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V.P. Zakharchenko, Cand. Of Sci.(Engineering),
S.S. Tovkach, Cand. Of Sci.(Engineering)
(National Aviation University, Ukraine)

Integrated automated test control systems of aviation equipment

An approach of solving the integrated automated test control systems (IATCS) tasks has been considered. The structure of IATCS, conditions of functioning, composition by the unity matrix, classification according to different criteria have been presented for understanding the system operation. It makes better to increase the level of automation as part of a complex system throughout the life cycle of aviation equipment.

Introduction. Integrated automated test control systems in the aviation industry is a complicated and varied in solving tasks, ergatic scientific and technical complex, designed to provide the maximum possible, in each case, the level of test work automation. The IATCS combines information-measuring and control functions as for test object: aviation equipment (AE) (and for the process – failure safety), and as for its conditions of functioning.

Problem of the research. The purpose of the functioning is a qualitative estimation and a corresponding measurement of its technical condition. It is achieved by using the high-performance computing environment, simulation methods (mathematical, seminatural, physical), methods and facilities of acceptance and performance the automated solutions. The solving of the IATCS tasks provides the staff and the complex tools test automation with the following support: technical, mathematical, program, information, linguistic, organizational and methodical. The IATCS should implement the decision of typical test cycle algorithm. The logic of interaction between the staff and the complex should ensure the performance of the main the test cycle functions.

The IATCS structure has fourteen functional subsystems:

$S_{\bullet 1}$ – the test plan; $S_{\bullet 2}$ – the test preparation; $S_{\bullet 3}$ – simulation of operating conditions; $S_{\bullet 4}$ – measurements parameters of the environment and the object; $S_{\bullet 5}$ – estimation parameters of the environment and the object; $S_{\bullet 6}$ – analysis and comparison estimates with expectations and conditions; $S_{\bullet 7}$ – completion of the test with satisfactory results; $S_{\bullet 8}$ – diagnosis of the object and the equipment; $S_{\bullet 9}$ – formation of corrective solutions; $S_{\bullet 10}$ – performance of corrections; $S_{\bullet 11}$ – registration of required results; $S_{\bullet 12}$ – display of the information; $S_{\bullet 13}$ – documentation of test results; $S_{\bullet 14}$ – control of the test process.

Each functional system $S_{\bullet j}\left(j=\overline{1,14}\right)$ represents the unity of the six types of support: S_{1j} – technical; S_{2j} – mathematical; S_{3j} – program; S_{4j} – information; S_{4j} – linguistic; S_{4j} – organizational and methodical.

Hence, the composition of the IATCS is represented by the unity matrix of interrelations the functional systems (FS) or by the integrity matrix of the complex:

$$S = \begin{Vmatrix} S_{1.1} & S_{1.2} & \dots & S_{1.14} \\ S_{2.1} & S_{2.2} & \dots & S_{2.14} \\ \dots & \dots & \dots & \dots \\ S_{6.1} & S_{6.2} & \dots & S_{6.14} \end{Vmatrix},$$

where at each column corresponds the functional system $S_{\bullet j}$ and at each row – the accounting connection between elements:

$S_j = \| S_{i\bullet 1}, S_{i\bullet 2}, \dots, S_{i\bullet 14} \| \quad (i=1,6)$, that determines the type of support, i. e the support system of the IATCS. The variety of IATCS may be classified according to different criteria. It is used for estimation the quality, scientific and technical level of test automation tools.

IATCS classification. According to solvable tasks – local and group systems (interrelations systems). According to relations with other systems – stand-alone and integrated systems. Stand-alone systems are independent to the higher ranks: computer-aided design (CAD), automated control system (ACS), ACS of the enterprise, ACS of the operation. Integrated systems are the part of subsystems.

Depending on the degree of unification decisions: flexible automated test systems (ATS) with the tools of the task and the object settings on the various techniques and test objects; ATS of certain classes; an unique ATS.

Depending on the level of test automation that estimated the proportion N_{ATP} of tests and the degree of coverage the life cycle stages: low automated $N_{ATP} < 25\%$; middle automated $25\% < N_{ATP} < 50\%$; high automated $N_{ATP} > 50\%$. Highly level of automation is achieved as part of a complex system throughout the life cycle: according to method of visualization the text display; according to performance of the IATCS as the most important criteria of the efficiency the IACS: according to low, middle and high performance; according to on the computer power.

Conclusion. Basic principles of the IATCS is the unity of the system which provided through integrity when creating a synergistic effect (during the operation of the system, it would have properties that cannot be reduced to the sum of the component properties); development; compatibility; standardization and invariance; accumulation of test experience. Global test automation criteria is the principle of a complex test automation at all stages of the life cycle.