

The project of research rig for analysis of aerodynamic impact of the wing in the tandem wing configuration

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Abstract:

The paper presents the conceptual project of the research rig to measure the aerodynamic loads on the wings in the tandem wing configuration. The main goal of the project is to check the results of numerical aerodynamic analysis made by MGAERO (Figure 1) and Ansys Fluent (Figure 2) with results obtained by wind tunnel tests.

First of all, the numerical model was prepared in the CAD system. Numerical model consists of two wings and fuselage. The wings are equipped with aileron on the outer side of the wing and flap in the inner part of the wing. The dimensions of the model were similar to the wind tunnel test model. Numerical computations are made for different AoA (angles of attack) and wing stagger, that is the distance between the wings.

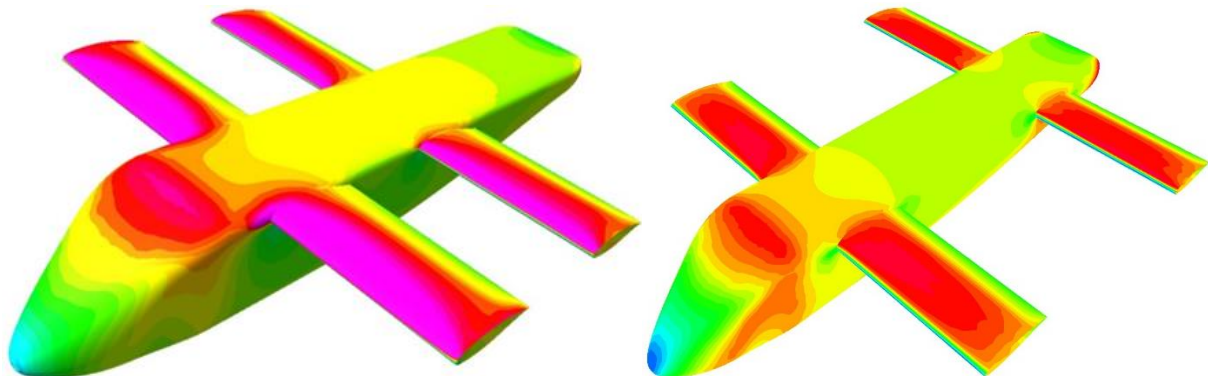


Figure 1. Pressure coefficient distribution generated in MGAERO for different stagger. Left: AoA = 10 deg, right: AoA = 0 deg.

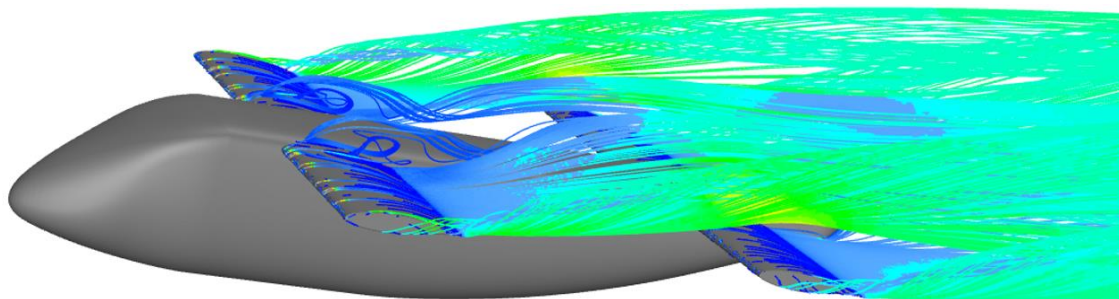


Figure 2. Streamlines generated in Ansys Fluent.

Aerodynamic analysis was made to obtain the aerodynamic coefficients and to define the aerodynamic loads for both wings. Based on those results, the research rig was designed. The main assumptions of the rig are the following:

- The rear wing is able to shift with respect to the front wing forward and backward.
- Front wing is not able to shift.

- The point of support can be adjusted to the position of the center of gravity.
- Two tensometric beams are used to measure forces on each wing (see Figure 3).
- In summary, eight beams are used to obtain aerodynamic forces and moments on both front and rear wing.
- The research rig is able to change the AoA, moreover the ailerons and flaps are able to deflect.

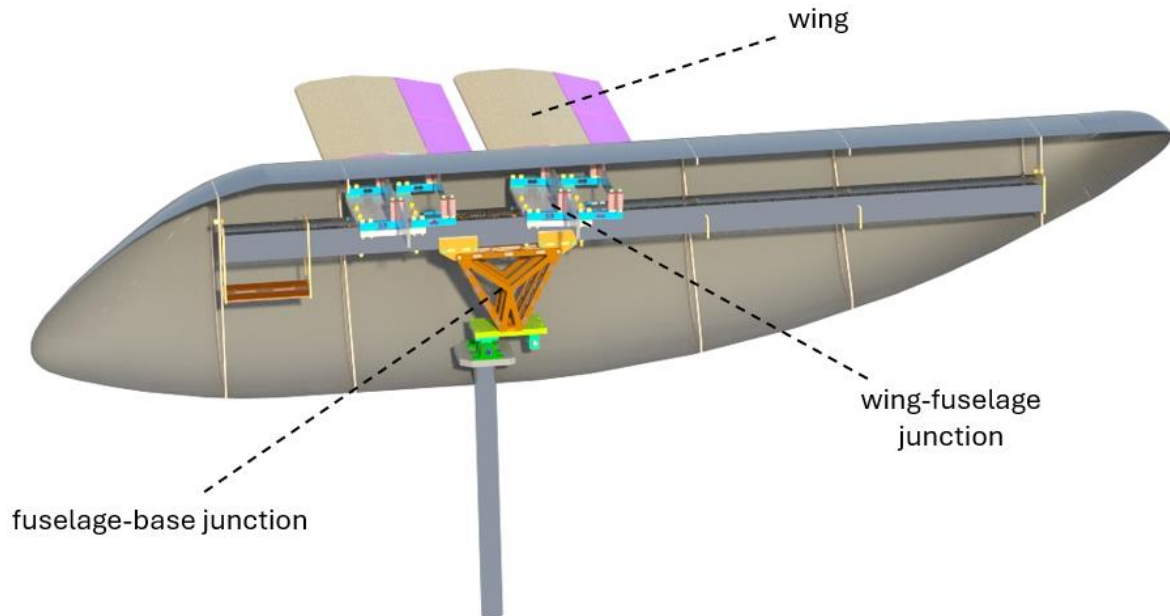


Figure 3. Research rig.

After preliminarily establishing the dimensions and materials for the model structure, strength calculations were performed. The calculations considered the conditions in the wind tunnel and not for the flight. The research rig is currently under construction and will be used for the wind tunnel tests. The final rig will allow to verify the CFD results with real flow around tandem wing model. Moreover, it will allow for dynamic analysis in the future (e.g. analyzing the state of equilibrium and the concept of optimal control of an unconventional configuration).