

DESIGN OF SMALL-SCALE TILT-ROTOR UNMANNED AERIAL VEHICLE

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Introduction. Unmanned Aerial Vehicle (UAV) is the aircraft without a human pilot aboard. UAVs are subcategorized as RC Models, which are controlled by a pilot via transmitter-receiver system, and Drones, which are fully autonomous. They are used for different military missions, such as surveillance and reconnaissance. They are widening their use in civil areas, for example, search and rescue operations, filmmaking, remote sensing of chemical leaks, crop spraying and monitoring in agriculture, etc. Most of the UAVs are either of airplane (fixed-wing) type or copter (Vertical Take Off and Landing) type. The aim of this project is to design the UAV that will combine the hovering abilities of multicopters with the endurance of fixed-wing aircrafts.

Materials and methods. The project will be accomplished through the following steps:

- Design constraints (specifications) are specified in collaboration with representatives of "Kazakhstan Aviation Industry" LLP;
- Conceptual Design is developed based on the information gained from literature and the team work;
- Aerodynamic Calculations and Optimization are conducted;
- Aircraft control system is developed;
- CAD model is created in DSS SolidWorks-EFD;
- Strength and aerodynamic analyses are carried out in the software (SolidWorks);
- The prototype model is built and flight tests are conducted;

The prototype is planned to be built from Styrofoam and carbon fibers. The necessary hardware includes flight controller, motor controllers, electric motors, propellers, batteries, transmitter-receiver, wiring, sockets, etc. These are going to be ordered from foreign websites (USA, China, Russia, etc).

Results and discussion. The project has started on September as a final year Capstone Project. It is in the stage of preliminary calculations. The prototype of the tilt-rotor UAV is planned to be developed from January 2015 and be presented on May 2015. It is expected to obtain the working prototype that is able to perform specified mission and have an endurance of <1 hour with payload <1 kg. The novelty of the project will be in the increased endurance, alternative method of rotor's mode change (horizontal to vertical and vice versa), and relatively low cost.

Conclusions. The project topic is quite significant for the area of Aviation and Defense area in the country. This is the pilot project that will, hopefully, trigger the design and engineering of the small-scale UAVs for various local military and civil missions in the future.

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References.

1. Fahlstrom, P.G., Gleason, T.J., 2012. *Introduction to UAV Systems*. Fourth dition. Chichester: Wiley;
2. Austin, R. 2010. *Unmanned aircraft systems: UAVs design, development and deployment*. Chichester: John Wiley & Sons