ANALYTICAL-SIMULATION MODELING OF THE AIR SITUATION

R. R. Shatovkin, O. V. Trubienko, A. A. Khudyakov
Federal State Budgetary Educational Institution of Higher Education "MIREA – Russian Technological University", Moscow, Russian Federation

Shatovkin@yandex.ru

I. INTRODUCTION

Modeling the air situation, with a high degree of correspondence to the real air situation, in aviation training complexes in the interests of training and maintaining the necessary practical skills of the flight management group and combat control officers is a rather difficult task. The results of the analysis showed that it is impossible to effectively solve this problem only by analytical methods or only by methods of simulation modeling [1]. In this case, an appropriate approach is the combined use of analytical and simulation methods, which determines analytical-simulation modeling, which allows you to combine the advantages and eliminate the disadvantages of these methods.

In analytical-simulation modeling of the air situation, a preliminary decomposition of the modeling process into its constituent sub-processes is carried out. For those sub-processes, where possible, analytical models are used, and for the rest, simulation models are built. This approach makes it possible to cover qualitatively new properties that cannot be investigated using analytical or simulation modeling separately [2].

The diagram of analytical-simulation modeling of the air situation is shown in Figure 1.

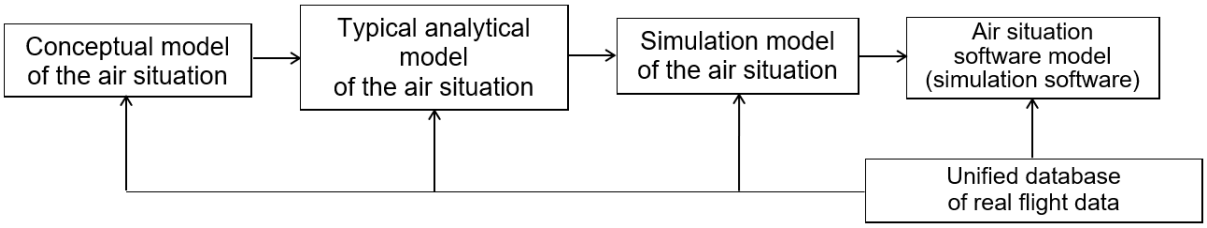

Figure 1. Scheme of analytical-simulation modeling of the air situation

With the indicated approach to modeling and the modeling scheme, it is required to develop an appropriate method of analytical-simulation modeling and a conceptual model of the air situation.

The purpose of the work is to develop a method of analytical-simulation modeling and a conceptual model of the air situation.

II. THE SOLUTION OF THE PROBLEM

At present, the processing of radar information includes the following stages, corresponding to a change in the qualitative properties of the formed information: primary processing of information; secondary information processing; tertiary information processing [2].

The proposed method for modeling the air situation is determined by the established order of processing radar information and, by analogy with the processing stages, includes three levels of modeling:

- modeling the air situation at the level of primary processing of radar information;

- modeling the air situation at the level of secondary processing of radar information;

- modeling the air situation at the level of tertiary processing of radar information.

By modeling the air situation at the level of primary processing of radar information at time t is meant the formation of S marks of air targets.

The parameters of the echo-signal of each air target (delay time relative to the emitted signal, Doppler frequency, phase shift) are determined by its type and belonging to a particular type of aviation, location in space.

Modeling the air situation at the level of secondary processing of radar information at time t means the formation of trajectories S of air targets.

By modeling the air situation at the level of tertiary processing of radar information at time t is meant to simulate the tactical reception of aircraft of a specific type and type of aviation based on the trajectories of the corresponding S of air targets, which makes it possible to form a common air environment.

The proposed method for simulating the air situation is illustrated in Figure 2.

In accordance with the proposed method for modeling the air situation, due to the established order of processing radar information and implying three levels of modeling, a conceptual model of the air situation has been developed.

