuman performance** through changing procedures and operational ATM structure can require intricate change management processes but can deliver significant benefits

A fundamental principle of enhancing airside capacity is the need to monitor performance. Only by measuring performance can new measures be assessed and refined.

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FATIGUE AND SLEEP MANAGEMENT

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Fatigue is a common phenomenon that may occur in all professions, but its effect can become worse among air traffic control operators (ATCOs), due to their constant execution of high-risk activities.

Negatively, it is seen as a cause of ATCOs' decline in performance

In contrast, it may be perceived as an automatic alarm system that will trigger when the operator's health is at risk or if his body is in urgent need of a rest.For example: thirst is an indication that our body is thriving for water.

Sleep deprivation and excessive wakefulness are said to be the key factors that contribute to fatigue. They could eventually lead to the so-called sleepiness. The reasons for sleepiness may vary from not getting enough sleep – the most common, using drugs, alcohol and cigarettes, lack of physical activity,obesity, the use of certain medications,..

Lack of sleep, notably, could make quite an impact on the work of an ATCO: More frequent occurrence of microsleeps; forgetfulness, especially in short-term memories, lack of situational awareness, low-effort decision-making, temporary poor problem-solving process, health problems: weight gain, sleep disorder, heart diseases,…

On the other hands, although being vastly affected by all the unwanted negativity, most ATCOs have always been able to get their jobs done thoroughly, by giving themself an effective fatigue and sleep management. Each ATCO, undoubtedly, will get himself a solution that he is most comfortable to do it, while the same could not work out for another.

However, there are some practical methods that are widely adopted, most of them are easy to follow, adapt and get used to:

Maintain a healthy bedtime routine – There is nothing wrong to demand for a frequent get up time as the more a person sticks to his bed passing his regular time, the higher the chance he messed up his sleep in the next day. Moreover, make sure the surroundings not disrupt your sleep, for example: a mattress that is suitable for you, a room temperature that you are most comfortable with. Any discomfort in this stage must be eliminated completely.

Napping – Nothing could refresh an ATCO out of drowsiness or tiredness in just a short period of time like napping. A nap with just 15 minutes during breaks could already give an incredible amount of effect for a controller's state of mind. But keep in mind that napping cannot substitute a regular overnight sleep.

Light – For people who are specifically sensitive to light, do your best to cover any sources of light that annoyingly catch your eyes during night, try not to stick your

eyes to your smartphone or any electrical devices that have the potential of harming them.

Noise – Unwanted noise can be quite irritating while sleeping, one of the best methods to reduce its effect upon your health is establishing soundproof systems on the bedroom walls, or distract your ears with something else that is soothing, i.e. a music playlist that consists of all of your favorite songs and play it softly through noise-cancelling headphones.

Caffeine – It is definetely not a work-for-all kind of thing. But it can serve as a booster for vigilance and concentration for some people. Furthermore, it relieves pain associated with sleep loss, increases stamina, improves reaction time and logical reasoning. Overall, caffeine has the ability to alleviate fatigue and counteract tiredness if used properly, but beware of the consequences of being addicted to caffeine as they will affect health in a negative way.

Stick to a healthy eating lifestyle – While a poor eating habit with junk food and few vegetables will worsen your well-being, sabotage your sleep, make your immune system become fragile; treating yourselves regular balanced meals with nutrient-rich foods will not only boost energy levels but also protect the human body from certain types of diseases, facilitate the process of falling sleep.

Medication – Sleeping pills may help you beat insomnia in the first instance, but do not let yourself be attached to it. Besides, using any types of drugs that aid sleep often brings undesired side effects, so it is vital have a proper consultation with doctors first.

Exercise - Exercise as part of your daily routine will lead to a safer, more restful sleep and can help relieve sleep disorders, such as insomnia. In addition, exercising regularly and not overwhelmingly will reduce stress and relieve anxiety. Exercise recommendations for ATCOs include: Exercise ought to be done a couple of hours before the fundamental rest time frame;with morning or day shifts, the perfect time to exercise is after shift, and for night shifts, the exercise should be done before the evening sleep.

With a heavy workload that ATCOs have to undergo each day, fatigue is quite inevitable. Nonetheless, there will always be a cure to this troublesome matter, each just must to acquire for themselves a or some techniques to help them cope with and get over this unpleasant dilemma.

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RECOMMENDATIONS FOR THE CREW OF THE AIRCRAFT, THE ATS UNIT AND THE GROUND SERVICE IN THE EVENT OF AN EPIDEMIC

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Recommendations to the crew of the aircraft

The aircraft flight crew, in case (s) of suspicion of an infectious disease or other public health threat on board the aircraft, reports to the ATS unit the following information: aircraft identification index, departure airport, destination airport, estimated arrival time, POB, number of suspected cases of illness board, the nature of the public health threat, if known.

Recommendations to airports

Airports should appoint: coordinator responsible for policy statement and organizational providing of preparedness; responsible for the operational implementation of the airport preparedness plan.

Channels of communication should be established with the necessary organizations or entities, such as: the local health authority, airport healthcare providers, airlines, local hospital , ambulance services, police, security agencies; travelers

An examination should be carried out in an amphibious measure, which should not create obstacles or unjustified delays in the flow of passengers and goods through the airport. It should be carried out with the help of reliable equipment by personnel trained in the handling and interpretation of the findings.

Contracting States may close an airport if it is located in or near the area of an outbreak of an infectious disease that could provide a serious public health risk.

Recommendations to airlines

Airlines should appoint: coordinator responsible for policy statement and organizational providing of preparedness; responsible for the operational implementation of the airline's preparedness plan.

Channels of communication with necessary organizations or entities should be establish, such as: airport authorities, ambulance services, air traffic control authorities, local health authorities, local hospital (s), police, travelers.

Airlines should establish: a system that allows cabin crew members to detect individuals with a suspected infectious disease; a system for treating people who may be infected with an infectious disease. It should also: establish general principles for passenger agents who may encounter suspected infectious diseases at the airport; cooperate with airport and health authorities on organizational matters such as the treatment of patients traveling.

For maintenance staff, airlines should determine: policy regarding the removal of air recirculation filters, including: a policy for venting vacuum drains, a policy regarding obligations related to the disposal of bird waste remaining as a result of bird collisions.

MOBILE MULTIPOSITION RADIO RANGEFINDING SYSTEM FOR PROVIDING REGULATED SAFETY LEVELS FOR NAVIGATION-LANDING OPERATIONS OF LIGHT-ENGINE AVIATION

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A significant part of routes with a low density of flights, aerodromes, and landing sites of local airlines (LAL) and special aviation(SA) are practically not equipped with radio technical navigation-landing equipment, and landing operations are performed with a visual orientation, therefore, it is not effective. The use of stationary or satellite navigation and landing systems (ILS, MLS, VOR/DME, GPS, etc.), for the above conditions, is not acceptable due to their technical complexity, high cost, or lack of coverage by the navigation field.

In this regard, there will be relevant and new development of a mobile (portable), small-sized, inexpensive, all-weather, multi-position, radio-ranging, request-response, certified in accordance with the requirements of International Civil Aviation Organization (ICAO), a drive system to the aerodrome area, pre-landing maneuvering, approach and automatic categorized landing of light-engine aircrafts (hereinafter MPLS [1]), designed for various tasks: ensuring the aircrafts flights of the LAL and SA; providing helicopters flights to offshore platforms and temporary landing sites, hard-to-reach terrains; automatic paragliders or unmanned aerial vehicles drive into the landing zone (hovering); manual control of the descent aircrafts trajectory; ensuring the aircrafts exploitation for processing farmlands, rescue operations, etc.

MPLS acting principle [1] is based on measuring the distances D_n between maneuvering aircraft and ground equipment (beacons-transponders TP, repeaters RP, operating in the DME frequency range, which location is known relatively to the runway [2]) and subsequent calculation the aircraft location. In this case, it is possible to use both special [2] and standard onboard equipment (radio locators, radio range finders (DME/P), radio altimeters) and standard formats of DME receiving-response signals or their frequency-time modifications, adopted by ICAO for goals of air traffic control, navigation and landing. MPLS provides flights safety, accurate aircrafts approach and landing in category I with the Required Navigation Performance – RNP 0,02/40 [1].

The principle of three-position navigation-landing system [3] operation for the aircraft manual driving “by devices”is shown in Fig. The algorithms for calculating aircraft coordinates are based on the trigonometric ratios of the triangular pyramid and tetrahedron volumes, by transforming which we can get the aircraft coordinates in real time [3].

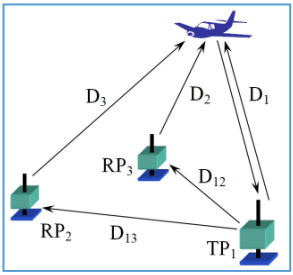

Fig. Three-component MPLSworking scheme

The aircraft location can be determined in the following way. The flight altitude H (Z coordinate) can be found from the volume formulas of the triangular pyramid: $V = \frac{1}{3} \cdot S \cdot H$ and the tetrahedron:

$$V^2 = \frac{1}{288} \begin{vmatrix} 0 & D_{12}^2 & D_{13}^2 & D_1^2 & 1 \\ D_{12}^2 & 0 & D_{23}^2 & D_2^2 & 1 \\ D_{13}^2 & D_{23}^2 & 0 & D_3^2 & 1 \\ D_1^2 & D_2^2 & D_3^2 & 0 & 1 \\ 1 & 1 & 1 & 1 & 0 \end{vmatrix} = \frac{\Delta_V}{288}.$$

A triangular pyramid-tetrahedron is formed at each moment oftime by three radiobeacons of the system and the aircraft. Fromhere: $Z = H = \frac{1}{S} \cdot \sqrt{\frac{\Delta_V}{32}}$.

The X and Y aircraft oordinates, relatively to the first transponder, are calculated as follows: $X = \frac{\Delta_X}{2 \cdot \Delta_0}$ and $Y = \frac{\Delta_Y}{2 \cdot \Delta_0}$, where:

$$\Delta_X = \begin{vmatrix} D_1^2 - D_2^2 + D_{12}^2 & Y_2 \\ D_1^2 - D_3^2 + D_{13}^2 & Y_3 \end{vmatrix}; \Delta_Y = \begin{vmatrix} X_2 & D_1^2 - D_2^2 + D_{12}^2 \\ X_3 & D_1^2 - D_3^2 + D_{13}^2 \end{vmatrix}.$$

By the measured (m) ranges values D_{1m}, D_{2m}, D_{3m}, system computing device calculates coordinates values X_m, Y_m, Z_m[3]. By the calculated (c) coordinates values of current aircraft location X_c, Y_c, Z_c, the calculation of ranges values is carried out according to the formulas:

$$D_{1c} = \sqrt{X_c^2 + Y_c^2 + Z_c^2},$$

$$D_{2c} = \sqrt{(X_c - X_2)^2 + (Y_c - Y_3)^2 + Z_c^2},$$

$$D_{3c} = \sqrt{(X_c - X_3)^2 + (Y_c - Y_3)^2 + Z_c^2}.$$

Further D_m and $D_c$are compared between themselves and processed in the microprocessor, according to proposed algorithms [3].

Creation and implementation of auxiliary, simpler in maintenance, with the possibility of configurations in various variants realization (taking into account consumer requirements), inexpensive and economical (aircraft trajectory correction leads to its route shortening, therefore, to fuel economy, etc.) navigation and landing aircrafts systems, than stationary, is an important aspect of the safety improving and flights efficiency of the LAL and SA aircrafts.

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INVESTIGATION OF PECULIARITIES OF JUST CULTURE POLICY

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Just Culture is a new look at the work of aviation staff, who argues that omissions or decisions based on experience gained for the sake of good should not be punished, but negligence, neglect or intentional misconduct are considered intolerant and should be abused. It points out that inadvertent, honest mistakes could be useful for the job.

Due to the Just Culture Policy if there is the safety occurrence provided with action or omission by ATCO that results in violation of regulatory provision there are three ways of resolving the situation. The first one when an employee encounters an incorrectly constructed management instruction, in such case all responsibility falls on the developer of the instruction. The second results in gross negligence that leads to criminal offense. But sometimes such violation could be represented like 'honest mistake' which has been done on the basis of experience and with good intentions.

Both controllers and managers know what is respectable and what is not for honest mistake but sometimes it's hard to draw the line between sincere fault and unacceptable behavior as human factor plays one of the main roles in such situations. This line protects us against intentional misbehaviour or criminal acts, and that the application of justice creates such protection. In drawing a line it is significant who exactly will do it, it is much more important than define the fine line. As all situations are counted subjectively. Many prosecutor do not understand the fact when deciding on air traffic controllers that controllers at work should constantly look for the fine line between the theoretical guidance of ICAO and the application of these instructions in practice in non-standard situations. In all cases, the person who will conduct the investigation should be familiar with all the subtleties of air traffic control and with many documents governing the powers and responsibilities of the dispatcher. He or she must has a cold mind and act solely for the benefit of the general public and the well-being of the passengers

So, Just Culture opens the new and more tolerant view of solving situations where violation of the rules takes place. It says that nowadays such called 'honest mistake' supposed to be acceptable because it is based on own ATCO's experience and practice with good intentions.

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INTERACTION BETWEEN HUMAN AND AUTOMATED SYSTEMS

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For many years, people tried to simplify their work performance, that is why today we have a great amount of various automated systems, particularly in aviation. Air Traffic Management (ATM) develops necessary technologies and systems that provide automation support to humans, with some key examples as follows: Radar Data Processing, electronic data displays, electronic flight strips, mode S down-linked airborne parameters, safety nets such as Short Term Conflict Alert, Medium Term Conflict Detection, Arrival and Departure Manager, Time Based Separation support tools, Aeronautical Message Handling Systems, Aeronautical Information Management. At the present stage ATM taxonomy identified spectrum of automation: from low level to high level. Low level of automation can be described as a level with maximum user interaction, and high level – as a level with a completely automated system. However, even highly automated systems need maintenance and some human monitoring. The system has to perform some routine tasks, but user has to perform in the loop to deal with the novel and unexpected [1].

Humans are susceptible to ‘automation complacency’ or ‘automation bias’. If technology appears reliable, humans will trust it. This may become over trust when they stop questioning information presented to them, even when it doesn’t look quite right. When user relies on the automation, he may not detect the system failure if it happens, even if he detects, there is no possibility to solve the problem manually. Users need to be appropriately skilled and competent to operate in fallback and contingency. They have to be supported with special training and advises if there is a need for deeper understanding how to operate with automated systems. The main task is to create balance between human and automated technologies and to create conditions, in which they can interact with minimum error and with maximum efficiency [1].

We have identified five main useful methods to create system of interactions between human and automated systems:

1. Users should be involved in all stages of system design and development. They are able to update their knowledge, explain actions, substantiate decisions, predict the development of situations, actively interact with the environment and perceive information of a different nature, receive decisions based on existing knowledge, store in memory necessary information and factual data. Usually artificial intelligence systems are created by the specialists - engineers, who transfer their knowledge about processes and objects, explain the scheme of reasoning for the choice of solutions, specific tasks, factors,to be considered. Process of working with the specialist is the receiving of knowledge, which can help in projecting of new technologies and comfortable conditions for their use [2].

2. Ensure that the technical performance, availability and accuracy meets the trust needs of the users, taking account of the natural human tendency to over rely on highly reliable automation and be biased by large data sets. Also, It is very important to provide experienced employees who can always configure the software and timely check the data of the automated systems with analog and create safe conditions for the continued use of these systems.

3. To avoid additional errors, there is a need to design the human machine interface (HMI) to be always ready if any problem occurs and have possibility to overcome it in a short period of time. Properly designed interface reduces human performance on routine tasks and gives time to deal with complex situations. However, there should be counted that more information does not necessarily equal more situational awareness. Users should be presented with the right information, in the right place, at the right time and in the right format. Technology should not misdirect user attention through high numbers of alerts.

4. Ensure appropriate team resource management principles are in place to support new or changed interfaces, roles or responsibilities that must be appropriate and unambiguous tothe individuals concerned.It is interaction not only alongthe “man-machine” chain, but also along the “man-man-machine” chain.In other words, in the process of his activity, a person interacts not only with technical devices, but also with other people.In order to have the correct interaction between employees and automated systems, the necessary procedure and compliance with special rules, such as safety rules and special instructions how to operate with systems must be established. An authorized person should supervise, distribute responsibility the employees and verify their work performance [2].

5. Ensure that new technologies are compatible with other systems that can be used. In any set of systems, each system is focused on its specific job, but it is necessary to obtain a total result from the whole set of systems which creates a general picture how to solve the problem or task. Also, there is a need to understand and manage the interdependencies across the total aviation system e.g. the output from one technical function can be the input to a different function. That is why a thoughtful compatibility between systems is very important for the final result.

Based on what has written before, the assumption occurred that the most perspective direction of improving information processes in human activity is the identification of optimal ways of human-machine interactions.Automation must be delivered safely. Such material is required to provide a framework for automation, which ensures that the right balance is achieved between ‘the manual and the ‘automated’ and to achieve appropriate human-technology integration [3].

