FSI Workflow for the Full-Potential Solver

Aeroelasticity is one of the key points when designing any aerospace system. It allows the detection of the structure and aerodynamic safety limits and the improvement of the system performance when operating.

The goal of this master thesis is to develop a partitioned fluid-structure-interaction (FSI) workflow for the study of aeroelastic phenomena at early stages of aircraft design. Requirements are thus accuracy, robustness and low computational cost. The workflow is implemented in python using Kratos Multi-Physics. To select an appropriate fluid solver, a comparison between a high fidelity variational multi-scale solver and a low fidelity potential solver is presented. The potential solver is selected due to its computational cost and the possibility to implicitly define the wake in the mesh using an embedded approach. This avoids to remesh within each fluid-structure-interaction iteration. The potential solver limits the application of the FSI workflow to study of static aeroelasticity of streamlined bodies flying at high Reynolds numbers and small AoA.

Static Aeroelasticity: Divergence

The static aeroelasticity study is focused on studying the divergence instability. To perform the divergence study, the free-stream velocities are divided in three different regions. The first region uses the Newton’s method with a unitary relaxation coefficient. The second region applies the Aitken method. The third region considers again the unitary relaxation coefficient. The first region captures adequately the tendency of the analytical results. This first region is physically, numerically and, also, mathematically correct. The second region, which is in the divergence region, is not possible to be captured due to a too deformed mesh or a nonconvergence of the results. The results in the third region, which captures the negative torsional deflections, follow the expected tendency, but with an offset.