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Comparative evaluation of unmanned aerial vehicle control system

The author considers the construction and comparative evaluation of unmanned aerial vehicle control systems. The interest that is shown to the unmanned aerial vehicles (UAVs) is completely natural. Various industries apply UAVs in different areas. Thus the objective of UAV designers is to provide a certain quality when controlling UAVs.

Introduction

An unmanned aerial vehicle (UAV), commonly known as a drone, is an aircraft without a human pilot aboard. UAVs are a component of an unmanned aircraft system (UAS); which include a UAV, a ground-based controller, and a system of communications between the two. The flight of UAVs may operate with various degrees of autonomy: either under remote control by a human operator or autonomously by onboard computers.

Unmanned aerial vehicles controlling is provided by an operator (Op) with the help of special devices of automation (fig. 1). Basic functional element of control systems is a commands forming device (CFD). As line transmission commands (LTC) can be used the leading communication lines, radio contact, directed laser radiation. An operator set a direction for a spatial route line (RL), according to which a UAV performs its flight. The channel of position control (CPC) of a UAV is optical in relation to the route line (RL) as a rule.

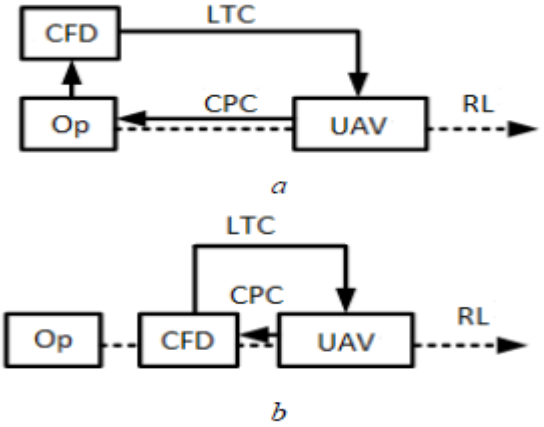

Fig. 1. Unmanned aerial vehicles control systems: a – manual; b – semi-automatic

Control systems can be manual or semi-automatic depending on their level of automation. In the manual system, the operator is located in the contour of UAV controlling. This operator assesses a UAV's position on the route and forms controlling commands via the CFD. The LTC is significant for the unmanned aerial vehicle, when providing its flight on the set trajectory. In semi-automatic systems (see Fig.1, b), an operator is excluded from the control circuit, the main task of which is to form the route line (RL). It should be noted that UAV controlling takes place automatically. Thus the CFD controls the position of a UAV enroute and forms controlling commands. One or other type of control system is used depending on tasks, fixed on a certain UAV. Researching basic indexes of control systems quality allows one to hold the comparative estimation and make recommendations directed on UAV effective application.

Solution of problem

The analysis conducted pertaining to the implementation of the control systems shows that they are the position systems of automatic control on the UAV inconsistency angle in relation to the direction set by operator. Thus the moment *Ms* of UAV stabilizing can be formed both on one and two channels. During the single-circuit system implementation (see Fig. 2, a), a stabilizing moment is formed on the sensor channel of angular rejection of a controlled object.

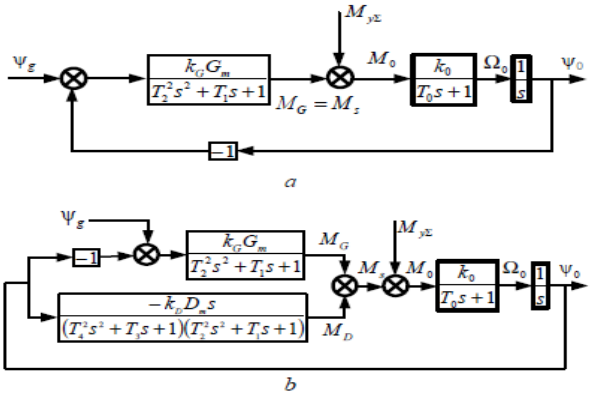

Fig. 2. Block diagrams of semi-automatic control system: *a* – single-circuit; *b* – double-circuit

It is necessary to take into account that parameters of different operators can substantially differ from each other. There can be some changes in one and the same operator, while doing a volume of executable work that turns out to bring on tension. Many of these changes depend on the fatigue of concrete individuals, as well as their capabilities and training.

From positions of the automatic control theory, a man is a dynamic link flexible enough. During studies and trainings, he adapts well both to the UAV control systems and to the terms, in which management is carried out. The main

point of this process is that the acquired knowledge and skills are constantly supported at a required level and developed constantly.

A high-confidence system like the UAV control system should be designed so that its logical and physical behavior can be easily analyzed and predicted. Therefore, there is a demand for an approach to facilitate both time-triggered design and message-triggered design. To meet this design challenge, UAV designers use the software which complies with all the requirements in the area of modern aviation.

It would be appropriate to mention the productivity–cost–efficiency complex of factors, which was developed to assess the effectiveness of the observation and searching abilities of unmanned aeronautical systems. These factors can also be used to comparatively assess several types of UAVs. To attain this goal, they calculate specified indices for each type and then, for example, applying hierarchy analysis technique they determine comprehensive estimates for each of them and choose the best sample UAV.

Conclusions

Thus judging from the tasks fixed on UAVs, this paper makes it possible to conclude the following:

– semi-automatic and hand control system can be implemented in practice;

– introduction in the complement of the controlling system of the adjusting channel for speeds of controlled object rejection is extended by the area of its stability, allowing to provide higher exactness of controlling;

– when assessing the UAV control system quality and the accordance with the requirements, it is necessary to take into account not only the perfection of the systems construction, but abilities and skills of an operator, level of his preparation and qualification.

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