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AIR TRAFFIC DELAYS PREDICTION MODEL

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Modern aviation in the line of rapid improvement and development are faced with more and more new questions. However, some old problems related to optimization, cheapening, comfort, maintenance, and many other aspects also occur and require a quality solution, for the reasons that emerge from the names of these problems. In our research, we calculate the delay time of arrival of the aircraft at the airport (or how much earlier the aircraft will arrive from the set time in the flight plan) while at the time of calculating the time parameter at any point on the selected route flight. That, in turn, will improve the optimization of the interaction of aviation services, personnel, the use of auxiliary systems and many other factors [1, 2, 3]. Such an opportunity for improvement will be especially valuable for large airports with a very dense stream of flights. An important factor for them is “on time”, because any delay, an oversight in the calculations of that time leads first of all to losses (due to downtime, the discomfort of passengers, breaking down the schedule of arrivals and departures of aircraft, etc.).Having the ability to calculate the delay time while still in flight, we can already take the necessary actions (speeding up, changing the route (if possible), selecting a window in the arrival schedule for a late flight) in order to minimize the negative impact of delays. Accordingly, if during the calculation it turns out that the plane will arrive at the airport before the required time, we can also perform a certain series of actions that will allow the aircraft to arrive on time and not violate the airport schedule (reducing speed, providing the flight with a window in the arrival schedule (if possible)) This function of this method will be useful for dispatchers, as it will help to significantly reduce the need to send a late or previously arrived vessel to repeat circles, waiting for their turn to land (we also save fuel). The main advantages of this method are simplicity of modeling, the possibility of application for any type of flight, the ability to include information provided by these methods in the on-board computer (flight plan) to visualize the information for pilots.The disadvantages include the need to refine the algorithm for taking into account weather conditions (especially wind). The need for the correct inclusion in the algorithm for calculating flight histories conducted with deviations from the flight plan for various reasons (which increases the overall error of the method).

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CONCEPT OF U-SPACE

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Introduction

The demand for drone services is steadily increasing, with the potential to generate significant economic growth and societal benefits [1], which means that, in order to realize this potential, concept of U-space must be developed. U-space is a set of new services and specific procedures designed to support safe, efficient and secure access to airspace for large numbers of drones. The U-space blueprint [2] sets out the vision for U-space, which aims to enable all new operations, including complex missions performed by vehicles with a high degree of automation, in all kinds of operational environment, including urban areas.

How could U-space be rolled out

Over time, U-space services will evolve as the level of automation of the drone increases, and advanced forms of interaction with the environment are enabled mainly through digital information and data exchange. Each new step will propose a new set of services while including an enhanced version of the services already existing [3].

- U1 – U-space foundation services provide **e-registration**, which enables the registration of the operator, drone and pilot with the appropriate information, **e-identification**, which provides access to the information stored in the registry based on an identifier emitted electronically by the drone and **pre-tactical geofencing**, which provides information that allows the drone operator to make use of the geofencing capability of the drone.
- U2 – U-space initial services include **tactical geofencing**, that brings the possibility to update the operator with geofencing information even during the flight, **tracking** - ground and air surveillance systems, **flight planning management**, which covers the receipt of a flight notification or a flight plan and provides the appropriate answer according to the characteristics of the mission and applicable regulations, **weather information**, **drone aeronautical information management**,which provides the operator with relevant aeronautical information, **procedural interface with ATC** - a set of defined procedures for some mission types where there may be an impact on ATC, **emergency management**, which provides the drone/operator with assistance information to manage the emergency situation, **strategic deconfliction**, **monitoring**, this service retrieves data from the tracking service and fuses it with information related to non-cooperative obstacles and vehicles in order to create air situation for authorities, service providers, and operators, traffic information, that provides the drone operator with traffic information coming from any kind of monitoring services.

- U3 – U-space advanced services include **dynamic geofencing**, that targets the drone itself and then this service requires data-link connectivity to a geofencing system that allows the data to be updated during the flight, **collaborative interface with ATC**, that encompasses shared situational awareness and procedures to enable a two-way dialogue supporting the drone operation in airspace where ANS are provided**, tactical deconfliction**, which allows the drone to receive the information and this deconfliction is set for the in-flight phase, **dynamic capacity management**, that monitors demand for airspace, and manages access to that airspace.
- U4 – U-space full services, particularly services offering integrated interfaces with manned aviation, support the full operational capability of U-space and will rely on very high level of automation, connectivity and digitalisation.

Benefits to society and economy

Drone users/operators:

Offer fair, flexible & open access to the airspace, where manned and unmanned traffic will operate safely and in harmony and unlocking market growth, jobs and services to citizens.

Regulatory authorities:

Maintain control over airspace, ensure privacy, safety, security & environmental protection, enforce registration & identification of drones and protect safety & security critical areas.

Citizens:

Offer new & innovative drone services, ensure safe & secure drone operation, respecting theprivacy of citizens, including data protection and ensure environmental protection (noise & visual pollution).

Businesses:

Enable competitive and cost-effective service provision, supporting the business models (e.g. data services and mobility)of drone operators, spurring jobs & market growth and support move towards automation & digitalization.

Conclusions

To conclude it might be said that drones are our future, new services for citizens, new business models and economic growth, so U-space must be flexible enough to encourage innovation, draw attention to its perspectives, support the development of new businesses and facilitate the overall growth of the European drone services market.

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ASSESSMENT OF THE RISK OF DEVIATION OF THE AIRCRAFT FROM THE MIDDLE OF THE ROUTE

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Air traffic management is based on the trajectory and flight plan of each user, which is built for him. The aircraft flies on the approved trajectory on a dedicated flight echelon [1]. Accurate keeping of the route and the level of flight is the key to air safety. One of the very serious problems is the deviation of the aircraft from the planned flight path, since in this case there is a high risk of collision with another user of airspace.

The most dangerous incident that can occur in aviation is the collision of two planes in the air, which will usually end in disaster for both aircraft.

The risk of reducing the distance between planes can be estimated using the probability density distribution model [2] or by statistical analysis of the input data as a simple relation [3] . The same estimation model of lateral plane deflections can be used in collision risk assessment.

In this article, we propose a new method of real-time risk assessment within a predetermined volume of airspace for flexible monitoring of security levels.

In order to maintain air traffic safety, ATC authorities use the separation of aircraft. Separation happens;

- vertical separation;
- horizontal (longitudinal or lateral) separation;
- combined (along track) separation - simultaneous application of vertical and one of the types of horizontal separation.

Horizontal separation is expressed in the creation of lateral separation minima, and according to Ukrainian law in our airspace can be expressed in different values depending on the area of ATC, the use of a particular navigation and radar system, and how it will be expressed.

We used probability density functions (PDF) ρ (x) to estimate the risk of unintentional deviation of the aircraft from the center line of the flight path. In fact, the lateral deviation of the aircraft from the border is not a very common event that may not occur during the icing period. Thus, the risk of unintentional deviation of the aircraft from the center line of the flight route can be estimated as the area under the PDF that is limited by the minimum separation values.

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IFPS – INTEGRATED INITIAL FLIGHT PLAN PROCESSING SYSTEM

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The Integrated Initial Flight Plan Processing System (IFPS) is a centralised service of the Network Manager operations centre (NMOC) designed to rationalise the reception, initial processing and distribution of flight plan data related to instrument flight rules (IFR) flight within the ICAO EUR Region known as the IFPS Zone (IFPZ). Flight plans and associated update messages may be submitted as individual messages or as repetitive flight plans. The IFPS shall check all messages received or changes thereto for:

- compliance with all format and data conventions;
- completeness and accuracy.

THE IFPS SHALL

- take action to ensure that the flight plan is acceptable to air traffic services.
- indicate acceptance or rejection of the flight plan or modification to the originator.
- ensure distribution of accepted flight plans and modifications thereto to all relevant Air Traffic Services Units (ATSUs) within its area of responsibility.
- also ensure re-addressing of accepted messages to any additional Aeronautical Fixed Telecommunication Network (AFTN) addresses as requested by the message originator.
- process supplementary messages including request flight plan messages and request supplementary flight plan messages.

THE IFPS REQUIREMENTS

1) All messages submitted to the IFPS for processing shall be submitted to both IFPS units, regardless of which unit shall be responsible for processing that message

2) All flight plans and associated messages for IFR/GAT flights or parts thereof operating within the IFPZ should, as far as possible, are submitted to the IFPS for processing at least 3 hours prior to the EOBT of that flight.

3) For those IFR/GAT flights departing within the IFPZ and proceeding outside, and for those IFR/GAT flights that depart outside the IFPZ and proceed to enter, it shall remain the responsibility of the message originator to ensure that the relevant ATCUs outside the IFPZ are addressed.

All aircraft flying into, departing from or transiting Europe within the General Air Traffic (GAT) Civil system must file an International Civil Aviation Organization (ICAO) flight plan with the Integrated Initial Flight Plan Processing System (IFPS) managed by the EUROCONTROL Network Manager. This system is the sole source for the distribution of the IFR/GAT portions of flight plan information to Air Traffic Control (ATC) within participating European Countries collectively known as the IFPS Zone (IFPZ).

HOW TO SECURE YOURSELF IN AN AIRPLANE IN THE MIDST OF A CORONAVIRUS

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Are you afraid to fly during a global outbreak of coronavirus? Just wash your hands.

Coronavirus is a respiratory virus that is believed to be transmitting through tiny drops of cough and sneezing. Other virus studies have shown that you are at risk during the flight if you sit no more than two or three rows from an infected person, that is, at the distance from which droplets can fly.Health experts say that the best protection against coronavirus is the same as against flu, common cold, and other types of viruses: Wash your hands often and use a hand antiseptic. On board the aircraft, turn on the air conditioner and direct it to your face to breathe filtered air.

In 2009, a study was conducted to monitor the transmission of the H1N1 virus on board the aircraft. It found that if 2% of passengers were infected during the flight, 5% of passengers were infected during the week after landing. The risk of infection with the virus for economy passengers was 3.6% higher if they were sitting in two rows from passengers with symptoms of the disease. For passengers sitting closer than in two rows in either direction, the risk of infection doubled, to 7.7%.Another study modeled the risk of disease in comparison between economy class and business class. The findings were obvious: The chance to get worse if you are surrounded by fewer people. If all seats on board are occupied, the risk of getting caught in the business class is lower than the economy class. But it can be the other way around if the business class is full and the economy class is not.

Health-care organizations do not warn against actual flight travel if you are not going to China. Airlines do not notice a significant jump in the cancellation of domestic flights. Companies are still sending employees on business trips – though not to China.

Fears about air travel are rooted in the fact that airplanes do carry infected people around the world. From here, the suspension of flights to China, and the screening of persons arriving in the US and visiting China.Although outside China, the new coronavirus is a threat to travelers in the first place, airplane flight poses no greater danger to you than staying in other places where you interact with possibly sick people: metro, cinema or queue in store. But on board, you really have close contact with other passengers, whether you want it or not.

Air in an airplane is usually divided into separate zones. The air around your area is only sucked in and recirculated in the same area. In addition, most modern aircraft drive recirculated air through a series of filters 20–30 times an hour. These high-efficiency particle retention filters, or HEPA, are suitable for operating environments and can remove 99.9% of particles, such as bacteria, fungi, larger viruses and viral accumulations, according to the CDC.

"The air environment in the cabin of the aircraft does not contribute to the spread of most infectious diseases", – CDCreported at a briefing on air transportation.

The World Health Organization notes that the general recommendations for travellers also apply to coronavirus:

-wash your hands frequently with alcohol or soap and water.

-when coughing and sneezing, cover your mouth and nose with a bend of elbow or cloth, then immediately -put out the cloth and wash your hands;

-avoid close contact with persons who have high temperatures and coughs.

-if you have fever, cough, and difficulty breathing, seek medical attention immediately and tell your healthcare provider about your previous trips.Some more tips from the Wall Street Journal editor about air travel:

-airline companies do not clean aircraft too thoroughly, so grab your sanitizer cloths to wipe surfaces such as the table top and armrests;

-if you're going to fly in a mask, you'll need something more serious than a normal surgical paper mask. According to doctors, these masks are designed to prevent your microbes from infecting others, and they will not be an obstacle to coronavirus from outside. You will need a mask-respirator #95, which is thicker than the usual mask. True, such masks are difficult to wear and wear for a long time;

-if your neighbor sneezes and coughs, ask him to cover his mouth. Ask the flight attendant to transfer you to an empty place. Even a medium chair will fit.

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THE PROVISION OF TRAJECTORY BASED OPERATIONS IN AIR TRAFFIC

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Presently, the efficiency of Air Traffic Flow Management is very limited due to the need of tactical interventions of Air Traffic Control (ATC).For solving these problems, the new ATM system was improved by enabling accurate Trajectory- Based Operation (TBO).

Trajectory-based operations will allow Air Traffic Management (ATM) systems to know, and if required, to modify planned and actual trajectory of a flight before or during its operation. This accomplished is via accurate information that is shared with air and ground stakeholders. So, participants have access to synchronized and up to date flight, meteorological, airspace and aerodrome information in four dimensions, with the fidelity required to perform its functions.Operating in such an environment, the stakeholders have clear visibility of the trajectories with the lateral, vertical or time constraints and/or other constraints that define them, as well as of the operational factors that may affect them.

For better network monitoring, earlier problem detection and wiser intervention the TBO should have the following elements:

- Accurate trajectory prediction capability for multiple interacting flights, by using the System Wide Information Management (SWIM) infrastructure;
- A comprehensive and continually updated database of flight trajectories with the feature of bi-directional association between slot and trajectory;
- Accurate airport surface movement models and ATC airspace models in order to compose the trajectory predictions;
- The “Nowcast” capability, which consists of continually ingesting the most up-to-date flight status information;
- A multi-objective, stochastic optimization algorithm for optimization of 4-dimensional flight trajectories with routing and traffic constraints

The provision of TBO will help Aircraft Operators to save cost through optimized trajectories, to improve safety and to reduce aircraft spacing’s that will be resulting in increased airspace capacity. For controllers and pilots, the TBO will be one step closer to traffic in a free route environment. It will give the ability to keep aircraft on closed-loop clearances, to reduce the chances of mistyped instructions and to perform free routes with very few published waypoints in flights plan, based on automated information.

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ENGLISH IN AVIATION

THE ROLE OF ENGLISH FOR IT-PROFESSIONALS

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English plays an important role in our everyday lives. Nowadays 750 million people all over the world use English and for half of them, it is a native language. Eighty per cent of information on the world's computers is also in English[1].

As for our future profession,it's very important to know and to understand this language. Many programs and application platforms are writtenin English. Our teachers offer us to select a language in which we want to learn particular courses. We believe that it is a very good experience to improve our language skills in such a way. Of course, many foreign IT-companies think that the knowledge of the English language is very important and require a good command of the language. Besides, all basic programming languages are based on English. If we want to understand them at first we must know this foreign language.

Many corporations like Apple, Microsoft, and Google also consider it as a global language. If we want in the future to get in contact with these companies or work for them we must do our best to know English well. Many certifications which we can undergo to improve our IT skills are offered in English. All sources which can help us to get to know different information about programming is also written in this language. Nowadays, many seminars and masterclassesare held in English.

As for out university subjects, we have the opportunityto take the Ciscocourse which is known all over the world. The material which helps us to pass this exam is available in English and if we can perform well at the end, we can count on a good job in this field.

Finally, we must say a few words about our English classes at university. Our English instructor gives us a good background in IT. We learn about different viruses, what components computers are madeof, what we can do on many basic programs on our computers. We think that it is very useful to learn about it not only in field-specific classes, but also in English for IT professionals. We also improve our speaking skills while learning some words or dialogues by heart.

The English language surrounds us like a sea, and like the waters of a deep sea, it is full of mysteries[1].

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THE IMPORTANCE OF ENGLISH IN AVIATION

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No wonder aviation is called the wings of the world ... Today it is one of the leading vehicle industries. Besides the fact that aviation helps to improve the economy of the state, it also helps people to be closer to anywhere in the world. Moreover, it is generally accepted that aviation has become so safety that, compared to cycling, you are more likely to have an accident in the second variant.

Alas, it was not always so calm and safety... In 1977, a terrible accident occurred at Tenerife airport. Two planes collided on the runway that day, killing 583 people. During the investigation, it turned out that the incident occurred due to poor command of the English language by the dispatchers and a deviation from the standard phraseology. Thus, we slowly approached the main question: why English is so important for aviation.

The example above shows us very clearly that aviation is a single mechanism where everything should work harmoniously and perfectly. All airport staff are simply required to know English and prescribed phraseology. For example, the word “take-off” can be used only in the phrases “take-off allow” or “cancellation of permission to take-off”. Such strict rules allow for a complete understanding between the crew and the dispatcher.

At this point, I want to dwell precisely on the interaction between the dispatcher, the crew and passengers. The flight attendant is required to know English to fully instruct foreigners on board.

The dispatcher and crew must be familiar with generally accepted aviation English since in the speed of flight every second spent trying to understand can be crucial for life. Based on this, ICAO has introduced new enhancements in the knowledge of English at the fourth and fifth levels on an organization scale.

The next item is important for engineers and students. Most technical instructions for use and construction was written in English. There may be some distortions in the translation, which will result in an incorrect or incomplete understanding of the structure, technical inspections, design, and operation. Again, this is all a security issue, since even a lack of one screw can lead to a massive disaster. That is why it is very important to introduce on a mandatory basis not only testing of airport employees for knowledge of English but also students of aviation educational institutions. Moreover, it is for students that it is necessary to increase the hours of studying aviation English.

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STATE-OF-THE-ART AIRPORT BOIMETRIC TECHNOLOGIES: OVER COMING OF PERTINENT CHALLANGES AND IMPLEMENT STRATEGY

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According to SITA forecasts, by 2036 the number of air passengers will double and reach 7.6 billion. To transport so many people, optimization of processes at airports is required.

The main problem, even in the most modern and well-planned airports and transport hubs, is everything related to security and passenger identification: checkpoints, check-in, boarding, transit transfers. Identification of passengers using biometric data significantly speeds up the verification process of the person.

In this regard, the scale of investments in the biometric systems of airports around the world is understandable. According to a study by SITA, an international organization providing telecommunications and IT services in the aviation industry, 71% of airlines and 77% of airports plan to introduce or develop biometric identification systems for passengers [1]. SITA head Barbara Dalibard believes that safe travel without annoying delays is what the air transport industry should strive for.

