Results of Simulation and Scaled Flight Tests Performed on a Rocket-Plane at High Angles of Attack

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Abstract: According to the study of the space flight market, there is a demand for space suborbital flights including commercial tourist flights. One of the challenges is to design a mission and a vehicle that could offer flights with relatively low G-loads. The project of a rocket-plane in a strake-wing configuration was undertaken to check if such a design could meet the FAA recommendation for this kind of flight. The project concept assumes that the rocket-plane is released from a slowly flying carrier plane, then climbs above 100 kilometers above sea level, and returns in a glide flight utilizing a vortex lift generated by the strake-wing configuration. Such a mission has to include a flight transition during the release and return phases which might not be comfortable for passengers. Therefore, the project was focused on numerical investigation of a possibility to perform those transition maneuvers in a passenger-friendly way.

The numerical simulations of a full-scale rocket-plane were performed using SDSA software package. The influence of elevator deflection change on flight parameters was investigated in two cases: a transition from the steep descent at high angles of attack to the level glide just after rocket-plane release from the carrier and an analogous transition after reentry to the atmosphere. In particular, G-loads and G-rates were analyzed. As a result, it was found that the values of these parameters satisfied the specific requirements during the separation and transition from a steep descent to gliding. They would be acceptable for an average passenger.

In order to verify the modelling approach, a flight test campaign was performed. During the experiment, a rocket-plane scaled model (Figure 1) was released from the RC model helicopter (Figure 2). Separate simulation of the experiment with the application of the scaled model was performed in SDSA. Results of this simulation appeared to be comparable to flight test results so it can be concluded that results for the full-scale rocket-plane are realistic.

All these results and experiment techniques will be presented during the conference and in the following paper.

Figure 1 The rocket-plane model during the flight campaign.

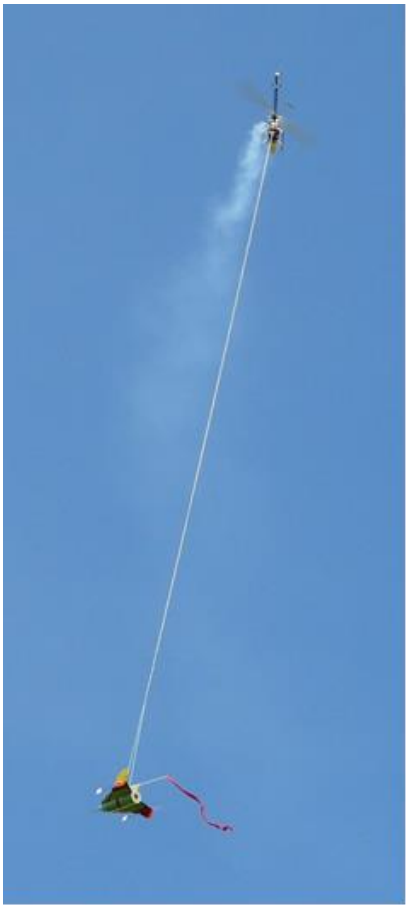

Figure 2 The rocket-plane model attached to the UAV helicopter during the flight campaign.