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Improvement of the methods of an estimation of management by flight safety level and flight validity with at operation aircraft maintenance

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Abstract
In this paper solution of the problem of estimation of the state of a complex system using the operative diagnostics methods, was based on a principle of generalization of the information of diagnostic parameters of different physical nature. The solution of this problem will be a source of the increased information about a technical condition of the research object. Results of introduction of these methods will help to develop recommendations and the actions to raise the level of a flight safety from the point of a view of aviation reliability.
Key words: scientific, diagnostics methods, parameters, reliability

Statement of a problem

Preservation of the flight validity of an aircraft while in operation service is an integral part of the general process of flight safety. At the same time, for estimation the flight validity of aircrafts, diagnostics means and methods, based on the various physical principles, allowing checking the most responsible engine units must be developed. Existing methods of operative diagnostics of aviation technical objects are capable of qualitative and quantitative estimation of the levels of flight safety and the flight validity. The analysis of the given methods shows that their use is rather limited by specificity of its application. The main of these methods are:

- diagnostics by results of the temperature and gas parameters analysis,
- diagnostics based on thermal parameters,
- vibration parameters diagnostics,
- oil diagnostics,
- optic-visual diagnostics,
- the analysis of combustion products,
- the diagnostics of a glider and functional systems.

The analysis of these methods shows that each of them has a certain scope and allows to estimate condition of the units and elements of the aircraft; but for the full and detailed control it is expedient to use set various methods. That is why there is a necessity of generalization the diagnostic information.

The demands to the flight safety support at the present stage aircrafts operation, at the international documents, require development of complex criteria of definition the technical condition of aircrafts and carrying out by means of them the general estimation.

One of ways to solve the given problem is use of the set of e various methods, allowing to estimate a technical condition of separate aircraft units.

There are some approaches of reducing this task to the generalized estimation of a condition of technical systems. They are reduced to revealing the informative generic parameter of a condition of the object. The main idea is based on that the process of a gradual change of the level of the flight validity, characterized by many components, is described by some one-dimensional function numerical values of which depend on control process components. This function is considered as the generalized parameter of the process. This can appear that the generalized parameter has not a concrete physical sense, and has of mathematical expression, which is produced artificially from controllable process parameters and is presented by a complex criterion of an estimation of flight validity P_{Σ}.

The generalized parameter should correspond to certain requirements. These requirements among others provide so-called processing to private parameters of the control, including:

- ranging on importance degree;
- definition among private parameters of criterion, has a crucial importance on the statement of the diagnosis of object.

In turn, by means of a combination of some methods it is possible to carry out a deeper control (as a rule, on the ground), however it often demands special conditions and a long time.

In this connection there is a problem to develop technique of estimation of the level of the flight validity with the use of the maximum number of the parameters obtained by means of the known methods of diagnosing (Fig.1).

So the problems a big complexity related to with the estimation of the technical condition of aviation technical objects due to enough high requirements to accuracy are solved giving priority not to analytical, but to numerical methods of the decision complemented by experiment, which operate exclusively using concrete numbers. Thus each special case is an independent problem with the decision, applicable only in the conditions of this case. The definition of general laws turns on to be a special, extremely difficult problem complexity of which sharply increases with a number of specific features of the investigated process. The influence of these features is reflected in the decision by means of the parameters of the problem characterized by properties of substances, essential to process, the shape and size of the system, physical conditions in which process develops. The parameters and independent variable (co-ordinates and the time) in general case form a full set of the arguments of the

problem; all required variables – the functions of these arguments. The modern problems are characterized by a large number of parameters what creates considerable difficulties.

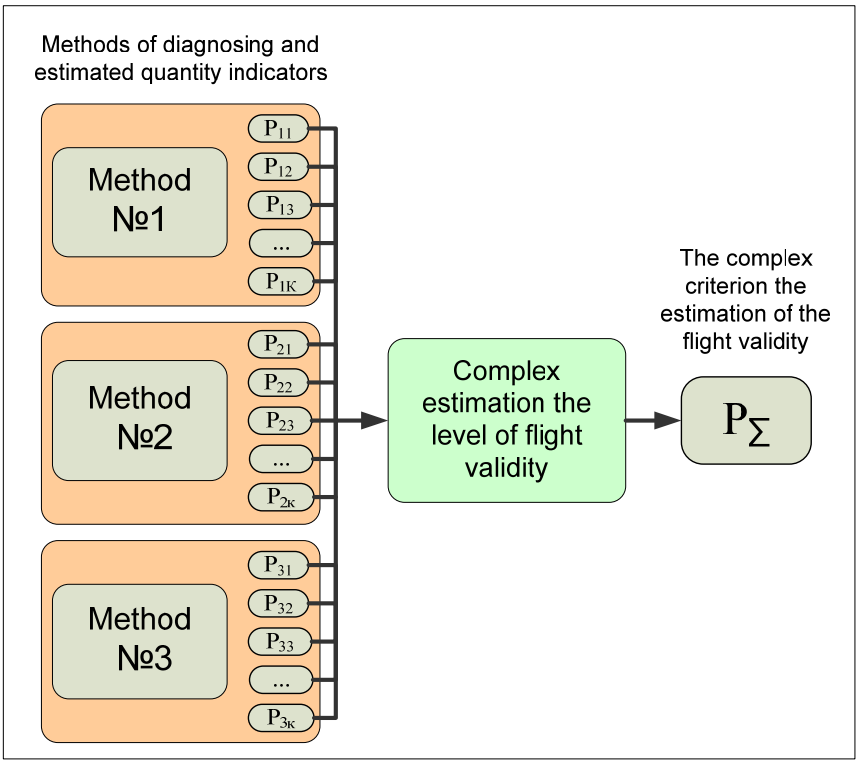

Fig.1. **The algorithm of the estimation method of the level of the flight validity of the aircraft**.

