

Software Testing: VSPAERO

Task for a *Master Thesis*

Background

Conceptual aircraft design provides around 50 core parameters of the aircraft. OpenVSP (<http://openvsp.org>) can be used to get a 3D representation of the geometry. OpenVSP-Connect (<http://openVSP.Profscholz.de>) can help considerably to set up an OpenVSP model. Subsequently, it is desirable to get an impression of the flow over this aircraft geometry or even to get some aerodynamic parameters like the lift curve slope. VSPAERO is the aerodynamic tool, which comes with OpenVSP. VSPAERO provides quick aerodynamic analysis options using the Vortex Lattice Method (VLM) or the Panel Method. It integrates actuator disks that can be used for aero-propulsive analysis. VSPAERO also comes with a viewer to display wakes and pressure coefficient changes. The idea of this thesis is simply to get familiar with VSPAERO, to comment on its handling, and to determine whether the software provides reliable and correct simulation results. A start from the very basics will be necessary to get familiar and to produce useful results.

Task

Task is simply the evaluation of OpenVSP's VSPAERO software by a sequence of experiments. The detailed tasks are:

- Literature review of the VLM and Panel Method.
- Description of OpenVSP and its aerodynamic code VSPAERO.
- Discretization studies to determine the sweet spot between correct and reliable results and a short simulation time.
- Literature review of analytical equations for the lift curve slope of a wing.
- Comparison of the lift curve slope of a wing calculated with VSPAERO (VLM and Panel Method) with the analytical equations.
- Literature review of analytical equations for the Oswald factor (span efficiency factor) of a wing.
- Comparison of the Oswald factor (span efficiency factor) calculated with VSPAERO for a straight wing, described by its aspect ratio, A and taper ratio λ with Hoerner's approach (<https://n2t.net/ark:/13960/t57f0bk2j>, page 7-4).

- Literature review of equations for the estimation of the induced drag of box wings (related to the reference wing).
- Comparison of the induced drag of box wings calculated with VSPAERO (as a function of the h/b-ratio) with equations from literature as well as previously obtained simulation results and wind tunnel measurements.
- Literature review related to the numerical visualization of the flow and the pressure distribution.
- Comparison of flow visualization options with the VLM and Panel Method of VSPAERO.

The report has to be written in English based on German or international standards on report writing.