The advantages of switching to biometric systems are obvious, but do not give in too much to the charm of the new technology and forget that it has disadvantages and vulnerabilities. For example, 99% of the recognition accuracy at Orlando Airport means that for every 100,000 passengers successfully recognized, there will be 1,000 losers who will be delayed and possibly late for the flight due to a system error. She simply does not recognize them as legal passengers or, even more sadly, she will take them for criminals. Another problem with biometric technology is the continued possibility of falsification. In some cases, attackers do not even have to contact the victim in order to gain possession of his biometric information [2].

Employees of New York and Michigan universities have trained artificial intelligence to generate universal fingerprints that match many real ones. Using these fingerprints, you can unlock most of the modern smartphones.

Despite the shortcomings and the high cost of introducing biometric technologies, there are so many demandedopportunities that we can expect their mass appearance at all major airports in the next few years. And we can only hope that the introduction of biometrics will reshape the travel experience, providing really an end-to-end, safe and convenient conditions for passengers.

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THE IMPACT OF MODERN INFORMATION TECHNOLOGIES ON A PERSON

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Nowadays, the influence of computer technology on the individual person and society as a whole is constantly increasing.This is due to an increase in the flow of information, which requires processing large volumes of information, mainly in a very short time, which has led to the emergence of a computer.But how many people thought about the impact of computers on everyday life and our health?

Social networks offer the opportunity for people to reconnect with their old friends and acquaintances, make new friends, trade ideas, share content and pictures, and many other activities [1]. Students can collaborate with their peers to improve their academic proficiency and communication skills. You can learn about different cultures and societies by connecting with people in other countries [2].Frankly speaking, when people create some programs or educational portals they mostly think only about benefits that people get from their invention. This has led to the emergence of many messengers that we use nowadays.

With the development of modern information technology and world transparency increasing the speed and volume of information transfer between elements of the world system,it is another integrative world factor. This means that the role of local traditions, which contribute to the self-sufficient inertial development of individual elements, weakens. At the same time, the reaction of elements to signals with positive feedback is intensified. Integration could only be welcomed if it did not result in a blurring of regional and cultural-historical peculiarities of development.

The influence of information technologies on the development of personality is ambiguous: on the one hand, computer technologies affecting the human psyche accelerate the development of mental processes and the formation of positive personal qualities, such as business orientation, accuracy, on the other – in the long-term interaction with the computer a certain specificity of mental processes is formed that can cause the emergence of stereotypes, difficulties in communication, complications in interpersonal relationships.

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DECISION – MAKING THEORY ON EXAMPLE OF AIRCRAFT ICING

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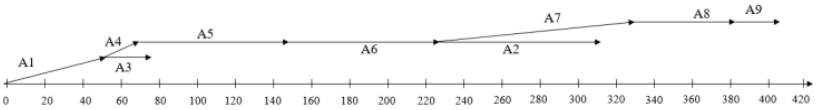
The ice deposits change the wing profile and disrupt the flow of air. This point drastically changes flight parameters such as lift, drag, controllability, etc. As drag increases, lift rapidly decreases - a natural pilot action to compensate for this would be to apply power and increase the angle of attack to maintain level, however, this leads to even faster ice accumulation as larger airframe surface is exposed. Ice formations on wing and control surfaces can lead to increased stall speed, sudden uncontrolled pitch or roll with difficult recovery and, potentially, eventual loss of control. To estimate the degree of decompression dangerousness, we used 2 methods: decision making in the emergency situation (ES) under uncertainty and decision making under risk.

To ensure proper air traffic service of any unusual and emergency situations exists a special checklist "ASSIST". This checklist provides all the necessary actions for the air traffic controllers. They are [1]:

- "A" - acknowledge the call; get the squawk;
- "S" - separate the aircraft from other traffic, give it room to manoeuvre;
- "S" - silence - on the frequency, provide separate frequency where possible - this prevents unnecessary clutter for the pilots;
- "I" - inform those who need to know and those who can help; inform others as appropriate;
- "S" - support the pilots in any way possible, start to think of alternative routings, etc.
- "T" – time, give the pilots time to collect their thoughts, don't harass them for information.

With the help of the method of experts' estimation, we have defined the time of each operational procedure in order to define the necessary critical time needed to perform help for the aircraft in icing. The network graph of time of the actions by an air traffic controller is shown below.



Critical time: 411seconds
Critical way: A1, A4, A5, A6, A7, A8, A9

Fig. 1. Network graph of critical time

The main method of decision-making under risk is analysis and solution using the graph in the form of a decision tree. Aircraft B737-800 flies from Kyiv to Lviv. At the quarter of its route icing problem has happened with aircraft. Ivano-Frankivsk is the nearest aerodrome. The pilot is informed about icing activity near Lviv ACC. Which of this scenario should the pilot take under conditions of risk: continue flight to the destination to make a diversion? This problem we will solve with the help of a decision tree with is depicted below.

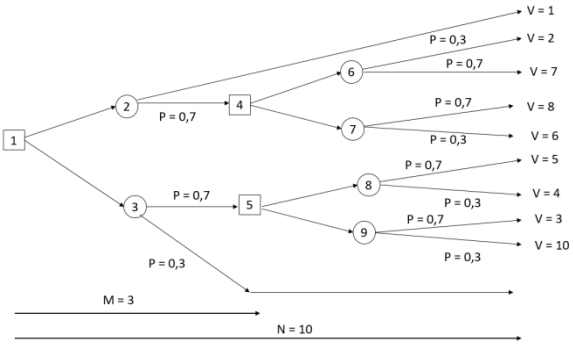


Fig. 2. Decision tree

The main goal of decision-making under uncertainty, as under risk, involves alternative actions whose disbursements depend on the random states of nature.A decision under uncertainty is when there are many unknown variables and no possibility of knowing what could occur in the future to alter the outcome of a decision [2]. From this point, we can conclude, that decision-making depends not on the person's knowledge, but his/her personality type.

To estimate the degree of icing dangerousness we used 3 methods: decision-making in the emergency situation (ES) under uncertainty and decision-making under risk. The first method is directed to determine the critical time and critical way according to the list of required actions and time needed to perform them according to ASSIST information. As a result, we obtained the critical time 411 s. The critical path is A1, A4, A5, A6, A7, A8, A9. The second method involves more detailed actions with possible risks which may arise and ways to manage the situation. The determined alternatives are: to continue flight; to make forced landing; to land on the nearest or at alternative aerodromes (Lviv) or divert to the departure aerodrome (Kyiv); to land at alternative aerodrome (Ivano-Frankivsk). According to calculations, the most suitable way is to land at Ivano-Frankivsk.

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STANDARDS OF ENGLISH KNOWLEDGE FOR AVIATION WORKERS

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Since 2008 ICAO approved new standard which described minimal level of English knowledge during maintenance and international flights. After a series of disasters world aviation community was concerned knowledge of English language among air traffic control operators and pilots, who are not native English speakers.

Safety of flights is provided by the high level of professionalism among pilots and ATC operators during routine situations, and more importantly – during emergencies. It is largely depends on knowledge of Aviation English. Insufficient level of English language skills may cause aviation catastrophe, aircraft crash, and different mistakes during the maintenance.

After analyzing different incidents related to human factor during functioning of the system "ATC operator – Crew – Aircraft – Environment", ICAO decided to add Aviation English as the risk factor, like mistakes during piloting, maintenance or ATC mistakes. Before ICAO introduced requirements about general English knowledge, pilots and ATC operators could work without knowledge of English. There were some cases when pilots from the not English speaking countries(for example France or Spain) just started speaking on their native language during the flight, or native English speaking pilots just started to talk in simplified English.

That's why ICAO, since the 5th March 2008 obliged pilots and air traffic controllers to be able to show their ability to talk and to understand the language they use for radio communication at least at level 4 (according to ICAO scale). But after introduction requirements about general English knowledge, ICAO received a lot of responses about the lack of qualified workers that is why they decided to defer it for 3 years – to the 5th March 2011.

The requirements are touching not only knowledge of the language but also phraseology and the speed of the speech. For example ICAO recommends to talk with the speed about 100 words per minute (Application 10, tome 2, chapter 5.2.1.5.3 PANS [b]). The content of the message should be easily understood after the 1st listening.

Modern aviation requires not only pilots and air traffic controllers with knowledge of English, but also technicians, managers, engineers, because all modern aviation documentation is in English, that is why ICAO continues its work implementing new laws and standarts of English in this field.

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THE USE OF NON-STANDARD PHRASEOLOGY IN EMERGENCY SITUATIONS

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Standard phraseology is often regarded as a must in every two-way communication between pilots and controllers as the use of any non-standard phraseology could lead to incidents or accidents. However, sometimes they have to use plain English in abnormal or emergency situations when there is no ready-made phraseology available that could fully provide information needed in an intended transmission.

Non-standard phraseology, or, in other words, plain English, is described as the spontaneous, creative and noncoded use of a natural language, although constrained by the functions and topics (aviation and non-aviation) that are required by aeronautical radiotelephony communications, as well as by specific safety-critical requirements for intelligibility, directness, appropriate, non-ambiguity and concision.

Evidently, standard phraseology always stands at the core of communication between pilots and controllers, but the role of plain language could not be overlooked.

Non-standard phraseology may be used in the following unexpected and non-typical situations: system failures, technical problems, damage to aircraft, obstacles on the ground or in the air, ATC equipment failure, terrorist threats, bomb alerts, sick passengers or crews etc.. It is considered much more formal than the language used on television and in everyday conversations.

An actual example of plain language being used by pilot to declare an emergency to air traffic controllers:

Pilot: Virgin 25B, we are going to have to declare a pan and go back to Heathrow. We have a medical issue with one of the pilots.

ATC: Virgin 25B, say all that again.

Pilot: PAN-PAN-PAN, Virgin 25B, PAN, we have a medical issue with one of the pilots after a lasering shortly after take-off. The other pilot is able to perform with his PNF (Pilot Not Flying) duties.

When non-standard phraseology is used, it should be delivered by the speakers in a clear, concise and unambiguous manner as required in standardized phraseology in emergencies or unusual situations in order to efficiently and safely give instructions, obtain and provide information, resolve misunderstandings, clarify or elaborate on instructions or when the need to negotiate information or instructions arises.

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THE ENVIRONMENTAL IMPACT OF AIR TRANSPORT. EXPLORE PROBLEMS AND DEVELOP SOLUTIONS

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Air transport connects the world, bringing people and goods together. The benefits of aviation also have an environmental downside. A natural question that needs to be asked is, "what effect is global aviation having on the environment?" Emissions, noise, industrial processes, and waste must be managed by the industry, reduced, and where possible eliminated. There are some factors, which have influence on environment:

- Aircraft Emissions that affect the global climate;
- Aircraft Emissions that affect the air quality;
- Aircraft noise

Aircraft emit a range of greenhouse gases throughout the different stages of flight. Aircraft are unique in that they emit gases directly into the higher levels of the atmosphere. Research suggests that gases can have different effects when emitted at this altitude relative to emission at ground level.

Scientific evidence strongly indicates that greenhouse gases contribute to climate change [1]. CO2 is generally viewed as the most problematic greenhouse gas. While many factors contribute to emissions in aviation, CO2 is primarily generated by burning carbon-rich 'fossil fuels' in engines. It has a long life cycle and plays a key role in climate change. Some factors are under the control of airlines, airports or regulators, but even the weather plays a part. In October 2018, The Intergovernmental Panel on Climate Change (IPCC) published its Special Report into the impacts of global warming. It concluded that climate warming due to human activities currently estimated to increase by 0.2°C per decade due to past and ongoing emissions [2].

Emissions from aircraft engines that affect air quality are Nitrogen oxides (NOx), Carbon monoxide (CO), Sulphur oxides (SOx), unburned Hydrocarbons (HC) and smoke. NOx in the lower atmosphere contributes to the production of ozone; ozone in the lower atmosphere is a pollutant, and contributes to global warming. Nitrogen oxides from high-altitude supersonic aircraft are thought to damage the stratospheric ozone layer, the protective layer that filters out harmful radiation from the sun [3].

Engine noise, especially around airports is another concern for the environmental sustainability of air travel. Noise is often defined as 'unwanted sound'. The law is clear that sound only becomes noise when it exists in the wrong place or at the wrong time - causing annoyance, sleep disturbance or other effects. Unlike most other forms of pollution, noise pollution depends not only on the physical qualities of sound itself but also on the human reaction to it. This makes measuring noise pollution a complex process.

Two basic measures for assessing noise impact are:

• Leq which means the 'equivalent continuous sound level'.

• Lden which uses an annual average of the Leq but also takes into account the additional annoyance/disturbance of noise generated in the evening and at night [4].

To assess the impact of noise, analysts identify how many homes and residents are located in areas where the Leq is over 57dBA or the Lden is over 55dBA (the levels at which noise has been considered to cause community annoyance) Average noise levels around an airport can be shown on maps known as noise contour maps.

Solutions to reduce impact of air travel on the environment

1. To deal with the problem of climate impact by the aviation industry, technology can be used in design and systems of planes to make them more efficient. A breakthrough in use of another type of fuel that is greener, like biofuels, hydrogen, solar panels and batteries, could save the world from the degradation of the environment.

2. Aircraft engines unlike other engines have no other greener alternative such as the use of solar or other renewable energy. Technological advancement in the sector might lead to electric planes that emit less and are more fuel-efficient. However, the sector remains negligent to matters of the environment.

3. One of the most effective ways to reduce amount of carbon footprint is by flying less often. This means in the case where other forms transport are available, it is not necessary for an individual to fly. Instead, driving or taking the train to the destination, as preference for majority of the people would mean airlines burn less fuel.

4. Carry less stuff. The more your baggage weighs, the more the plane has to carry and the less energy efficient it is.

In summary, it can be said, that the flying is indeed bad for the planet because it contributes to global warming, pollution, and leaves a huge carbon footprint. Aviation is growing very rapidly and, if left unchecked, will continue to grow at a very high rate.

Airplanes are important in various ways, such as import, export, tourism and business. Nevertheless, the importance of the industry comes with adverse effects, which continue to affect the climate with little or nothing to do because of how the industry is tremendously growing and there being no alternative to kerosene as fuel. Moreover, not paying attention to this problem can lead to irreversible processes.

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CRYPTOGRAPHY IN EVERYDAY LIFE

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In the age of the active development of digital technology, there is an urgent need to protect information.One of the most effective ways to do this is cryptography.

Cryptography is an important element of data protection. It can successfully solve a number of information security problems in computer systems and networks. Moreover, it is a combination of data encryption methods aimed at protecting this data and making it useless for illegal users. Real cryptography should provide such a level of secrecy to be able to protect critical information from decryption by large organizations.

Cryptography knows many different methods of data encryption. Many of them are based on complex mathematical structures, such as elliptic curves, rings, and finite bodies. There fore, the development of an integrated cryptographic system requires a good knowledge of mathematics.

Cryptography can be found in the lives of even ordinary users. Any messenger like Facebook can be an example of it [1].Facebook has a stored copy of your private messages because it doesn't use end-to-end encryption – and it's not the only one. Encryptions scramble messages so that if they'r eintercepted while being delivered they cannot be read. Facebook Messenger encrypts messages by default from the sender to its server, and then encrypts the message between the server and the recipient. Usually, the only people with the 'key' to decipher an end-to-end encrypted message are the sender and the intended recipient. It's particularly useful for sending sensitive information like bank details which you wouldn't want to fall in to the wrong hands or be stored anywhere online [2].

In conclusion, it is worth saying that cryptography is an important aspect of IT and is used by many applications and enterprises to protect user information.

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THE HISTORY OF AVIATION PHRASEOLOGY FORMATION

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The first planes took off in the sky more than a century ago. The lack of communication facilities made impossible the communication between the pilot and the ground services. During the aviation era flights were made at low altitudes, and the pilot could navigate the landmarks. However, the aviation did not stand still and the communication equipment between the pilot and the controller began to appear and long-range flights at high altitudes became possible.

Unfortunately, according to a report by the Interstate Aviation Committee, the creation of international routes and the emergence of a large number of airlines have led to significant increase in aviation events due to lack of understanding in the process of conducting pilots radio exchange with the air traffic controller and incorrect interpretation of aviation terms and their transmission via radio channels.

Since the aviation safety is directly dependent on quality of speech the specialists decided that it was necessary to choose a single language for radio exchange and to turn it into an operational language with maximum adaptation to any situations.

English became such a language in aviation. Studies by the Aerospace Linguistic Foundation, which compared 18 languages, showed that choosing English as an aviation language as the official language of radio exchange was the most optimal, as there were significantly fewer aviation events per 1 million flights (2 vs 5) than when using another language.

The next step was understanding that communication should be organized in a proper way. In 1982, the pilot A.F. Pchelinov set out his own observations and considerations regarding the relationship between crew members' professional communication and flight safety. The author noted that in order to minimize the time spent on speaking, "crew members try to construct sentences as simple as possible when constructing sentences, using well-known, expressive, audible words that carry specific meaning and have a clear interpretation." Moreover, he added that the speech of commands should start with the name of the equipment to be used in the operation like "landing gear retracted or extended", "remove flaps"; better perceived messages that convey the most important information (call signs, names, etc.) within the first two seconds; due to memory limitations, compressed and clear messages are better perceived, with a total number of words not exceeding eleven.

