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DESIGNING HIGH-ALTITUDE UNMANNED AIRCRAFT

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The paper represents a design solution for high-altitude unmanned aircraft (UAV). Unmanned aerial vehicle (UAV), is an aircraft controlled autonomously by the onboard computer or remote human pilots. Compared to manned aircraft, UAVs were originally used for missions too "dull, dirty or dangerous" for humans. While they originated mostly in military applications, their use is rapidly expanding to commercial, scientific, recreational, agricultural, and other applications, such as policing, peacekeeping, and surveillance, product deliveries, aerial photography, agriculture, smuggling, and drone racing. High-altitude UAV is referred to the UAV operating at the altitude beyond 18 km.

This report discusses design considerations for high-altitude UAV [1,2] with electric propulsion, made by aerodynamic load-carrying scheme “flying-wing”. Solar-powered high-altitude UAV is the high-altitude UAV powered mainly or entirely by solar cells. The propulsion system of High-altitude UAV is divided into electric (fuel cell, Li battery, solar cell or any combine of them) and engine. With the increasing price of oil, solar powered UAV converting solar energy into electric directly received significant interest. It is believed that after overcoming technical difficulties, solar powered high-altitude UAV will be able to stay and operate in the high-altitude, because of the inexhaustible solar energy from the sun. In the considered project, the following fundamental decision was proposed: the UAV uses photoelectric converters as the sources of electrical energy at day and batteries at night. It is supposed, that solar cells are assembled into solar panels. These panels are mounted on the surfaces of the wing and winglets.

The chosen mathematical model to estimate solar radiation [3] is based on date, altitude and geographic latitude of the flight, as well as a mathematical model for estimation of electric energy considering the area of solar panels, and their position relative to sunlight and efficiency of solar cells.

Flight conditions at high altitude are characterized by low pressure, temperature and density of air. These conditions increase the energy consumption for the implementation of horizontal flight and the normal functioning of the equipment. The proposed profile of the flight with step-changed altitude allows to satisfy the condition that the available capacity of the power plant is equal or greater than power required for flight and operation of the equipment. A stepped flight profile consists of the following sections: daytime - climb and horizontal flight at high altitude with charging; night-time – descent and horizontal flight with low energy consumption batteries.

The report presents the results of the calculation of required and available capacities for the certain altitudes day and night flight at certain latitude, the estimation of the structural weight and propulsion and volume-weight layout of the UAV.

References

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