METHODS AND ALGORITHMS FOR RECOGNIZING TARGETS FROM UAV

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Abstract. Examples of application and methods of target recognition from UAVs are considered, and the relevance of the methods used in the future is described.

Keywords. UAVs, target identification algorithms.

Created for military needs, nowadays, UAVs are increasingly used for peaceful purposes, for some they still seem to be expensive toys, however, this point of view is losing its relevance, now, using modern sensors and methods, the UAV is a powerful tool, with an ever-expanding field application. Promising areas of application of unmanned aerial vehicles include [1]:

- multispectral survey;
- aerial photography;
- keep records of animals from the air;
- control of oil and gas pipelines;
- geodesy;
- monitoring of forest resources;
- monitoring and identification of moving objects;
- cargo delivery;
- unmanned security, etc.

For most of the listed areas, the issue of object recognition is relevant. Depending on the capacity of the task, calculations can be performed on the aircraft itself, at the UAV control point, or using cloud technologies. In the latter case, this will make it possible to operate with wide computing power without significant material costs [2]. Further narration will imply that the issue of computing power is not decisive.

For photo processing- and video material coming from the aircraft, you can use neural networks [3]. Among the main areas of application of neural networks are forecasting, decision making, pattern recognition, optimization, data analysis. A laborious and time-consuming part of the neural network development process is training it. training of a neural network is a multidimensional optimization problem, since the function can have an arbitrary form. training in the general case is a multi-extremal non-convex optimization problem [5].

The following (iterative) algorithms can be used to solve this problem:

— local optimization algorithms with the calculation of first and second order partial derivatives;

— stochastic optimization algorithms;

— algorithms for global optimization (global optimization problems are solved by enumerating the values of the variables on which the objective function depends).

Also, to identify an object in some situations, it is sufficient to compare the contour of an object for this, the following methods are used: Fourier descriptors, using the calculation of moments, the morphing method or the method of polar diagrams [6].

Each method is optimal under certain conditions, for example, the method of polar diagrams gives a significant gain in performance when recognizing objects of the same type of complex shape, for example, when recognizing aircraft in photographs (Figure 1) [6].

Also, the “friend or foe” pattern system can be used for recognition. The system works according to the following principle. The UAV sends a certain signal over the radio channel, this signal receives the target and sends, or does not send a response. If the answer is received, and it coincides with the correct one, the system recognizes the target as "its". If no response is received or an incorrect response is received, the system recognizes the target as "foe" [7].

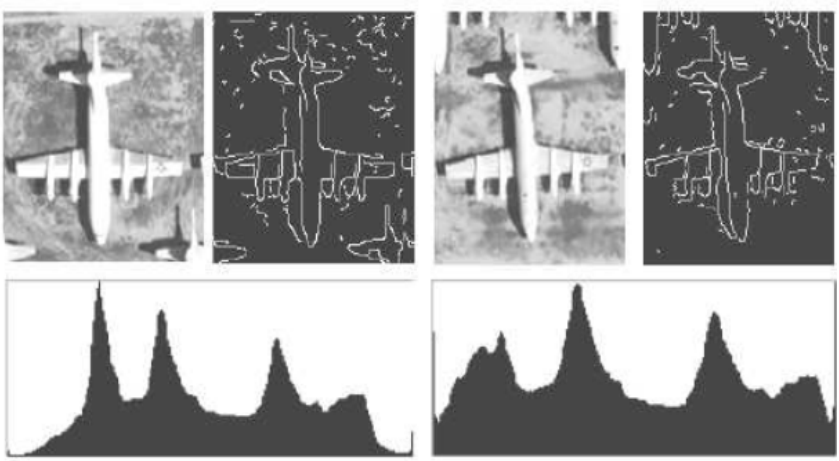

Figure 1 – two objects of recognition and their corresponding diagrams

When checking a target for "friend or foe", not only encrypted signals can be used. The system can be executed in such a way that it will ask an unknown object to perform a certain algorithm, consisting of some mathematical actions and send an answer. If the answer does not match the correct one, the object is identified as "alien" [7]. The disadvantages of this method include the fact that for this method to work, the identification object must have a radio receiving and transmitting system, which reduces its scope.

The above methods help to identify objects through photography and video filming, with their subsequent processing and using radio communication. Many of them can be implemented using the internal resources of the UAV, but if the task is unnecessarily laborious, there is the possibility of using cloud computing.

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