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MAIN FEATURES AND PECULIARITIES OF RADAR SIGNAL REFLECTION FROM THE SEA SURFACE

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Nowadays travelling by plane became one of the most effective methods, whereas long distances can be overcome in a matter of hours. The safety of the flights is a major factor in aviation. To ensure this the location of the aircraft should be known. This is the main goal of a radar. To determine the coordinates of the aircraft we need to know the distance from the radar to target and the azimuth. The ground station is a rotating antenna. The radar sends an energy pulse towards the target, some of that energy is reflected back and captured by the radar. If the speed of energy propagation and the time interval between the emitted and received pulses is known, the distance to the target can be calculated. The azimuth of the aircraft from the radar is determined by the position of the antenna rotating at the time of receipt of the response.Taking into account the fact that the radar generates signals not only in the direction of the target, but also on the sea surface, the reflected signal can limit radar detection ability. Also some external factors such as the nature of underlying surface, the possible loss of signals, the reflection from non-aviation objects, weather conditions might influence on radar's ability to correctly and timely identify targets. In this article the main features and peculiarities of radar signal reflection from the sea surface will be considered.

The sea is a distributed target and the magnitude of the reflected signal depends on the area of the irradiated zone. In order to enable the influence , the signal reflected from the sea surface is described as radar cross-section devided by irradiated area. It may be defined as $\sigma^0 = \sigma/A$ (σ — radar cross-section, A — irradiated sea area, σ^0 — local interference coefficient). Figure 1 shows how local interference coefficient changes depending on the glide angle.

There are three area on the graphic quasi-mirror reflection, plateau or diffusive scattering and interference zone. In the area of quasi-mirror reflection when the angle of descent is close to the vertical reflected radar signal is large enough and it is called altitude reflection. While designing a radar which is intended to work above the water surface it is important to take into consideration altitude reflection. Considering the reflected signal in the vertical fall can be so large that the energy can flow to the radar through the side lobes of the aerial diagram. As a result some noise occurs and target's location can be calculated completely wrong. The value local interference coefficient is decreasing while the angle of descent is decreasing too in plateau zone. In this area a straight wave interferes with the reflected almost as it propagates over a flat earth's surface.

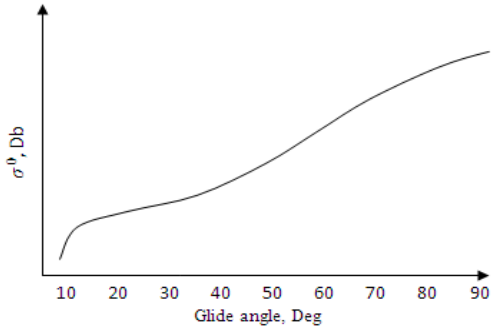

Fig. 1. Change of local interference coefficient depending on the glide angle

It is worth paying attention to polarization. At glide angles of more than 60 degrees, the polarization of the signal has little effect on its reflection from the sea surface. However, at small glide angles, this effect becomes significant. With a calm sea and light wind, the reflection of a signal with horizontal polarization is much less than the reflection of a signal with vertical polarization. With increasing wind, the reflection of a signal with horizontal polarization increases faster than the reflection of a signal with vertical polarization. Therefore with strong sea waves, the difference in the intensity of signal reflection from the sea surface becomes less dependent on polarization As the reflection from the sea surface is different for the two polarizations, the behavior of the reflected signal at small glide angles can also be different. The reflection of the radar signal from the sea surface with horizontal polarization is more similar to “flashes” than from the sea surface with vertical polarization. The reflection of the signal with vertical polarization occurs from the wave surface.Among other factors affecting signal reflection, weather phenomena can be distinguished. For example, rain, snow, and ice can smooth out waves in the ocean

Also, measurements of the radar signal reflection can give erroneous results if reflection from the rain is not taken into account. Ocean pollution can also reduce or smooth out waves. In addition, Various objects on the surface, clouds and rain often create effects that are perceived as a target, or they can change the nature of the reflection of the signal from the sea surface. All of these features must be noted while designing a radar intended to identify targets on or near the sea surface.

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HACKERS IN OUR LIFE

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A computer hacker is any skilled computer expert that uses their technical knowledge to overcome a problem. While "hacker" can refer to any skilled computer programmer, the term has become associated in popular culture with a "security hacker", someone who, with their technical knowledge, uses bugs or exploits to break into computer systems.A hacker attack is a set of actions aimed at searching for vulnerabilities in digital systems, for example, computers, smartphones, tablet devices, or even entire computer networks. It should be noted that hackers are not always engaged in malicious activities, however today the term “hacking” is usually used in the context of illegal actions, and hackers are called cybercriminals who seek financial gain, protest, collect certain information (that is, engage in cyber espionage) or just want to have fun. The term so popular today appeared in the late 1970s. In 1980, the "Psychology Today" magazine published an article called "The Hacker Papers", which discussed the issue of computer addiction. In 1982, the American science fiction film "Tron" was released, in which the protagonist calls himself a hacker and intends to penetrate the computer system of the company. The plot of the film "War Games", released a year later, is built around a teenager's attack on the computer network of the North American Aerospace Defense Command. This fantastic film presented hackers as a threat to national security. Contrary to the belief that these feature films anticipated real events: a group of young people hacked the computer system of the United States and Canada.

In general, we can say that hackers usually intend to break into the protection of an individual computer or computer network, being driven by one of four motives: criminal activity brings financial benefits: the object of the hunt is credit card numbers or even entire banking systems; the right to call yourself a hacker is inextricably linked with public recognition, which motivates hackers to leave special tags on hacked websites. Often they simply engage in digital vandalism to show everyone what work they have been able to do; hacking also exists at the state level: in this case, hackers aim at corporate or state secrets, destabilize the enemy’s infrastructure, or even spread hostility and confusion in the society of a country. Be careful, maybe someone is trying to hack you now.

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STANDARD AND NONSTANDARD PHRASEOLOGY IN AVIATION ENGLISH

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This study aims at investigating the lexical items in Aviation Phraseology that has both standard and nonstandard meanings when Pilot and Air Traffic Controller (ATC) use them in radiotelephony. Through the analysis and a survey research, the present study reveals that the lexical items go ahead, hold short, priority, and affirm are used occasionally in nonstandard ways that might lead to misunderstanding, and thus posing potential conflict situations. Precisely, the non-standard use of Aviation Phraseology in this study shows discrepancy in the efforts of the International Civil Aviation Organization to provide “maximum clarity, brevity, and unambiguity”.

English was established as the official language of the International Civil Aviation Organization (ICAO) in 1951, and only in 2011 has the ICAO implemented language requirements on aviation personnel including the usage of standard phraseology in all radio communication. In recent years, most aviation disasters have been caused by human errors, and one of the most common forms is miscommunication, which can potentially lead to catastrophic aftermath. One contributing factor to the occurrence of miscommunication is the wrong interpretation of instructions. For example, the controller may use a certain word with standard definition to command, but the pilot may interpret the word incorrectly.

In June 2014, there was a runway incursion at Ottawa International airport declared. There was a collision between a Medevac helicopter and A300 cargo plane. The ATCO arranged Medevac’s clearance by setting: “LF 4 Medevac Roger, while we wait amend your Ottawa 3 for a right turn heading 290˚ balance unchanged”. The tower controller detected that AW139 was crossing the hold short line at the time when FDX 152 Heavy (A3OO) was landing on runway 25. The airport controller first instructed to LF4 Medevac using general English “while we wait”, which can be misinterpret as “line up and wait”. Furthermore, the Medevac pilot contemplates a clearance to take off in case of the instrument flight rules clearance. Another circumstance is that the Medevac pilot did not monitor runway condition before moving across the hold short line, which caused the runway incursion with FDX 152 Heavy (A300) approaching to land.It was found out that the controller had never been required to use either of these phrases since qualifying.

Phrases: *go ahead, hold short, priority* and *affirm* were identified with standard and nonstandard definitions. The standard definitions were based on Radiotelephony Manual

ICAO’s Standard Phraseology while the nonstandard definitions of the identified lexical items were based on the analyses in the ATCs Air Traffic Controllers’ and Pilots’ surveys and on the ICAO Phraseology Reference Guide.

Lexical phrases	Standard Use	Non-standard Use
Go Ahead	to give permission to state a request	to move forward
Hold Short	to not cross or enter the mentioned runway	to proceed or to continue
Priority	to state emergency situation that is often mentioned together with the terms “MAYDAY” or “PAN-PAN”	considered non-standard if it does not state the kind of emergency
Affirm	used to define “yes”	should be “affirmative”

Situations where Nonstandard Use Occurs (Air Traffic Controller Survey): 28.57% of the respondents picked Route or En-route Clearance where nonstandard phraseology is most commonly used. However, it is during Taxi Clearances, Landing Clearances, and Approach Clearances where nonstandard phraseology is seldom used with 3.57%

Situations where Nonstandard Use Occurs (Pilot Survey): It is during Takeoff Clearances, Altitude Clearances, Approach Clearances, and Landing Clearances where nonstandard phraseology is commonly used with 15.79%. However, the pilots agreed that during Route or En-route Clearances and Taxi Clearances non-standard phraseology is rarely used.

According to the Air Traffic Controllers and Pilots and on the ICAO radiotelephony manual, Air Traffic controllers, pilots and aviation students should be aware that lexical items with standard and non-standard definitions exist.

Aviation staff should also know that the nonstandard definition of a lexical item can create confusion and should know the proper phraseology for each situation during flight operation, so that there will be a transparent communication in giving clearances to prevent misunderstanding.

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MICROWAVE GENERATOR USING 0.12 μM CMOS TECHNOLOGY

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An electronic oscillator is an electronic circuit that produces a periodic, oscillating electronic signal, often a sine wave or a square wave. [1]. They are widely used in many electronic devices ranging from simplest clock generators to digital instruments (like calculators) and complex computers and peripherals etc. [2] Common examples of signals generated by oscillators include signals broadcast by radio and television transmitters, clock signals that regulate computers and quartz clocks

The p-channel MOS transistor must be designed according to the design rules and usual design practices. The p-channel MOS is built by using polysilicon as the gate material and P+ diffusion to build the source and drain. The PMOS device requires the addition of the n-well layer to the polysilicon and diffusion layers. The P+ diffusion must be completely included inside the n-well layer, to work properly.

The poly/poly2 capacitor simply consists of a sheet of polysilicon and a sheet of poly2, separated by a specific dielectric oxide which is 20 nm in the case of the default CMOS 0.12 mm process. The contacts are placed on both sides of the capacitor, between poly and metal on the left, between poly2 and metal on the right Fig.3.5. The gate oxide is not used here because of its low breakdown voltage. A dual-oxide (5 nm) would also suffer from voltage over-stress that may occur in many analogue designs, such as power amplifiers in radiofrequency. Moreover, a thick oxide suffers from fewer process variations, which ensures better control of the final capacitance [3]

As process variations mainly affect the peripheral aspect of the layers, square geometry performs better than rectangular geometry. The optimum dimensions lie between 10 x 10 mm and 50 x 50 mm. If larger sizes are used, gradient effects affect the quality of the oxide which is no longer uniform in the whole dielectric surface. Consequently, the capacitor should be split into 50 x 50 mm units. Also, no device or diffusion region should be designed next to the capacitor. It is highly recommended to shield the capacitor area by using a guard ring of contacts which limit the substrate noise that may couple to the lower capacitor plate. Also, the high impedance node should be connected to the upper plate of the metal, which is more isolated from the substrate and lateral noise.

A passive component designed to resist changes in current. Inductors are often referred to as “AC resistors”. Using the parameters (2 turns, width 10μm, spacing 5μm, hollow 53μm), the coil inductance approaches 1 nH, with a quality factor of 45.58. A high-quality factor Q is attractive because it permits high voltage gain and high selectivity in the frequency domain. The usual value for Q is between 3 and 50. A significant improvement consists of using metal layers in parallel. The selection of

metal 1, metal 2, up to metal 6 reduces the parasitic resistance by a significant factor, while the capacitance is not changed significantly. The result is a quality factor around 45, for a 1 nH inductor.

The layout of the PMOS oscillator without a tail current source is shown in Fig.1. Each PMOS transistor has 5 fingers with a channel width of 0.12µm. So, the total channel width is determined as 5×0.12µm=0.6 µm. We`ve used the real capacitors and inductors.The results of simulations are taken by Microwind software shows waveforms and spectrum of PMOS oscillator. Fig.4 shows the maximal value is equal to 2.61 V, is close to 1.2 V.

The amplitude spectrum of the PMOS oscillator is shown in Fig. 3. The first harmonic frequency which we get is 11066 MHz at voltage 1549.04 mV. From this figure, we can see that the next harmonics insignificantly small, so we neglect it. It means that the phase noise does not effect our microwave oscillator.

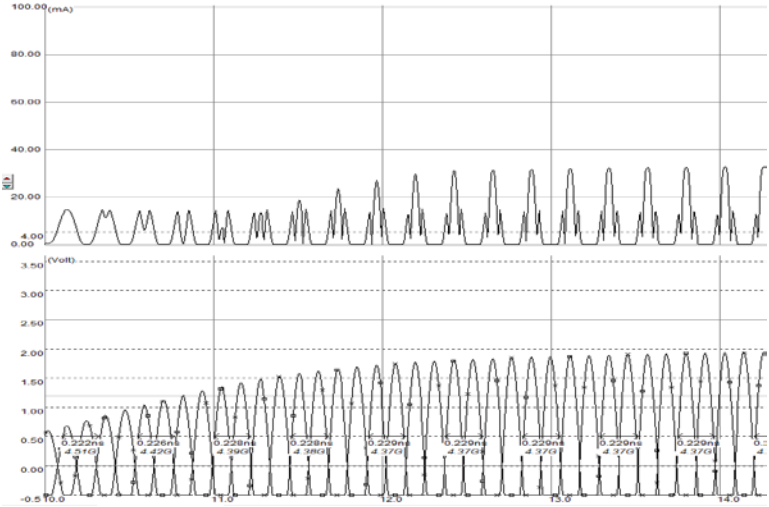

Fig. PMOS oscillator waveforms, and current

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SIMPLIFIED TECHNICAL ENGLISH AS THE WAY TO REDUSE AVIATION MAINTENANCE ERRORS

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As we know, English is the international language in aviation which is most frequently used in technical documentation. Nonetheless, for about eighty percent of maintenance staff, English is not a native language. In some cases, it can lead to misunderstanding and in turn even to accidents. Thus, the Simplified Technical English (STE) was developed to reduce the maintenance errors caused by difficulties with language.

In 1979 Association of European Airlines (AEA) decided to integrate a simplified form of English into aircraft maintenance documentation. They wanted to satisfy such requirements as a small number of words, words should have a clearly defined meaning, they should be defined parts of speech and have a simplified structure.

It was performed extensive work and, as a result, specifications for writing maintenance manuals were released. According to them, documentation written in STE is required to be:

- accurate (corresponding to standards with high accuracy);
- complete (including all needed information);
- relevant (related to a document topic);
- concise (including all information in the shortest form);
- convincing (should be undeniable);
- meaningful (with meaning for purpose);
- unambiguous (leading to only one conclusion).

Nowadays Simplified English Maintenance Group (STEMG) still supports the STE and realizes updated issues for specifications. The language should be improved according to the development of technologies and innovations. It is also important to obtain and register feedback from maintenance workers and inspectors.

The STE specification includes two parts:

- set of writing rules;
- controlled vocabulary.

The first part about writing rules contains grammar and style aspects, rules regulating words, layouts, and sentence length usage. Nevertheless, the STE writing rules do not replace English Grammar, they are like a guide for readers that obtain texts on STE.

The vocabulary contains general words that are simple and easy to recognize. In general, each word should have only one specific meaning and be definite a part of speech. Moreover, STE allows some specific additions to vocabulary that are oriented

towards a concrete company or a project. In such cases, words are submitted according to specific rules of STE, and they must be assigned to one of the listed categories of the STE Specification.

Today, the aviation industry is developing very fast, more and more new innovations are being integrated into it with the purpose to increase system dependability and reliability. So, errors made by humans can become the cause of events that in turn decrease the dependability. In aviation, the human factor is directly associated with technical maintenance. There are a lot of contributing factors (connected to language difficulties) that may lead to errors while performing maintenance:

a) maintenance staff have not enough oral and/or written English skills;

b) very complicated task instruction (Task Cards);

c) not full or incorrect understanding of information from aircraft technical manuals and documentation;

d) lack of time (commercial pressure).

Undoubtedly, the language that is used in technical documentation and aircraft manuals is very important to provide correct maintenance performance. It is especially true when this language is foreign for a person who carries out procedures relying on such documentation.

In brief, the key role of STE is the reduction of errors caused by the human factor in exploitation and maintenance processes. Consequently, the STE is like a basic structure for connection between design engineers and maintenance staff. The correct understanding of technical documentation and manuals by mechanics and inspectors will help to increase aircraft safety and reliability.

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KEEPING TRACKOF HUMAN BIOPOTENTIAL

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An important factor in controlling an aeroplane is the pilot himself. Therefore, it is important to know in what physical and psychological state he is. To do this, you need to read the pulse, sweat and other factors. You also need to establish a continuous connection to the data processing point [1].

Biopotential refers to electrical signals associated with the functioning of the human body. We can discover and harness electricity to build the devices that allow us to detect and monitor and analyze the electrical signals used by the body to perform the physiological and intellectual processes.

Anyways, so this or that biopotential can tell us something about the state of the human body. Next, we have “R-to-R” detection. The R-to-R interval refers to a specific measurement associated with a person’s heart rate [2].

In keeping with the general analogue-front-end architecture, the MAX30004 conditions the input signal digitizes it, applies some digital signal processing according to the needs of the application, and provides the final data to an external processor via a standard serial interface (in this case SPI).