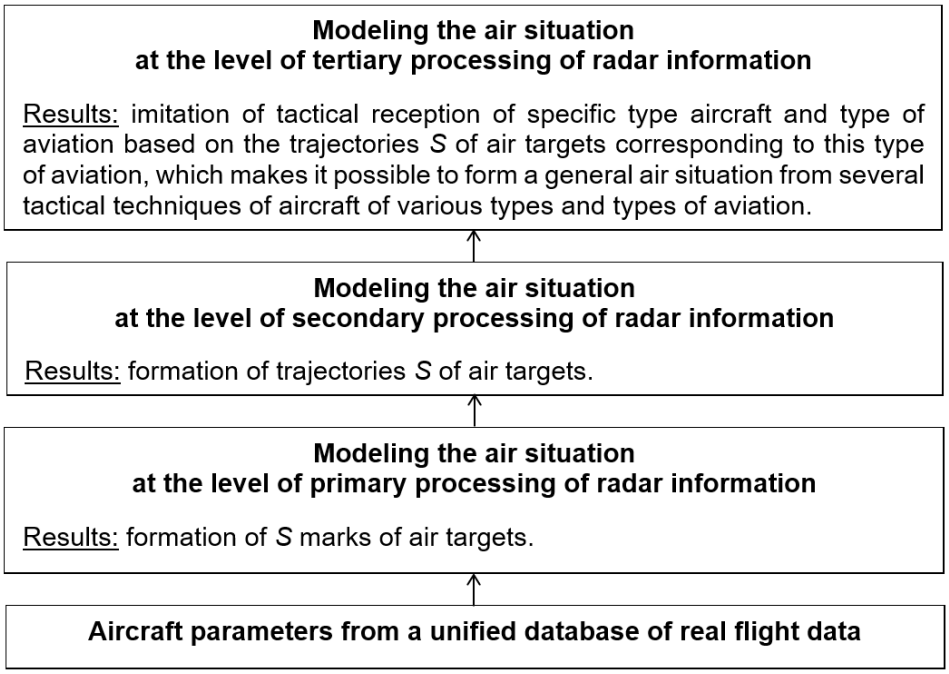

Figure 2. Method of analytical-simulation modeling of the air situation

The conceptual model of the air situation, in turn, reflects, with the completeness necessary for solving the task, the prototype system in one or another content aspect and is written in natural language using the provisions of naive logic. It is introduced in order to clarify the feasibility of using one or another theoretical apparatus when constructing a typical analytical and simulation models, concretizing this apparatus, taking into account the specifics of the modeled system.

The developed conceptual model of the air situation makes it possible to formally describe the air situation in accordance with the three accepted levels of its modeling and to determine for each level the corresponding type of modeling (for the first and second levels – the use of a typical analytical model and, accordingly, analytical modeling, for the third level – the use of a simulation model and, accordingly, simulation modeling).

III. CONCLUSIONS

As a result of the research, a method for analytical-simulation modeling of the air situation has been developed, which makes it possible to form an air situation identical to the real air situation for three levels of radar information processing, due to: the formation of marks of air targets based on an analytical model – when modeling at the level of primary processing of radar information; formation of trajectories of air targets on the basis of an analytical model, taking into account the type of each air target, its belonging to one or another type of aviation, determining the parameters of the echo-signal of an air target – when simulating at the level of secondary processing of radar information; simulation of tactical reception of aircraft of a specific type and type of aviation based on the trajectories of the corresponding air targets and the formation of several tactical receptions of aircraft of various types and types of aviation of the general air situation – when simulating at the level of tertiary processing of radar information.

On the basis of the proposed method, a conceptual model of the air situation has been developed, which makes it possible to formally describe the air situation in accordance with the three adopted levels of its modeling and to determine the corresponding type of modeling for each level.

REFERENCES

[1] Babina O.I. Comparative analysis of simulation and analytical models // Simulation modeling. 2009. No. 1. P. 73–77.

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