IMPLEMENTATION OF UAV'S GROUP APPLICATION USING ARTIFICIAL INTELLIGENCE TECHNOLOGIES

D. A. Lisovsky

JSC "AIRBURG", Ekaterinburg, Russia

In modern conditions, the importance of using groups of unmanned aerial vehicles (UAVs) for conducting combat operations is increasing. Key challenges in this field include enhancing autonomy, combat effectiveness, reliability, and safety of systems. Addressing these challenges requires the implementation of advanced optimal control methods based on artificial intelligence (AI) technologies [1].

Artificial intelligence represents a set of technological solutions capable of mimicking human cognitive functions, including self-learning and decision-making without predefined algorithms. This enables achieving results comparable to those of human intellectual activity, which is particularly crucial for solving complex UAV group control tasks [2].

To effectively address such a large-scale problem, it is necessary to decompose it and identify more specific subtasks. One of the initial steps is defining the scenarios for UAV group deployment, as the scenario determines the distribution of tasks among onboard UAV systems, manned aircraft, and ground control stations. The following scenarios are outlined in this work:

1. **Reconnaissance and Target Designation.** In this scenario, UAVs perform tasks such as detection, recognition, target designation, and strike damage assessment. Controlled weaponry is deployed from manned aircraft. Swarm algorithms are used to coordinate UAV actions, treating the space as a grid. Each

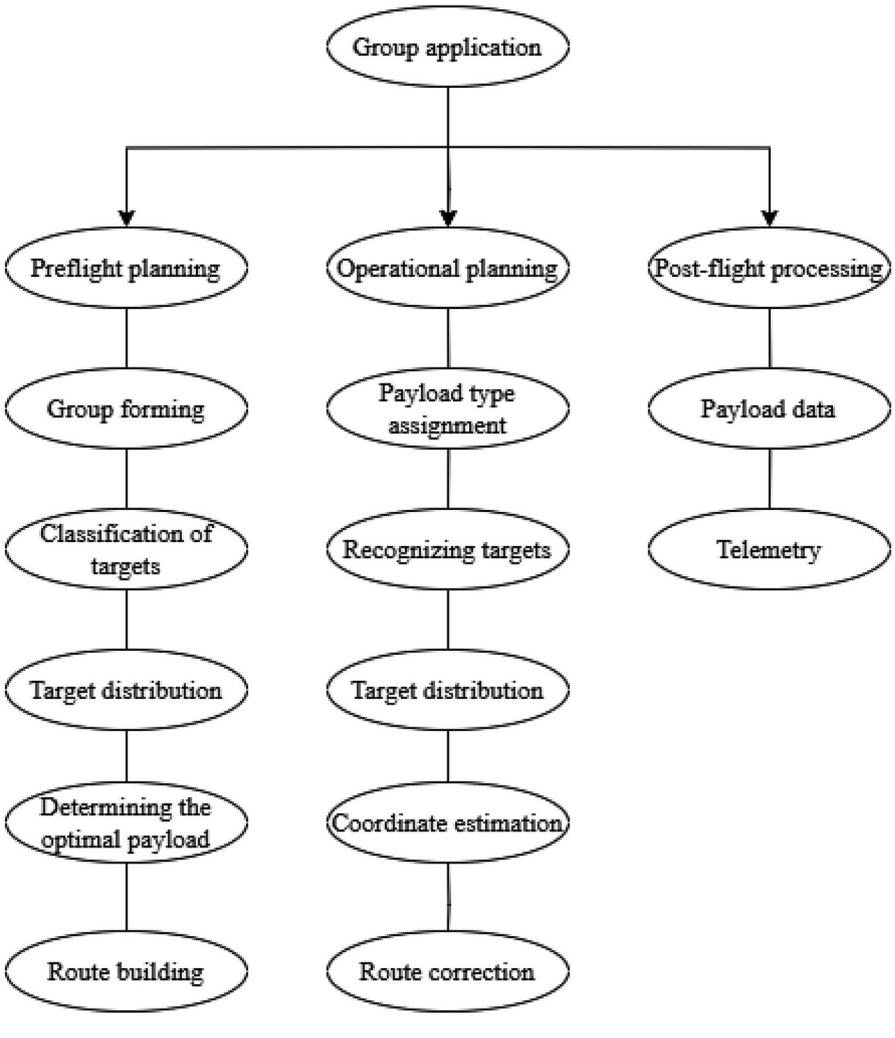

Fig. 1. Tasks in the realization of group application of UAVs

robot analyzes its local environment and makes decisions based on information about the occupancy of neighboring “cells”. This approach simplifies system scaling and enhances its robustness.

2. **Counteraction and Engagement.** This scenario involves strike UAVs equipped with high-precision aviation weaponry. Targeting is carried out by an operator from a manned aircraft. The primary tasks of the UAVs include suppressing air defense systems and selectively engaging key military-economic targets based on their priority.

3. **Reconnaissance-Strike Operations.** In this case, UAVs are capable of autonomously performing the full cycle of tasks: detection, recognition, target designation, weapon launch, and strike damage assessment. This is feasible both in predefined areas of ground targets and in airspace.

Tasks can be structured according to the stages at which they are addressed (fig. 1).

The stages of pre-flight planning and post-flight processing assume the availability of a certain amount of time for preparation and computation, as well as the ability to use powerful computing systems whose size and weight are not critical parameters, unlike scenarios where they would need to be integrated into onboard equipment. In contrast, the stage of operational planning involves solving tasks under limited time and computational resources.

During the research, scenarios for the group application of UAVs and the tasks that need to be addressed for their implementation were analyzed. A method for classifying tasks based on the stages at which they are solved has been proposed. For each task, solution methods based on artificial intelligence algorithms have been suggested, including recurrent [3] and convolutional neural networks, fuzzy logic algorithms [4], and swarm algorithms.

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