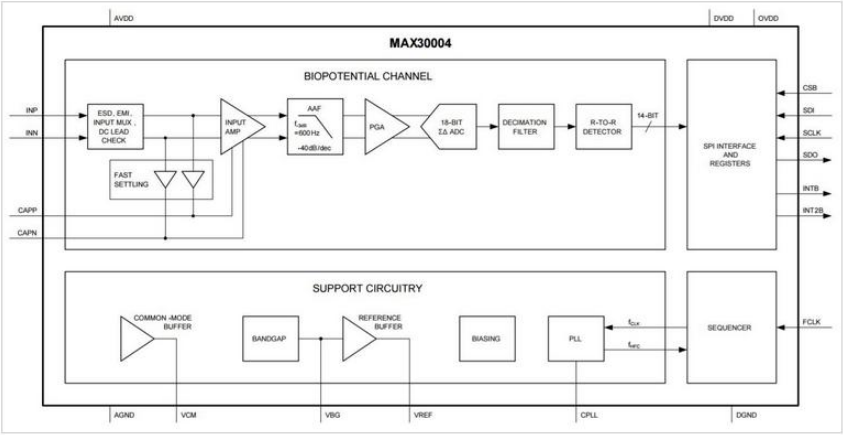

Fig. 1 Block diagram of MAX30004

Note, that the input signal is differential.Sort of amplitudes in a standard heart-rate monitor application are small—generally less than 1 mV. Hence the need for carefully designed analogue signal-conditioning circuitry. The following diagram shows an equivalent circuit that can be used to model the electrode interface. It also specifies the EMI filter that constitutes a large portion of the external components required in a typical MAX30004 (Fig.1) application.

The MAX30004 can be configured to enter a low-power sleep mode between heartbeats. From a human perspective, it seems rather stressful to be falling asleep and waking up so frequently, but apparently,it's not an issue for the MAX30004, and it certainly seems like a good way to extend battery life.

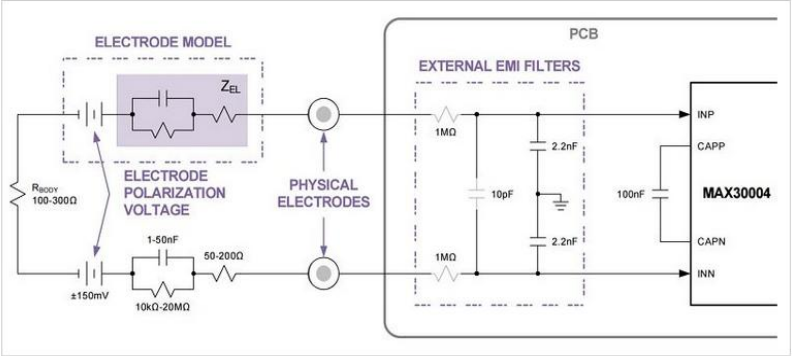

Fig.2 Implementation

Besides, as usual, few external components are required. It is can be some capacitors, and a microcontroller, and the circuit that produces the differential input signal. The fundamental components are electrodes. In this context, an electrode is something that attaches to the body and introduces physiological electrical signals into the environment of a standard electronic circuit. Also, the need for carefully designed analogue signal-conditioning circuitry (Fig.2).

The device reads the data, sends through the server to the database, which is processed by the algorithm, but because of neural networks [3] and then the conclusion is read in missing control centre.

Ultimately, a device that reads data about the pilot's biopotential and sends it to a database, where there is an algorithm that determines the state of the person, is created. Creating neural networks will make it easier to identify and predict a human condition. Also, in the future, you can create an algorithm that allows you to recognize false data that the pilot transmits and to prevent the consequences. For example, recently in the Alps, a plane dropped, where the second pilot led him uphill. All passengers were killed. With such a device, the checkpoint would certainly notice changes in pulse rate and other factors, and in such case, the first pilot would not leave the cabin.

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THE INFLUENCE OF NATURAL PHENOMENA ON THE FLIGHT SAFETY: MICROBURST ACTIVITY

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Obviously the weather plays an extremely important role in aviation, particularly in flight safety. The sky could be either a friend or an enemy for the airplanes taking off into it every day. Fortunately, people have learned a lot about the weather and its phenomena. All of the aircraft are built with respect to it. People can even predict the weather. So, what is the problem? The problem is that some natural phenomena are unpredictable.

Let us speak about microburst – one of the most uncommon but very dangerous phenomenon for aviation. It was firstly suspected in 1972 by a researcher called Ted Fujida who was flying over a Siberian forest when he saw how thousands of trees had been blown down in a pattern radiating outwards from a single point [1]. He understood that it could not be a tornado because the tornado follows a path and thus the research into this phenomenon began. Only in the 80s NASA finally got the understanding of how microbursts are caused and recognized that even a large aircraft could not survive them.

Unfortunately, on August 2, 1985, the fears came true. As Delta Airlines Flight 191 approached Dallas-Fort airport, it flew into a thunderstorm. At 800 feet plane's speed suddenly increased to 173 knots without any throttle. Just as suddenly, the speed dropped to 119 knots, even though the pilot was applying full power. To prevent a stall, the pilot pushed the nose down but the plane could not gain height anyway. The aircraft struck the ground over a mile short of the runway [2].

A microburst is a shaft of fast-moving cold air that hits the earth from high up in the atmosphere, then spreads out in all directions. It is caused when a thunderstorm carries massive amounts of wet warm air high into the atmosphere. This air then cools and rushes to the earth because of its huge weight [3].

To draw the conclusion one could say that people always adapt to everything. It was written before that pilots had learned how to cope with microburst. Yes, it is great, however, on the other side of the coin they did it because of an accident which had been occurred before. It is not very good practice, nevertheless, it exists. People must strictly follow the existing rules and continue to explore the weather to develop flight safety more and more.

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WHAT SKILLS OF A PROGRAMMER WILL NEVER BECOME OBSOLETE AND ALWAYS BE IN DEMAND?

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Today, programming is at the peak of demand. All industries are developing thanks to technologies that programmers create, so this profession is considered one of the most promising.Programmers' skills for different specializations will vary. However, any programmer solves many problems that require not only logical thinking, perseverance, a creative approach to solving each problem, but also the ability to constantly improve.

Most of the programmer's work involves writing source code in one of the programming languages. There is always the possibility of vulnerability in a product, so it is important for a programmer to be able to write not just clear, but a safe code. Attention to code testing is a key skill for safe programming, without which it will never be possible to protect a web application from hackers.Since companies compete for qualified specialists, this skill will help you get into the most interesting and advanced projects.

I also want to add that one of the most important skills for a programmer, and for an IT specialist as a whole, is the ability to plan and manage his time.If it is pumped, a reliable member of the team is obtained from the developer.Violation of the promised terms even for the most experienced programmer with extensive knowledge can turn into a conflict and at least spoil his impression of a specialist.

Like any other skill, the ability to plan time can be pumped. First you need to learn to understand exactly how much time it takes.Today, there are a lot of tools for this: plug-ins, time trackers for development environments, extensions to chrome, fitness bracelets with a reminder, etc.In the evening or at the end of the week, you can sit down and analyze how many hours you actually devote directly to your direct task.All "distracting" actions (chatting, drinking coffee, watching videos on YouTube) also need to be considered. If it becomes clear that you are not efficiently allocating your work hours, you can use pomodoro methods or similar time management techniques.Having real information about how long you can complete a certain task, you can plan work with great accuracy.

As a result, I can say that the ability to write clear code, proficiency to plane and manage time, system thinking, working with version control system – these and other skills are useful regardless of the direction of development and technologies used.

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SPYING ON INFORMATION SYSTEMS THROUGH ELECTROMAGNETIC RADIATION

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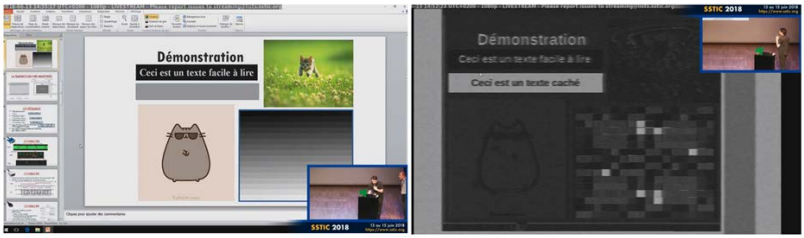
Side-band electromagnetic emissions, as a result of nonlinear processes, are generated and radiated into the environment in the blocks of technical equipment such as keyboards, computer monitors, printers, etc. The level of hidden signals may be sufficient to receive a radio signal at a certain distance from the electronic devices, so it's critical to understand the nature of the phenomenon.

Tackling this issue has become all the more urgent in the current world of digital transformation. The main purpose of the research is to analyze side-channel leaks through electromagnetic radiation and to identify basic methods of protection. The first publications about emanating spurious transmissions appeared in the early '80s of the last century. An article that was written by Dutch scientist Wim Van Eyck "Electromagnetic Radiation from Video Display Units: An Eavesdropping Risk?", published in December 1985, has drawn the greatest attention to the topic of leaking electromagnetic emanations. [1]

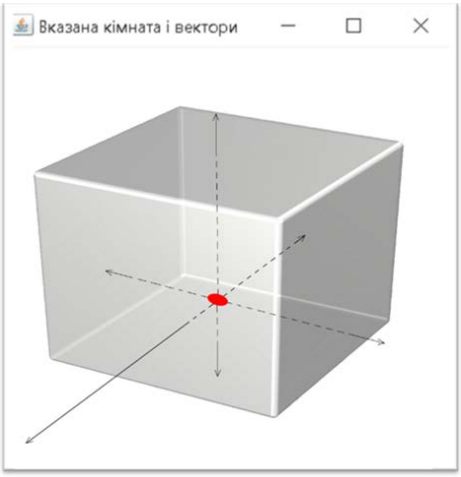
Experts consider traditionally that this form of eavesdropping is very time-consuming and expensive, and this task requires the use of advanced sophisticated special equipment. But, to intercept the side-band electromagnetic emissions the enemy can use even 15$ worth equipment. A software package (TempestSDR), that recovers images from a computer monitor and video card, is a good example of an inexpensive method of eavesdropping. Such software solutions reduce costs and increase mobility for picking up side-band electromagnetic emissions.



Img.1. Demonstration of picking up side-band electromagnetic emissions (10 meters) with TempestSDR at SSTIC conference

The most dangerous method of spying on information systems through leaking emanations is called Soft TEMPEST. It was described by M.G. Kuhn and R. D. Anderson. The experts believe that there is a special computer virus that allowseavesdropping the information from the computer using unintentional radio or electrical signals. It searches the confidential information in the computer memory,

and if relevant information is found, it is used to modulate the signals of side-band electromagnetic emissions. The authors suggested using a video bus to transmit these signals. However, the program can be created under any other bus in computer architecture that can be programmatically controlled. [2]It is necessary to determine the size of the “controlled area”, which controls the presence of unauthorized persons in the facility, and the possibility of using intelligence equipment because in this zone there is a chance of interception the information.After analyzing indoor radio propagation models, it was determined that Hata and COST231 MWM are the most versatile and can be used to describe the threat model. It was decided to develop the special software that will effectively calculate the “controlled area”. There are several scenarios of spreading electromagnetic emissions: external - external; internal-external; internal - internal.



Img.2. Software for calculating the “controlled area”

From these facts, one may conclude that the widespread use of computer technology in data processing systems has raised the problem of protecting information from unauthorized access. Notice that the protection of data in information systems has several specific features, because it is not rigidly connected to the carrier, and therefore can be copied and transmitted through other communication channels.

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WHY IS CYBER SECURITY IMPORTANT IN THE MODERN WORLD?

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Presumably, you're now very much aware that cyber security is something nobody can afford to ignore. Unless you hide from the world's media, you must know that hacks and data breaches regularly affect firms of all sizes. Often these incidents are significant enough to make the front pages, causing irreparable reputational damage to the companies involved.

Fundamentally, we're living in a far more technologically-advanced world than we were as recently as a decade ago. If you need convincing of this, consider the fact that the iPad has only been around since 2010, and the iPhone only came out a few years before that. Average broadband speeds have increased by roughly five-fold in the last decade, making it possible for businesses and individuals to do far more online.

A particularly valid example of the change that this has facilitated is the rise in cloud services. Nowadays, most businesses take for granted such things as easy online document sharing, email that's available on every device, and databases accessible from everywhere. While the years have seen enterprises increasing deployment of business-critical applications in the cloud, Amazon's Elastic Compute Cloud has only been available since 2006 [2].

Protecting your personal data is very important in ensuring your business is never compromised. Failure to protect your information will lead to destroying the trust that your customers have to your business. You also need to ensure that your data is well protected by ensuring that you have strong passwords. Those who have lost their cash through cybersecurity found themselves in that situation because they used weak passwords. So if your company does not have the policy to help their clients set strong passwords, it is high time you made drastic changes before it is too late.

Cybersecurity is also very important as it plays a significant role in increasing the speed of your website. This is because the virus and the malware that might attack your system will not only steal your important information, but it will also slow your systems. This can cause a lot of misfortunes to your business. Do you know why? It is because most people are time sensitive. If they try to access your system and they realize that it is slow, then there are high chances that they will never come back [5].

Cyber security doesn't involve just businesses and the government. Your computer, tablet and cellphone probably contain information that hackers and other criminals would love to have, like other people's email addresses, names and birthdates. Suppose, for example, a hacker had access to your contact information. He could then send an email or text message to everyone you know, using your name, encouraging them to click on a link containing malware. In a connected world, we

each have a responsibility to protect ourselves and the people we interact with, and it all starts with understanding cyber security [6].

The online world is a dangerous place for both individuals and organizations alike. Without good cyber security measures, there's no way to protect privacy or other sensitive information on the Internet. With so many people and business being dependable on the online world, it's essential that the main focus goes on the cyber security [4].

One of the most important groups to teach about cyber security is our youth. While they may not be banking or using credit cards to shop online, they can make it very easy for cyber criminals to access data through creating in secure personal accounts.

Weak passwords and bad practices in email or social media make it much easier for others to hack into your account and gain access to your friends' and family's data. Whether it's a bank account number, a photo best kept private, or complete identity theft, no one wants to be responsible for cyber crime on their loved ones [1].

So, cybersecurity is a very important topic and has very severe consequences when not properly addressed. It focuses on keeping networks secure and information safe from hackers. Cyber threats can have ramifications for individuals, businesses, and in some cases entire nations. Upcoming trends for cybersecurity include increased automation and inclusion of artificial intelligence, mobile devices becoming a threat to businesses, internet of things devices becoming targets for hackers, businesses training employees to deal with social engineering, and cyber threats resulting in tougher regulations and possible legislation [3].

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THE IMPORTANCE OF LEARNING AVIATION ENGLISH FOR NATIVE SPEAKERS

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English is the de facto an international language of civil aviation. It is an incredibly helpful language in the aviation. All radiotelephony communication between the pilot and ATC is held in English. Due to this fact, it is essential to learn Aviation English for non-speakers and native speaks as well.

Native English-speaking aviation professionals are automatically estimated level 6 ICAO, they may also be sub-standard communicators in Aviation English, prone to the use of non-standard terms, demonstrating impatience with non-native speakers, and speaking excessively, and too quickly. Such native speaker failures tend to worsen in emergency.

When pilots and ATCs communicate, they use special aviation terminology, speak in a technical manner and this makes their language sound like a special code. This code is not changed, if the plane flies over Kyiv, London or Beijing and pilots connect with a local air traffic control tower. Have you ever heard “wilco”, “mayday mayday mayday” or “roger” in the films about aviation? They are used everyday in the cockpit.

The Aviation language consists of a mixture of professional phrases and plain English. Aviation English has a specific alphabet which makes spelling on radio communication easier to understand and approximately 250 aviation terms.

In general, native speakers and aviation officers for whom English is not native have the same opportunities and responsibilities in mastering the aviation English.

The main reason why for a third-part listener, aviation English may seem like some kind of code, because the messages of pilots and controllers should always be as clear and concise as possible. And for this reason, native English speakers are learning their native language to some extent.

Native speakers are ideal English teachers, but in some cases, a native speaker may be in a difficult situation if the aviation language rules are not followed.

In some situations, they may use phrasal verbs or idioms that can interfere with the smooth exchange of information. People who have learned English as their second language in such situations will respond more specifically, as they will directly follow the so-called code that they know by heart.

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FREE ROUTE AIRSPACE

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Abstract — these days, one of the major problems with the usage of airspace is its lack. Major quantity of delays in air transport are closely connected with the overload of airspace in regions with the high traffic.

At present, aviation is the largest link in the field of passenger and cargo transportation, and also in other activities to improve their efficiency. Due to this, the networks of routes are insufficient to meet the needs of today's air traffic flow. To solve this problem, concept of "Free Routes Airspace" was created. The concept is an airspace within which users can freely plan a route between a designated point of entry and a specific point of exit, with the possibility of planning a route through intermediate (published or unpublished) points, without reference to the ATM route network, depending on the available airspace in the area. Air traffic within this airspace remains subject to ATM control.

The concept of free route airspace is not intended to completely replace the network of ATM routes, but only a part of them, and will be installed over the airspace with ATM routes mainly. The lower limit will be set as low as possible, taking into account the unity, complexity and congestion of airspace in each area, and the upper limit will be at the maximum permissible height of use of the airspace. Generally, the free route airspace will be classified as "Class C" airspace with some exceptions depending on the conditions in each area. Horizontal boundaries will be selected mainly based on operational requirements regardless of the boundaries of the existing areas of controlled airspace.

The main advantages of using free route airspace:

• Reduced flight time;
• Reduced the number of conflicts;
• Reduction of CO_2 and other pollutants.

The main problems that may arise are:

• Conflicts can be more difficult to detect;
• Implementation to changes to the separation methods used.

Generally, the use of free route airspace will improve flight efficiency, increase the capacity of the ATU sectors and make the usage of available airspace more flexible.

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ELECTRONICS

MODERN ELECTRONIC MOBILE WEATHER STATIONS

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Today on the market you can find weather station of any format. They are different in price, function and purpose (for the field, greenhouses, barns, gardens, etc.) and the number of options.

