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The features of the information integration and complex processing in the airborne situational awareness systems

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Abstract

The features of generalized data about the state of the surrounding area forming are considered. These data are formed by means of integrated multisensor airborne system. For example, the means of data integration as the targets grouping and radar image and digital map superposition are presented.

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1. Introduction

In recent years, it should be noted the development of air and space effects in the following areas[1,2]:

- extension of the combat capabilities of aircraft for different purposes;
- reduction of personnel losses;
- decrease the economic costs of production and combat use of aircraft;
- strengthening the role of group activities until the manifestation of the "swarm effect";
- the use of weapons based on new physical principles, such as electromagnetic weapons.

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The most rational way to implement these trends is the use of unmanned aircraft (UAV). The use of UAVs in the complex, ever-changing conditions of use require a qualitative improvement in their "intelligence", which determined the use of the application to them of the term "robotic systems" (RS) air-based.

If we assume that a machine with a robot anthropomorphic (human-like) behaviour[3], that mean its ability to continue using heterogeneous sensor data, perform analysis of the situation, to carry out its forecasting, decision-making, to carry out specific actions to implement them and to analyse the results. At the same time the highest manifestations of "humanoid" robots these are the ability to learn, make decisions in unusual situations where there is no possibility to use the laws of formal logic, the ability to solve the problem of affixing different ways and the ability to conduct joint activities in a group for a common purpose.

The availability and quality of all of these components characterizes the level of intelligence ("humanoid") RS. However, it should be emphasized that none of the existing UAV fully satisfy the combination of these attributes, i.e. the concept of RS in the annex to the UAV is conditional. Obviously, the situation analysis, decision-making and analysis of the results of its implementation provides a human operator, who is trained in the operation of RS. The functions of information support of the operator on the basis of location of the sensors, as well as actions to implement the decisions taken assigned with UAVs.

Further under the RTC airborne we understand man-machine system "operator – UAVs", capable of fully or partly perform analysis of the situation, make decisions, implement them, analyse the results of actions and trained in the operation, including through joint actions in the group.

It is obvious that to solve problems of varying complexity requires a different level of drones' intelligence. The desire to increase its level determines the need to expand the UAV capabilities when solving intelligence and strike missions in the framework of individual and group activities.

Although the problem of intellectualization of autonomous actions of individual drone in varying degrees are solved, intellectual support group activities is in its infancy.

To be specific, a group using the RS will understand joint actions of several UAV to address common challenges.

Group use of UAVs gives rise to a number of problems, which are caused by the following features:

- no scenarios of group activities, especially in dealing with the shock of tasks: copying of piloted aircraft techniques leads to underutilization of the combat capabilities of the UAV;
- the difficulty of formalizing description of group activities and to formulate a collective interest, which must implement management systems and information systems for each band member;
- the appearance of a higher hierarchical level of management, ensuring the realization of the desired destination group;
- the complexity of using classical optimization algorithms due to a sharp increase in the dimension of the problem being solved;
- complexity of information management within the group;
- the complexity of the identification information from a variety of purposes;
- complexity of importance ranking group purposes, depending on the task;
- the complexity of the target distribution in groups attack and protection;
- complexity of information exchange with both the operator and between drones;
- the need to prevent possible damage and collisions in the UAVs group;
- the complexity of the group management with operator.

2. Formulation of a Problem

One of the most pressing and complex issues for group use of UAVs is to optimize their interaction with the operator. The difficulty of solving the problem is caused not only the complexity of the optimization of the chain "to obtain information – its analysis – forecast – decision – action – analysis of the results", but also the lack clear performance criteria for a group application of RS and its evaluation by system performance survivability, informative, dynamic and sensitivity change in the situation, which should characterize its excellence within the "system – environment (conditions of use)".