The generalization of the problem has a great value, i.e. is working out a such forms of research in which the least possible number of the parameters is presented in an explicit answers. The general principle of the universalisation is transition to the variables including parameters in a latent kind.

For achievement of the purposes of the universalisation the methods of theory of similarity are used. The theory is applicable if research consists of the decision of the mathematical problem which has been formulated in the form of the system of basic equations and the local conditions containing additional data, necessary for allocation to the special case and expressed through characteristic values of the variables defining concrete features of physical conditions (system geometry, regime conditions).

The universalisation is carried out on the basis of transition to relative variables - the relations of variables to their characteristic values. Thus the equations will be transformed to a dimensionless kind: variables under the badge of differential operators are replaced with relations and parameters unite in the expressions representing sedate dimensionless complexes which enter into the equation and a kind of numerical multipliers at differential operators.

These complexes are designated π_1, π_2..., π_r; their number in each equation of the unit is less than the number of its members. All specific features of the process are defined through complexes π which obtain a sense of parameters of the problem considered in the relative variables. The final result in relative variables is represented in the form of the equation by which the required variable is defined as a function of the time, coordinates and complexes π. The preset values of all complexes π give the unique decision covering all possible combinations of individual parameters, satisfying answers to these values of complexes.

In the absolute variables, representing the products from the relative variables on corresponding scales the reference, the set of the decisions is mutually transformed by means of proportional transformations, i.e. each is similar to others. Hence, every possible special case of the process unite on values of the complexes π in groups so that within each all of them cases in a relative representation are identical, and in absolute - are similar.

Such conformity is called as a physical similarity; thus processes are called similar, the complexes π – are criteria of similarity. For criteria of similarity it is the special system of designations which consists of the two first letters of surnames of the scientists who have brought the essential contribution to the given area of a knowledge, and corresponding names (for example, Re - Reynolds's criterion, Fo criterion of Fure - dimensionless time) are accepted. Equality of criteria is a unique quantitative condition of similarity of processes; besides of them, it is necessary identify dimensionless local conditions (i.e. their similarity). This position is a theoretical basis of physical modeling.

The concept of physical similarity of the processes, originally limited to the requirement of their physical uniformity, now logically strictly extends on a case of

processes of various physical nature. The basis for this generalization essentially strengthening possibilities both the theory of similarity and a model method, - the full independence signs the processes of similarity from their physical nature. The regulation idea is important for theory of similarity and the model method. The criteria of similarity have a certain physical sense - an average measure of a relative intensity of the effects essential to the process. If any effect in the given conditions becomes very weak in comparison with others and its influence is admissible to neglect, the criteria characterizing its relative intensity, drop out of consideration and process gets property regulation in relation to these criteria.

The decision of such rather actual problem will allow to reveal an information potential of the given methods.

Also it is necessary to consider that realization of the given problem besides mathematical rules and the assumptions, specific requirements to formation of the adapted databases, should take into account the general requirements, approaches with the clear and accurate purposes, strategy, programs and techniques which are used at formation of the general safety management system.

Conclusions

In this connection, it is possible to draw the following conclusions:

1. The estimation of the flight validity of the aircraft using one method of operative diagnostics is ineffective. It is necessary to use a set of various methods whenever possible.
2. Complex use of the methods of the operative diagnostics, based on a principle of generalization of the diagnostic information of the set of parameters of the various physical nature, is the source of the increased of the information about a technical condition of the object of research.
3. For diagnostics of the aviation techniques it is expedient to use the parameters possessing maximum information, supplementing and specifying each other.
4. For development of a technique of a complex estimation of level of the flight validity of the aviation technical objects, it is necessary to consider the existing approaches, mathematical methods to find out the generalized indicator of an estimation of the flight validity, capable to consider the new "Latent" interrelations.

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Orlaivių techninėje priežiūroje taikomų vadybos metodų vertinimas pagal skrydžio saugumo lygį ir skrydžio galiojimą

Reziumė

Moksliniame darbe sprendžiamas kompleksas problemų. Tam naudojamasi operatyviosios diagnostikos metodais, kurie grindžiami informacijos apibendrinimo principu. Informacija renkama apie įvairius diagnozavimo parametrus pagal tam tikrus fizinio pobūdžio darbus ir yra informacijos apie tiriamojo objekto techninę būklę šaltinis. Metodų taikymo rezultatai padės parengti rekomendacijas ir veiksmus, kuriais siekiama didinti skrydžio saugumo lygį ir aviacijos technikos patikimumą.

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