Weather station - a device for monitoring the weather conditions on the street and indoors. The device provides weather forecast, determines atmospheric pressure, humidity level, temperature, and performs a number of other measurements.The meteorological station is useful for sensitive people, parents of often chilled children, and those with asthma and cardiovascular disease. This device is useful for fishermen, gardeners, agronomists.

The simplest weather stations include three devices that are combined in a single housing or act as separate sensors:

- thermometer - measures air temperature;
- barometer - measures atmospheric pressure;
- hygrometer - measures humidity.

More sophisticated models are further equipped with an anemorumbometer or weathervane that measures wind direction and velocity, an odometer or a pluviograph used to determine rainfall per day.

Semi-professional - a more expensive option that allows you to install additional modules and the necessary software. As a result, the measurement accuracy is increased.A projector, moon and zodiac calendar, display backlight may also be provided.

Professional - the most expensive solution that is used in highly specialized areas, such as the oil industry, marine meteorology. Such devices are assembled from numerous modules under specific conditions, thereby achieving high measurement accuracy.Standard functionality: thermometer, hygrometer, barometer, wireless sensor that captures wind speed and direction, USB port, remote control.

The La Crosse WS272 is a wireless thermometer-hygrometer with the function of oxygen quality control in room. The La Crosse WS272 thermometer-hygrometer consists of a main unit and an external thermometer La Crosse WSTX37 IT +.

The La Crosse WSTX37 IT + external temperature sensor is installed on the street or in another room at a distance of up to 100 meters of direct visibility from the main until La Crosse WS272. The external sensor measures the air temperature and transmits the measured value to the display of the main until.The display of the main device La CrosseWS272 displays the measured temperature and humidity in the room, indications of the outside air temperature, indications of CO2. When exceeding the

permissible level of CO2 in the room, the thermo-hygrometer La Crosse WS272 informs by and additional light indicator.

The CO2 Thermohydrometer Walcom HT-501 is used in the industry and in the home to determine the concentration of CO2, relative humidity and temperature in the premises.It has compact dimension, simultaneously displays the value of CO2 concentration, relative humidity, temperature, date and time on the liquid crystal display. Also, the screen shows the level of charge of the built-in battery. The device can be connected to a PC via a USB port for making adjustments using a software package and for transferring recorded measurements to obtain graphic charts and a detailed list.

The AZ-7788 is a highly effective device for monitoring the CO2 content in the air. The device is set with a 15-degree tilt angle for easy viewing and reading. The current time and calendar are displayed on the screen. The warning level of CO2 concentration is set to within 1000 ~ 5000 ppm when the signal is switched on. The large screen displays the CO2 content, temperature, humidity, date and time.

DT802 – analyzer concentration of carbon dioxide CO2, designed to monitor the air quality and measuring the level of CO2 in offices, hospitals, educational institutions, in places long stay people. Measurement of the gas analyzer is based on the sensor NDIR (non-dispersion infrared). The principle of its work is based on the absorption of CO2 by molecules of radiation in the infrared range.

Air Visual Pro can be used indoors and outdoors. Automatic calibration takes into account surrounding factors: temperature, humidity and contamination, so as to accurately determine the level of PM2.5 and CO2 in the air.All AirVisual Pro users are united into once community and become sources of data that uses machine intelligence for analysis and recommendations. Through a special mobile application or website, the company is encouraged to monitor air quality, weather forecasts, including the data of nearby monitors, as well as receive tips for improving the environment, such as ventilating the room or turning on the cleaner. To monitor the indicators of air pollution in different places is offered in real time.

The considered devices are very similar to each other. Basically, they have similar functions: measurements of air temperature, humidity and carbon dioxide concentration.But I think that for everyday household use, at least there is not enough measurement of the concentration of carbon monoxide, the source of which are gas stoves, ovens, heating boilers, etc.

Also, most of the described devices are suitable for measuring the quality of air in one room (for example, a kitchen), since they have measurement sensors built into the device.

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PARKTRONIC

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Theme of my science project is layout of parking sensors. For a start I tell what is this, which function of this device and with which repair parts consist of. **Parking sensor** – it`s an optional proximity sensor system installed on vehicles to facilitate parking maneuvers, warns the driver of approaching an obstacle in the bling spot of the car. Detection of obstacles is monitored by sensors. They are installed on the rear or front bumper of the car and the principle of their operation is based on ultrasonic waves. They constantly emit waves. When a foreign object or obstacle enters their area of influence, they signal the electronic unit.

Main platform of building of parking sensors is Arduino [1]. To setting-up layout of parking sensors will needed such as parts:

- bread board;
- Arduino UNO scheme;
- wires;
- rangefinder 5V;
- cabel USB – A;
- piezo emitter 10 mA;
- LEDs 5-10 kOm (2 greens, 2 yellow, 1 red);
- resistors 8 kOM (5 pieces);
- schema connection`s of parts.

In order to make it work, you will need a software such as Arduino IDE[2]. After you must create program code on C++[3] language. Libraries that's be used in code: #define led2…8, #define buzzer (for piezo emitter), #define trigPin and #define echoPin used for rangefinder. Functions that's be used in code: digitalWrite() – measuring; delayMicroseconds() - stops program execution for the number of microseconds specified in the parameter. General peace of code writted in cycle if else.

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PORTABLE CARDIOGRAPHS

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Cardiovascular diseases is quite common, difficult to track, and often leads to death, especially in older age. Many people with diseases of this group have a need to regularly record the state of the heart. The world of modern technology can provide them with devices for such health monitoring.

The trends in modern medicine are such that disease prevention is becoming increasingly important. Deviations in the functional state of the body from the norm detected at an early stage can reduce the burden on the healthcare system, since treating a disease in the progressive stage is much more complicated and more expensive than in the initial stage.

There are a number of devices designed to create a cardiogram at home.

These, for example, include the portable device for ECG (electrocardiogram) from the company WIWE - a small and compact portable device with an integrated single-channel ECG. This device works in conjunction with a mobile application. WIWE diagnoses user health and records single-channel electrocardiograms (ECGs). Recording takes only 60 seconds. Information is analyzed in the application. The application provides an assessment of the state of health, in case of risks, to warn a person and offer to take the necessary measures. Also, the application can measure the level of oxygen in the blood, heart rate, has an internal pedometer, and calculates calories. The device itself is small and easy to purchase. Of the minuses, I can name its price (11 thousand hryvnias at the time of writing), as well as the fact that all the data remains in the application, without the possibility of receiving it as a separate file.

It is also necessary to mention the English cardiographs of Heaco. These are portable cardiographs, of different sizes, different channels, with a color screen and the function of instant printing of a cardiogram. They automatically issue a diagnosis, have a color screen. Of the minuses, you can designate a high price tag (from 18 to 26 thousand hryvnias), relatively large dimensions and the fact that information cannot be obtained in electronic format.

The Italian GIMA ECG apparatus, unlike the previous ones, has a small price tag (3 thousand hryvnias). It is intended for the self-monitoring of cardiac arrhythmias and the preservation of ECG data for their subsequent analysis and study. The device registers all data on the work of the heart and displays the result on the display. ECG results can be viewed not only on the monitor of the cardiograph, but also transfer data to a computer for saving and processing using a special program and bluetooth. Of the minuses - the inability to work with it using a smartphone, a separate program is required.

There are also Polish Mida portable cardiographs on the market. They also instantly print a cardiogram, have a multi-channel recording, screen. In minuses, you

can also write down the price (20 thousand hryvnias), size, inability to get a file with data.

I can not say about Ukrainian portable cardiographs from Biomed. They also have multi-channel recording, screen, instant printing. But, unlike its predecessor, it makes it possible to examine the cardiogram on the computer, but a separate program will be required to open the file. The device is medium in size, and costs from 16 to 35 thousand hryvnias.

Xiaomi also produces portable cardiographs. HiPeeWeCardio is a professional medical device that quickly measures ECG so you can detect cardiovascular problems and start treatment on time. HiPeeWeCardio ECG uses an advanced ECG waveform analysis algorithm similar to the in-patient ECG principle, which can detect heart rhythm disturbances, myocardial ischemia, and strong static pressure. It is small in size and light in weight. Has its own application that can interpret data. Automatically transfers information when in contact with hands, and has a nice design. But it is still impossible to get a separate file with an ECG, and also a device cannot be purchased in Ukraine.

Given all of the above, it can be said that people who might need a portable cardiograph - it is likely to be unavailable. Also, such devices often have unnecessary functions, a large size, too accurate sensors. Which increases the cost, complicates the use, and more often than not, in this type of device.

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ELECTRONIC SCOREBOARD WITH WIRELESS CONTROL

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With each passing day the development of electronics is progressing. The application of new technologies enables the creation of electronic devices with powerful functionality without significant cost compared to existing devices. An important role in the life of modern society is occupied by information output devices, the development and modernization of which is an urgent task.

High power electronic scoreboard with remote control module and wireless interface designed to display useful information. It can be placed on the facades of tall structures to ensure its best visibility. The electronic scoreboard consists of 14 segments, which are grouped into two large seven-segment indicators. Each segment has its own control module that controls the color and luminance of the segment. All segments are combined into a system that is managed via the Bluetooth wireless interface, with the ability to use a mobile application on a smartphone.

Figure 1 shows a model of device construction developed in SolidWorks. The lighting element for each segment is a RGB led ribbon. The housing of the segments is made of foamed PVC and milk acrylic as the front panel. The body of the frame is welded, made of metal tubes of rectangular cross section. In each segment there is a printed circuit board on which modules of the lowering stabilizer, the PWM controller and the current amplifier are placed. The appliance is powered by a 220V. The electrical schematic diagram of the device is presented in Fig. 2.

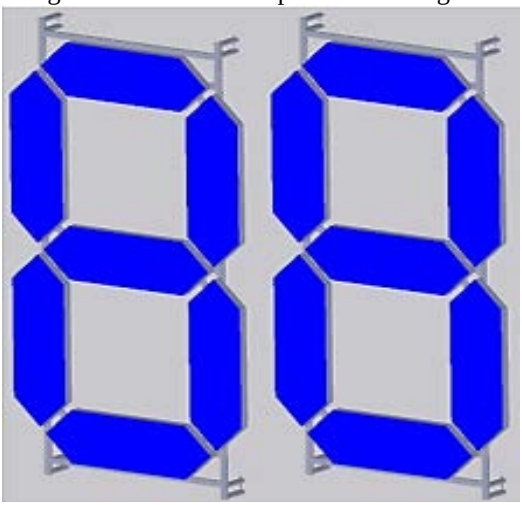

Fig. 1 Model of device construction

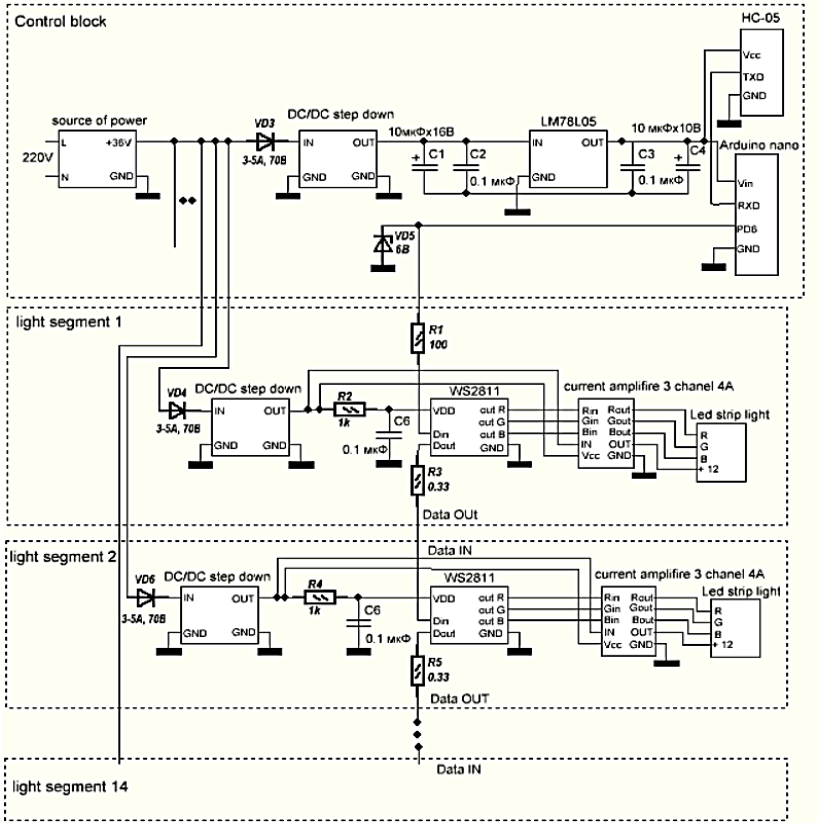

Fig. 2 Electrical schematic diagram of the device

As can be shown from Figure 2 the power is supplied to the segments in parallel. Each segment has its own down-voltage converter and an LED driver chip for processing the information signal. Also, a Zener diode is provided in front of each group of seven segments to reduce the interference with the information signal. The control modules in the segments are connected to each other by an information feed. The entire system is controlled from the phone, through an application to control the Bluetooth module. The commands from the phone come to the Arduino Nano module, which decrypts them and forms a package of commands with modes of operation for the modules of segment control.

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AUDIO SPECTRUM ANALYZER

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Audio spectrum analyzers are useful in numerous special tasks e.g. in musical and movie production, speech recognition, speech processing, educational purposes, etc.

An adequate platform for an audio spectrum analyzer is either an FPGA (Field Programmable Gate Array) or a microcontroller. For laboratory works in DSP a spectrum analyzer based on the STM32 F4 Discovery board was developed. The analyzer consists of 3 main parts: ADC, microcontroller unit and LCD display.

STM32 F4 Discovery is perfectly fitted for audio signal processing [1] through its FPU and DSP instructions usage, which makes data processing faster and more efficient. Another big advantage of this board is the 12 – bit embedded ADC, which allows performing the high-frequency sampling.

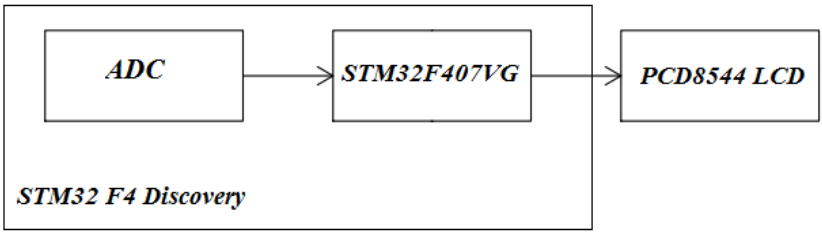

Figure1. Block diagram of the audio spectrum analyzer

For data representation, PCD8544 LCD is used. It is an undemanding, compact LCD display that uses an SPI interface for communication. Another feature of this display is theoretically relatively fast update rates [2].

This audio spectrum analyzer was designed for educational intentions. With the help of this device, students will be able to learn the fundamentals of digital signal processing, such as Fourier transform and its applications, spectral analysis and its application, sampling theorem, audio processing such as comparison sound quality, data rate, etc.

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PROBLEMS AND PROSPECTS OF THE DEVELOPMENT OF AVIONIC SYSTEMS

ERRORS AND VIOLATIONS IN AIRCRAFT MAINTENANCE

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Error is an unavoidable part of being human. It was estimated that we make over 50 errors each day. For example, approximately five per cent of phone calls dialled are wrong numbers, and the average error rate with simple arithmetic is around three per cent. Most everyday errors have minor consequences. However, maintenance errors can have more serious consequences, and are not always caught and corrected as easily. However, the most important part in error elimination is understanding of its causes and learning how to deal with error's consequences.

Many people are familiar with the feeling that they have been doing a familiar task on autopilot. Slips occur when we perform a routine action that was out of place in the situation, usually because we are distracted and habit takes over. For example, in the first week of January, it is not uncommon to write the previous year. Many slips in maintenance are slips of the pen, where a signature is put in the wrong place or a checklist item is missed Slips also occur when using tools and when activating cockpit controls.

A lapse occurs when we forget to complete an action we had been intending to perform. Examples are forgetting to remove tools or rigging devices at the end of a job, forgetting to close hatches, or leaving nuts finger tight when the intention had been to torque them up. One of the most widely reported lapses in maintenance is talking to replace all caps. Many lapses occur when the engineer has been interrupted part way through a task, often when called away to a more urgent job. They may then also return to the task. Leave out a step, or lose their place in the task. In the following case a person forgot to finish a task after an interruption.

Violations are deviations from safe operating procedures, recommended practices, rules or standards. Although they can be committed unintentionally (e.g., driving in excess of the speed limit without being aware either of the current speed or the local restriction), most violations are deliberate. People generally intend the noncompliant acts, but not the bad consequences that occasionally ensue. Only saboteurs intend both the act and its adverse consequences.

While it is not possible to make hard and fast distinctions between errors and violations (since some violations can be mistakes), the important differences between these two kinds of potentially unsafe act are summarized in Table 1.

Error management, in its general sense, is as old as organizations with potentially hazardous operations. Today, all such organizations employ a wide range of error-reducing and error containing techniques.

In aircraft maintenance, these include: Personnel selection, Human resource management, Training and retraining, Licensing and airworthiness certification, Checking and signoffs, Quality monitoring and auditing, Incident reporting systems, Procedures, rules and regulations, Implementation of ISO 9000+, Total Quality Management (TQM).

Table 1

Error	Violation
Unintended	Usually deliberate
Arise mainly from informational problems; incorrect or incomplete knowledge, either in the head or in the workplace	Arise mainly from motivational factors and are shaped by beliefs, attitudes, social norms and organizational culture.
The likelihood of errors can be reduced by improving the relevant information	Violations can only be reduced by changing beliefs, attitudes, social norms and organizations cultures

Isolated from the rest, violations are not so dangerous, but with a combination of other factors or sudden faults, violations can lead to catastrophic consequences. As a violation is a deviation from the procedure being performed, it is possible to offer several options for eliminating this type of error:

- optimization of the maintenance procedure (exclusion of parts that have no practical value);
- provision of working personnel with the necessary set of tools (to exclude maintenance with “wrong” tools);
- optimization of working space on aircraft for easy access to the necessary components and assemblies;
- the introduction of a system of encouragement and punishment in working groups with a high level of violation;
- optimization of work schedule for engineers to eliminate time pressure.

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PHOTO RESOLUTION OF DIGITAL AERIAL CAMERA

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Frequency-contrast characteristic (FCC), that is, the function of transmitting modulation in optics and photography is one of the parameters that characterize the quality of the image reproducing system. The digital aerial camera consists of a lens, a matrix, a processing channel and a display (Fig.1):

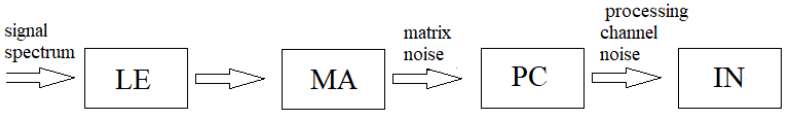

Fig.1. Mathematical frequency model

The FCC of a digital camera is a product of the FCC of a lens, matrix, processing channel, and indicator (display):

$$W_S(\upsilon) = W_{LE}(\upsilon) W_{MA}(\upsilon) W_{PC}(\upsilon) W_{IN}(\upsilon).$$

The FCC, as well as the signal-to-noise ratio, allows estimating the resolution of a digital camera.

Today, to evaluate the quality of the aerial photography system, there are two methods of determining the resolution of the equipment: full-scale and laboratory. The first method is represented by laying the test object on the surface of the plane over which the aircraft is flying. This is a very costly method, so the quality of the photo and video image is checked on the indicator using electronic tests (reproduction of colour stripes and straightness of inclined lines) formed by FMS (Flight Management System). In this case, we only check the effect on the image quality of the processing channel and the display (indicator), i.e. the impact of the lens and the matrix on the image quality is not evaluated. There is no way to know the quality of the digital aerial camera. The second method makes it possible to evaluate the impact of image quality on the whole system, but it requires sufficient time and equipment, so it is not used in aviation. This so-called "light-to-light" method allows you to evaluate the quality of an image from an image object to the reproduction of its image on the indicator (display).

For measuring FCC of a digital camera it is necessary to determine the contrast ratio of a digital camera, a laboratory unit, consisting of two tripods and an optical shaft, is required. The first tripod has a platform for mounting a digital camera, and the second has a holder for attaching the printed table EIA1956. Both tripods can move along the optical shaft and adjust the height of the tripod itself.

The laboratory unit is as follows (Fig.2). The table itself looks like this (Fig.3):

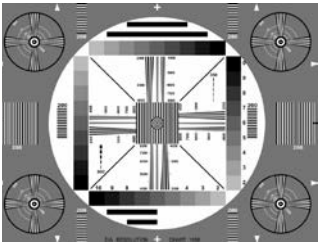

Fig.2. The laboratory unit Fig.3. Test table (measure EIA1956).

To measure and calculate the frequency-contrast characteristic the next steps are:

1) affix the printed table EIA1956 on a tripod, provide sufficient and uniform illumination;

2) position the camera on another tripod so that the table image fills the entire screen horizontally at average zoom values. With the exposure set correctly, all 10 semitones should be played in the optical wedge image;

3) provide an absolutely stable position of the camera and take a test photograph of the table;

4) position the camera so that the table image occupies the entire screen vertically and horizontally at the same zoom value as in point 2, and perform a photographic survey; 5) important condition when shooting: small white triangles from below, top, left and right of the table (benchmarks) should touch the boundaries of the frame, not the restricted area in the viewfinder, that is, it is necessary to control the image on an external monitor with a visible area of 100% frame coverage;

6) download the test object image using the LOAD command in Right Mark Video Analyser (RMVA) utility;

7) by the command "ZOOM" form and define the area of the test object image for measurement;

8) go to "Region> White Sample" to determine the white level;

9) press the "Region> Vertical Regions" button and try to position 2 red areas so that they do not extend beyond the dark edges of the wedges being analysed;

10) correct the zero brightness level in the darkest half-tone of the optical wedge;

11) use the GRAPHIC command to plot the FCC.

The results obtained can be used to develop technological conditions for testing digital video cameras and aerial cameras.

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CONTROL OF MECHANIZATION OF A FLEXIBLE WING OF THE AIRPLANE WITH APLICATION OF PIEZOELECTRIC EFFECT

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At present, the classic approach to the design of new aircraft can only slightly (1-2%) improve aerodynamic quality and improve taking-off and landing performance. Therefore, in recent years, increasing attention has been drawn to the possibility of using an adaptive wing to improve the aerodynamic performance of the aircraft by changing the geometry of the wing depending on the flight mode.

The flexible wing requires the use of an elastic outer casing. Power frames inside this sheath, when using actuators, smoothly change the geometry of the wing. Deviation of moving elements while maintaining the contours of a stroke according to some law, selected based on experimental and computational studies, allows redistributing the pressure on the wing surface in such a way as to prevent the flow failure or significantly weaken its development in the selected flight mode. As a result, the efficiency of the bearing surfaces of the wings, which operate in the mode of controls, improves, and during maneuvers the adaptive wing gives a significant gain in improving the aerodynamic quality [1].

The purpose of the presented work is to develop a flexible wing model and its control system. The wing model was selected, which has an aerodynamic profile in the form of a rectangular shape, 2.5 m long, 0.6 m wide, 1.5 m2 in area, a biconvex profile with a chord of 2.5 m, a profile thickness of 0.1 m and a curvature of 15%. The model features flexible surfaces on the front and rear edges made of flexible composite materials. They can change their shape due to the executive elements of the control system. The model's control system includes computer, voltage control unit, voltage sensors, piezoelectric plates, memorized alloy power elements. The control process is as follows. The piezoelectric plate generates a signal passing through the voltage receiver and fed to the computer. It identifies the position of the wing and issues a command to replace it. The command signal is supplied to the voltage control unit, which sets the values of the electrical circuit parameters to which the memorized alloy power elements are connected. Under the influence of the current, they heat up and change the shape of the control surface [2].

In the future, it is planned to create an experimental model of the model and carry out appropriate tests.

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INFRARED DETECTION SYSTEM AND AVOIDANCE OF COLLISIONS WITH SMALL AIR OBJECTS

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Now, the number of airplanes collisions with birds is much higher than the number of collisions with UAVs, but the number of UAVs is constantly increasing. As well as the risk of collision, so it is crucial to detect small objects at a safe distance to avoid collision with them [1]. Airport security services control small objects in the airspace of an airport, they control the movement of birds, UAVs and other airborne objects using radar systems such as Merlin and Robin Avian System. Therefore, when the aircraft is flying outside the airport, the crew must monitor the airspace on their own to detect small objects. Thus, to facilitate the crew's detection of dangerous airborne objects in the direction of flight, it is necessary to use airspace survey systems. It is proposed to use infrared collision prevention systems to detect birds and UAVs in the direction of flight.

It is proposed to use infrared collision prevention systems to detect birds and UAVs in the direction of flight. Any unmanned aerial vehicle is an aircraft that moves with the help of an engine, mainly a heat engine or electric motor, these types of engines radiate infrared energy [2], so such a UAV can be detected by an onboard infrared collision avoidance system.

The temperature of the bird's body is higher than that of the human body and, depending on the species, lies in the range of 38° to 43° C. The temperature of the UAV with electrical engines ranges from 70° to 80° C. Therefore, it is quite difficult to detect birds and UAVs over long distances with the passive onboard infrared detection system.

It is necessary to have a receiver with a large sensitivity limit or to increase the energy of the infrared radiation of the object to detect small objects with a low temperature over a long distance. Today, infrared spotlights are designed and commercially made to irradiate objects by infrared radiation of a given wavelength, and allow objects to reflect this radiation, increasing their infrared radiation energy [3]. Therefore, the use of an infrared spotlight along with a passive infrared detection system and avoidance of collisions on board the aircraft will allow the detection of small air objects at a safe distance to avoid collisions with them.

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THE THERMAL RADIATION OF UNMANNED AERIAL VEHICLES

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Radiant heat transfer is a complex process of heat transfer, which is caused by the transformation of the internal energy of a substance into the power of electromagnetic waves, the propagation of these waves and the absorption their by the substance.

Aluminum is used to reduce weight in UAV type "Quadcopter", and the maximum temperature of the electric power plant does not exceed 80°C, therefore when using other types of UAVs, the capability of detecting by thermal radiation receiver will enhance by increasing the size of the air object and by using other types of power plant (such as internal combustion engines) that have a higher operating temperature. Therefore, the input data for the calculation thermal radiation of UAV are: front area of the quadcopter - 0,04 m^2; the maximum temperature of the motor is 80°C; housing material - aluminum; maximum detection range - to 5000 m; the threshold sensitivity of the radiation receiver - 10^{-9} W.

The following conditions should be fulfilled to detect a quadcopter object in the air space by its infrared radiation:

$$\Phi_{QC} - q\Phi_L \geq 0,$$

where Φ_{QC} is the quadcopter thermal radiation stream that focuses on the radiation receiver; Φ_L – minimum (Limit) radiation flux or threshold sensitivity of the radiation receiver; q is the signal-to-noise ratio required for a given detection probability.

So the stream of thermal radiation of UAV must exceed the threshold sensitivity of the radiation receiver $\Phi_{QC} > \Phi_L$.

According to the Wien's displacement law for the temperature of the power plant of the copter T=80°C, the maximum wavelength of thermal radiation is λ=8.2 μm. As the temperature of the power plant decreases, the maximum wavelength will increase. Thus, we will choose for the calculations the average wavelengths range λ = 8-14 μm.

When passing through the atmosphere, the radiation flux loses its power, so the flow of intrinsic radiation of the object Φ_{RAD} entering the radiation receiver is a function of the object temperature, distance to the radiation receiver, area and other components. The calculations are presented showed that the quadcopter own radiation flux at a distance of 5000 m is close to or below the threshold sensitivity of the IR radiation receiver. Therefore, it is necessary to increase the radiation flux of the quadcopter for its detection by infrared airspace survey system.

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TRANSMISSION OF FLIGHT INFORMATION FROM THE AIRCRAFT VIA SATELLITE INTERNET

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Currently, the safety issue in aviation significant. Experience has shown that on-board recorders are a reliable source of audio and parametric information. Nevertheless, they not always possible to fix the causes of accidents, although it can take much time. The possibility of transmitting visual and parametric information in real-time in the mode of duplication of flight information becomes satellite Internet, which is used on some aircraft to transmit data over the Internet to the ground online, to ensure reliable storage and timely processing of all flight data. That creates a convenient direct system, which can involve the necessary specialists. Transmitting visual data from zonal video cameras in compression modes can provide useful information about the flight. Use digital IP camcorders that have their video server and transmit images in digital format over LAN/WAN/Internet using TCP/IP or UDP/IP. For the aircraft, it is possible to use the dome Turbo HD-camera Hikvision DS-2CE70D0T-ITMF with 1920x1080 pixels with EXIR-illumination. This allows capturing great photos in low light. The Ethernet network is described by the IEEE 802.3 (10 Mbps) and 802.12 (100 Mbps) standards. In addition, the so-called Gigabit Ethernet with a transmission speed of 1 Gbps has already been introduced. An Ethernet network with a transmission speed of 10 Gbps is used. The IEEE 802.3 specification has been developed for it.

The changing role of Ethernet for aircraft necessitated the development of a new standard - ARINC 664. This standard adopts the Ethernet network, following the IEEE 802.3 specification, for use in on-board data networks. Subsequently, ARINC 664 should replace ARINC 646. The central devices in on-board networks are routers. Should have at least one such device on board. Through it, the connection of on-board networks with out-board networks is provided, including with a wireless local area network on ARINC 763 (through radiotelephone, satellite or microwave communication channels). The router interacts with the flight crew, ground crew, on-board networks and ground networks. For satellite Internet, the aircraft should have a built-in “KONTRON ACE FLIGHT” server, which acts as a hub between the cockpit wireless network and is switched off by the Satcom-antenna for data transmission and reception, high power transmitter, signal exciter and receiver.

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THE ISSUE OF UAV AND CONDITIONS OF THEIR IMPLEMENTATION

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Before implementing a concept of unmanned aerial vehicles or remote piloted systems, which capabilities and advantages these systems have and what is their main aim should be defined.

Remotely piloted aircraft (RPA) ıı one type of unmanned aircraft. All unmanned aircraft, whether remotely piloted, fully autonomous or combinations thereof [4].

Remotely piloted system (RPAS) is a remotely piloted aircraft, its associated remote pilot station(s), the required command and control links and any other components as specified in the type design.

RPA may encounter many types of hazards. The *Global Air Traffic Management Operational Concept* identifies the need to limit the risk of collision to an acceptable level between an aircraft and the following hazards: “other aircraft, terrain, weather issues, incompatible airspace activity and, when the aircraft is on the ground, surface vehicles and other obstructions on the apron and manoeuvring area” [3]. One should not assume that the hazard, the severity of the risk or the mitigation strategies will be the same [1].

For RPAS to be fully integrated into allowed airspace and at aerodromes, mitigations to the hazards will be needed. Air traffic management will help mitigate the risk from these hazards (e.g. incompatible airspace activity) for RPA as for other aircraft [2]. However, DAA (detect and avoid) capabilities or other mitigations (e.g. operational procedures) are required for RPA to limit the risk from the following hazards:

a) conflicting traffic;

b) terrain and obstacles;

c) hazardous meteorological conditions (i.e. thunderstorms, icing, turbulence);

d) ground operations (aircraft, vehicles, structures or people on the ground); and

e) other airborne hazards, including wake turbulence, wind shear, birds or volcanic ash.

RPAS need to comply with airspace rules and procedures and associated safety requirements established by the State and/or ANSP [1]. One or more DAA capabilities may be needed to meet requirements to address the hazards unless the RPA exposure to these hazards and risk to persons, property or other aircraft can be reduced to an acceptable level through restrictions to the RPA operating environment, flight timing or flight profile [2].

For example, if an RPA flies in segregated airspace (i.e. no other aircraft present), then a DAA capability to DAA other airborne aircraft may not be required. However, if an RPA cannot be prevented from encountering these hazards, then

systems and procedures may be needed to provide appropriate DAA capabilities for each hazard.

Collision avoidance (CA)

CA may be achieved through the use of an approved DAA capability for conflicting traffic. If installed, a DAA system for conflicting traffic should alert the remote pilot of impending collisions so that last resort actions or manoeuvres can be executed [1].

This collision avoidance system must follow a certain algorithm, which correspondingly is downloaded to the system and in case of this link loss the remote piloting should be implemented [4].

RPA hazard detection

RPA may detect passive or active hazards, including conflicting traffic, using optical and non-optical technologies. Detection may be supported by the use of a database (e.g. terrain and obstacles) [3].

Optical techniques. Optical techniques are based on visible and near-visible (ultraviolet and infrared) EM radiation. Examples include video, light detection and ranging (LIDAR) and thermal imaging. Optical techniques are generally ineffective in instrument meteorological conditions (IMC).

Non-optical techniques. Non-optical techniques are based mainly on radio-frequency electro-magnetic (including microwave) radiation. Examples include primary radar, SSR, ADS-B and multilateration. Non-optical methods are generally not dependent on meteorological conditions [1].

DAA

The DAA capability for RPAS may have one of the following kinds of equipment:

Manual on Remotely Piloted Aircraft Systems (RPAS)

a) detect and avoid. DAA capability to provide specific resolution manoeuvres to avoid a hazard with manual or automated execution. An example of manned aircraft is an ACAS system integrated into the auto flight system;

b) detect and advise. DAA capability to propose a range of potential resolution manoeuvres to avoid a hazard with manual execution. An example of manned aircraft is the traditional ACAS system;

c) detect and inform. DAA capability to provide essential information for the hazard that the remote pilot may use along with other information to develop and execute an avoidance manoeuvre. An example of manned aircraft is weather radar and associated display [1].

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MAINTENANCE ERROR MODEL

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Introduction

To find out the reasons of maintenance errors and its reducing, investigators use a maintenance error model. And the most widely used is the Maintenance Error Decision Aid (MEDA) – a structured process, used to investigate events caused by maintenance technician and inspector performance. Nowadays, instead of an "error" investigation process this method regards an "event" investigation process. That is why the corresponding MEDA model was developed to include not only error component but also violation component (that involves non-compliance with regulations, policies, processes or procedures).

Main Body

First of all, it is important to define the difference between an error and a violation. According to the definition in MEDA user`s guide, an error is human action (or human behavior) that unintentionally deviates from the expected action (or behavior). Moreover, in this guide they distinguish such types of errors: part installed incorrectly, part not installed at all, part installed in not appropriate location, the lack of oil after servicing, the fault was not noticed by inspector, tool left in the engine cowling. Meanwhile, a violation is defined as human action (or human behavior) that intentionally deviates from the expected action (or behavior). Furthermore, in practice two, these notions are acting together sometimes.

It is obvious that there are specific reasons that lead to errors or violations. So, anything that affects on quality of maintenance technician or inspector`s job is called a contributing factor. There are a lot of things that can negatively affect on the task performance, e.g. bad lighting in the area where the task is to be carried out, the lack of tools or parts to do the job, incorrect hearing or understanding of supervisor`s instructions, the lack of training with specific tasks and so on. All of these reasons can be as contributing factors of the event.

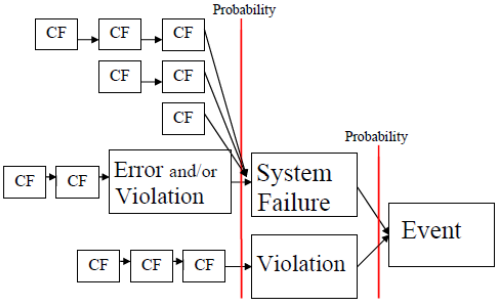

Fig. 1. Final MEDA Event Model

The final MEDA event model (Fig. 1) was several times advanced from the initial and simplest one that in turn, included only a contributing factor that leads to an error which causes an event. While the final model includes probabilistic nature of relationships that are between contributing factors (it can be contributing factors to contributing factors), violation (sometimes a violation can be directly a cause of event and sometimes – a cause of

system failure), system failure and event (can be caused by an error, by a violation or by error and violation combination).

Thus, from the final MEDA event model, Boeing represents three basic assumptions of MEDA philosophy:

- A worker has no intention or purpose of making errors while performing his/her job;
- In most cases, an error is a result of several contributing factors;
- Many of the contributing factors of an error can be managed.

The MEDA process includes five steps that are key in the investigation:

1. Event – the company decides which event it is necessary to investigate.
2. Decision - the company identify if an event is maintenance-related and if it is, then they need to perform a MEDA investigation.
3. Investigation – it is necessary to fill in the MEDA results from consisting of next six sections:
   a. General Information;
   b. Event Description;
   c. Maintenance system failure;
   d. Chronological Summary of the Event;
   e. Summary of Recommendations;
   f. Contributing Factors Checklist.
4. Prevention strategies – analysis of investigation results that leads the company to review, prioritize, implement and track prevention stages to avoid or reduce the probability of likelihood or similar errors in future.
5. Feedback – it is important to provide feedback which purpose is to estimate the improvements from changes and obtain workforce views and advises.

Conclusions

The MEDA investigation process was widely used all over the world since its inception in the middle of 1990s. Nowadays, it is used by many large airlines, maintenance, repair and overhaul organizations. Furthermore, today we still have tendency of MEDA usage increasing because it helps to perform reactive maintenance-caused event investigation process, to reduce mechanical delays, to improve maintenance procedures, to improve line maintenance workload planning.

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FLIGHT SAFETY

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According to statistics, the aircraft is the safest means of transport. Aircraft accidents occur about 200 times less frequently than car crashes. Nevertheless, every year, the number of aircraft in the sky increases. And therefore, the risks of aircraft incident also increases [1] the number of accidents explains this. For example, over the past 100 years, there have been 26,000 aircraft accidents. It means that flight safety plays the most crucial role in the development of aircraft.

Flight safety is a feature of an aircraft that determines the ability to fly without danger to people's life and health. In such a way, aircraft designs are continually being refined, new methods of operation are introduced, and the crew's training is optimized.

As a result of such improvements, throughout the years, the amount of aircraft incidents steadily decreases.

There are many reasons why aircraft accidents take place: human factor (36%), technical issues (24%), weather conditions (6%), terroristic acts (5%) and other. As statistic shows, most accidents happen due to human factor. As the pilot is one who has the last say in what actions to take throughout the flight, pilots must know how to counteract different operational errors. [2]

Line Operational Safety Audit (LOSA) is considered an important method that helps to develop solutions to errors, threats, and other undesirable states. LOSA uses professional observers that collect data during flights such as but not limited to:
potential threats to safety; how the risks are addressed; the errors such threats generate; how flight crews manage these errors; specific behaviours that have been known to be associated with accidents and incidents.

Frequent usage of LOSA can ensure that human error has less impact on the overall amount of aircraft incidents. As flight crews will be more qualified on what type of common mistakes are made on what can be done to avoid them. [3]

Flight safety is an essential factor in aviation. The introduction of different flight management systems should ensure a reduction in the number of aviation incidents.

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TELECOMMUNICATIONS AND RADIO ELECTRONIC SYSTEMS

RESEARCH OF THE ADVANTAGES AND DISADVANTAGES OF THE NETWORK VIRTUALIZATION OF NETWORK RESOURCES OF A CONSISTENT ARCHITECTURE OF 5G NETWORKS

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5G technology (fifth generation) is the abbreviation of the fifth generation of mobile communications, which will replace the current 3G and 4G. The main features of the 5G standard are:

- The peak data rate is at least 20 Gbit / s downlink (i.e., from the operator to the subscriber) and 10 Gbit / s uplink to the mobile base station. Overall, this means a 20x increase in speed compared to 4G LTE. [1]

- 5G connection density - at least 1 million connected devices per square kilometer.

- Mobility-5G will allow the subscriber to travel at speeds up to 500 km / h (in 4G - 120 km / h).

- Energy efficiency - the "sleep" mode of base stations and the reduction of the radius of action of cells in dense networks will significantly reduce energy consumption.

- The increase in spectral efficiency will be downward 30 bits / s / Hz on the uplink - 15 bits / s / Hz.

- Delay in ideal 5G network conditions is up to 1 ms (compared to 20 ms for LTE).

At high frequencies, there are also disadvantages. Extremely high frequencies transmit a signal within line of sight between the antenna and the receiver. Moreover, radio waves of this range strongly attenuate during transmission over long distances, since their energy is absorbed by hydrometeors (rain, fog, snow) and other objects [2]

For these reasons, the location of antennas in 5G networks must be carefully planned. Perhaps it will be small antennas in each room or building, or large, located throughout the city. Maybe even both of these types. Most likely, you will have to use many repeaters that transmit radio waves further to provide 5G support over a long distance.

One of the directions for the development of fifth-generation 5G wireless networks is Network Function Virtualization (NFV) [3]. The main idea of NFV is to separate network functions from hardware. The fact is that the functions of the telecom operator are constantly expanding, and with them the network, the launch of any service involves the integration of additional equipment and, accordingly, the

presence of additional space in the hardware rooms. This increases the consumption of resources. In addition, equipment quickly becomes obsolete. The fifth generation of wireless communications will give a new qualitative impetus to the development of new services. NFV should move the telecom industry from an extensive way to scale wireless networks to an intensive one, making them flexible and dynamic. It is expected that NFV will be in demand primarily among telecom operators who are preparing to launch the high-speed 5G mobile communications generation. Network Function Virtualization is part of the 5G concept. Gigabit speeds of the standard will open wide multimedia capabilities to users, and operators will be able to diversify the services offered [4].

Therefore, in modern realities for mobile operators, two priority functions of the network core are priority: vIMS (virtual IP-multimedia subsystem) and vEPC (virtual evolved packet core). The first is responsible for the transit of multimedia files using the IP protocol. The second provides the functioning of the core network standard LTE. It is on the basis of vIMS and vEPC that such services as voice transmission in the fourth generation networks - VoLTE (Voice-over-LTE), calls via the fixed Internet and Wi-Fi networks - VoBB (Voice-over-BroadBand) and Wi- Fi calling, connection of Internet of Things (IoT) objects and M2M technology (Machine-to-Machine).

Fixed-line operators require network functions such as vCPE (virtual customer premises equipment), which is necessary for virtualizing the functions of subscriber equipment for corporate clients, and SD-WAN (software-defined WAN), through which the coordination of the corporate WAN network is carried out [5].

It is also important to understand that for the operational maintenance of virtualized networks, employees must be qualified.

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PROSPECTS OF 5G IMPLEMENTATION IN UKRAINE

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4G networks, which are just beginning to develop in Ukraine, have brought not only high speed and bandwidth, but also the opportunity to revolutionize many areas of business through high-speed mobile network connection. At the same time, the world's first fifth-generation networks are being actively implemented. **5G technology.** 5G technology (fifth generation mobile communication) is often called the technology of the future [1]. Today it is in the early stages of its evolution.

Although the standard has not yet been fully formed, the following features of the fifth generation technologies can be identified: maximum data transfer rate - up to 20 Gbps; ultra-low data transmission delay - less than 1 ms; support for a large number of subscriber devices (up to 1 million per 1 sq. km); expanded support for specialized ICT services; reduction of the cost of operation and energy consumption of 5G networks to 10% of the current consumption of 4G networks [2]. **Areas of implementation 5G networks.** The fifth generation of mobile networks promises to be a particularly groundbreaking development for key industries and, consequently, the economy industry. In general, mobile networks will become an important part of the infrastructure. This is to be expected: over the past few years, mobile communications have proved indispensable not only in everyday life, but also in large-scale industrial and innovative processes.

The capabilities of services of the fifth generation are designed to change our perception of the Internet. New data transfer rates and scales will help develop industries, medicine and maintain a reliable security system. It is expected that the 5G network will be able to connect CCTV cameras, weather sensors, "smart" homes and electrical networks. The following industries will be widely used in 5G: education, agriculture, heavy industry, medicine, energy and automotive.

Thanks to 5G networks, "smart cities" will appear, in which it will be possible to transmit real-time information from a much larger number of sensors at various objects [3]. It will be possible to connect to the system sensors for monitoring the condition of housing and communal services, sensors of "smart lighting", sound, which help to monitor the observance of order in the city. They will be able to catch suspicious or loud noises, and the information will be automatically sent to law enforcement.

Implementation of fifth generation networks in Ukraine. The launch of a new generation of communications is a rather lengthy procedure, as the necessary frequencies are determined first, tenders are held for the purchase of the necessary equipment, as well as auctions for the sale of frequency licenses. It is technically impossible to jump over 4G network. For taking into consideration this feature, operators who build a 4G network and perform existing upgrades, lay the foundation

for further migration to the 5G network. In the early stages, these two technologies will be coexist.

Another obstacle to launching 5G networks is the lack of free frequency spectrum. It is assumed that in future networks, this resource will expand, including due to the millimeter range. It is also believed that there will not be enough devices to support the new network to implement 5G. Ericsson, Huawei, ZTE, Nokia and Samsung are considered to be the main suppliers of equipment for building 5G networks. The proposals of the Chinese companies Huawei and ZTE are more interesting for operators, but due to trade wars with China, the United States continues to pressure its allies and economic partners to abandon the use of Chinese equipment [4]. Therefore, they will not be able to introduce this technology in Ukraine in the near future.

In addition, the cost of 5G communication in Ukraine will depend on the timing of its implementation, on when the frequency resource will appear and how it will be used. It is planned that by 2035, the infrastructure of 5G networks will support 22 million jobs across the globe, and its contribution to global GDP for the period from 2020 to 2035 will be $ 2.4 trillion [5]. Among other things, the implementation of forecasts requires the work of thousands of specialists who will integrate technology into our usual spheres of life.

Conclusion. 5G expands the context by offering a new understanding of technology: an innovative platform on which many industries will receive additional impetus to development. This means the emergence of completely new services, business models, types of interaction between devices, production chains and infrastructure. Thus, in Ukraine, 5G networks at the first stage are likely to be highly specialized, aimed at the needs of business customers. After all, for the mass introduction of any technology requires effective demand. In this regard, our country still has a lot to do to improve both the economy and the welfare of the population.

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SYSTEM OF REGISTRATION AND MONITORING OF UAV

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Future information technology

Ensuring the safe use of UAVs is one of the most important problems that need to be completed during the ubiquitous entry of UAVs into both business and everyday life. The introduction of advanced information technologies is of great importance.

UAV's registration

With the spread of UAVs, new threats to public safety are being created. For this purpose, it is necessary to register all UAVs.

UAV's monitoring

Widespread monitoring of UAV movements will make all UAVs trackable. For people, this will guarantee security, because today the airspace of the world is almost empty, and with the development of this area in Ukraine and in the world, the space will be overcrowded.

Advanced technologies

Communication is still one of the key issues in UAV monitoring. The problem of the fastest transfer of information remains unsolved. We need network with the minimum delay and high speed of data transfer. In order to properly support radio access technologies, universal coverage of modern cellular networks should be created in Ukraine.

Research

The work is devoted to solving the problem of UAV monitoring and registration. The provisions of the documents concerning UAVs in Ukraine and the world were considered.

Developed software

I created software that provides registration and monitoring of UAV.

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RESEARCH OF THE CHARACTERISTICS OF A HORN ANTENNA BASED ON A RECTANGULAR BELOW CUTOFF WAVEGUIDE WITH A PARTIAL DIELECTRIC FILLING AND A COUOLING LOOP

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One of the promising types of antennas used in the ultra-high frequency (UHF) range are horn antennas [1]. The main advantages of such antennas are range, simplicity of design, reliability of operation. Therefore, the consideration of the characteristics of the horn antenna of reduced geometric dimensions due to the partial dielectric filling (NPD) of the foreign rectangular power wave excited by the communication loop is a very important task.

The results of the study of the characteristics of the horn antenna on the basis of a foreign rectangular waveguide with a NPD and a communication loop are presented (Fig. 1).

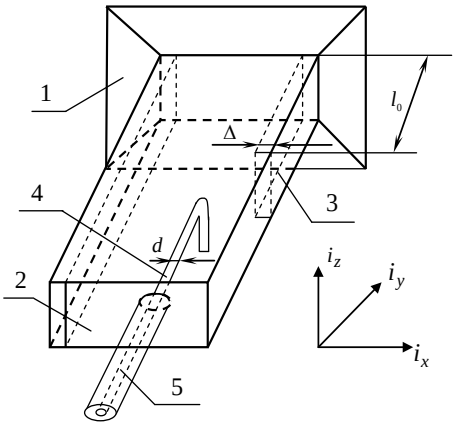

Fig. 1. Research of the characteristics of a horn antenna based on a rectangular below cutoff waveguide with a partial dielectric filling and a couoling loop

The antenna consists of a pyramidal loudspeaker 1, to which is connected a foreign rectangular waveguide 2. In the waveguide 2 are two rectangular dielectric plates 3 adjacent to its side walls and the communication loop 4, which is a continuation of the coaxial power line 5 (Fig. 1). On fig. 1 mark d – the diameter of the wire of the communication loop, l_0 – the length of the dielectric plate, Δ – the width of the dielectric plate.

The mirror method was chosen for the experimental measurement of the antenna gain. Accordingly, it is proposed to use a resonance model (rectangular

resonator) for the analysis of such antennas. The formula for calculating the input resistance of the communication loop, which excites the resonator, is obtained. The formula takes into account the additional resistance in the loop circuit, which appears due to the excitation of the electromagnetic field in the resonator and has the following form [2]:

$$Z_{вх} = R + \sum_{\nu} \frac{j\omega M_{\nu}^{2}}{e_{\nu}\left(\omega_{\nu}^{2} - \omega^{2} + \frac{j\omega\omega_{\nu}}{\varphi_{\nu}}\right)}, \quad (1)$$

where R – own reactive component of the resistance of the communication loop, Om; ω – oscillation frequency in the resonator, rad/s; ω_{ν} – frequency generator for ν-type oscillation, rad/s; φ_{ν} – the quality factor of the corresponding resonator ν- type oscillation; e_{ν} – coefficients that determine the intensity of different types of fields that are excited in the resonator; M_{ν} – entered a notation that is equal to:

$$M_{\nu} = \int_{l} \overline{A_{\nu}}\left(\overline{r}\right)\overline{dl}, \quad (2)$$

where $A_{\nu}\left(\overline{r}\right)$ – proprietary functions, which can be used to decompose a given extraneous current flowing through the communication loop.

Formula (1) taking into account (2) allows you to calculate the standing wave ratio (SWR) and the gain of the antenna in particular.

The results of the experimental measurement of the dependences of SWR on the change in length are presented l_0, width Δ of dielectric plates with relative dielectric constant $\varepsilon = 8{,}5$ and the diameter of the wire of the communication loop d in a rectangular waveguide of dimensions $7{,}2 \times 3{,}4$ mm for ratio type H_{10}.

Optimal dielectric plate sizes and communication loop positions are proposed to improve antenna alignment.

The results of experimental measurement of the antenna gain are given, which do not have significant differences with the calculations. The considered dependences of the antenna gain have a resonant character, which indicates the correctness of the application for the analysis of such antennas of the resonant model.

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TWO-STAGE OPTIMAL ALGORITHM OF FILTRATION THE CHANNEL FREQUENCY RESPONSE IN OFDM SYSTEMS

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One of the widely used technologies for transmitting information in channels with frequency selective fading is orthogonal frequency division multiplexing (OFDM). The main advantages of OFDM are high spectrum efficiency [1].

One of the problems that must be solved when demodulating OFDM signals is the estimation of communication channel parameters. The probability of error in reception depends on the accuracy of the channel estimate: the more accurate the estimate, the less error probability can be achieved during data transmission. Quasi-optimal two-stage channel frequency response estimation algorithm described in detail in [2].

Two-stage optimal algorithm of filtration the channel frequency response is based on pilot signals in structure of OFDM symbol and describes by equation

$$p(H \mid Y) = \frac{p(H \mid Y_1, y)\, p(H \mid Y_2) P(Y_1, y) P(Y_2)}{p(H) P(Y)}. \quad (1)$$

Channel frequency response can be estimated in pilot positions. At first stage should be performed filtration of the array with channel frequency response estimates in directions from left to right and from right to left. The results of filtration are posterior probability density $p(H \mid Y_1, y)$ in direction from left to right and extrapolated probability density $p(H \mid Y_2)$ in direction from right to left.

At second stage should be calculated conditional probability density $p(H \mid Y)$ by the way of combining the posterior probability density $p(H \mid Y_1, y)$, extrapolated probability density $p(H \mid Y_2)$ and priory probability density $p(H)$. The $P(Y_1, y)$, $P(Y_2)$, $P(Y)$ are probability density of observations that uses as normalization factors. The similar algorithm can be used for tasks of image processing [3].

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