Implicit large eddy simulations for airfoils using compressible and incompressible discontinuous Galerkin solvers

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Abstract. ***We present implicit Large Eddy Simulations for NACA0012 airfoils at various Reynolds numbers (Re = 1x10^4, Re = 1x10^5 and Re = 1x10^6) and Angles of Attack (0 ≤ AoA ≤ 10 deg) using two discontinuous Galerkin formulations.***

On the one hand, we use a compressible solver based on a nodal DGSEM formulation and supplemented with a stabilising split-form formulation (Pirozzoli) and Roe interface fluxes, ref [4,5]. On the other hand, we use an incompressible DG-Fourier formulation that uses the interior penalty parameter to provide localised dissipation, ref [1,2]. Both solvers enable high order computations by varying the polynomial order inside mesh elements, which are here set to P=3 and P=4.

We provide results of aerodynamic coefficients and pressure distributions using both solvers to show how they are able to provide under-resolved flows that agree well with experimental data and well established solvers (Xfoil or Ansys-Fluent) as shown in figures 1 and 2.

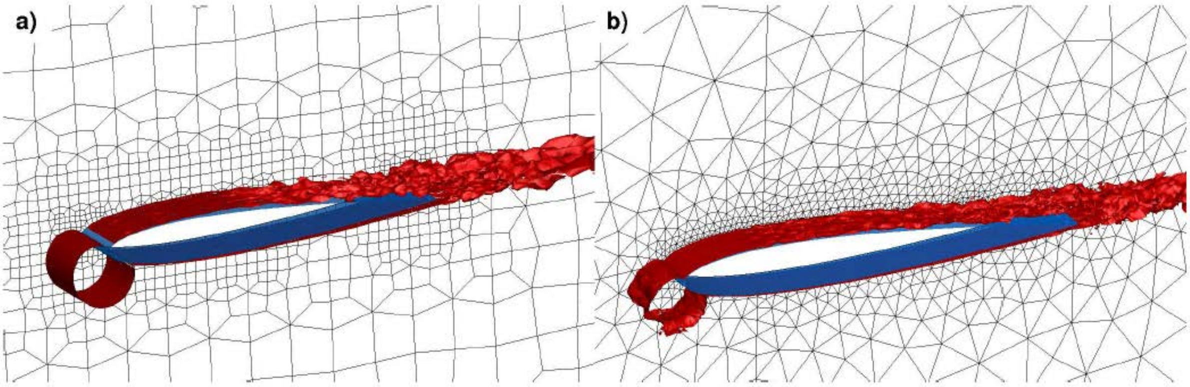

Figure 1 NACA0012 airfoil at Re = 1x 10^5 and AoA=5 for P=4: a) Compressible DG solver b) Incompressible DG solver.

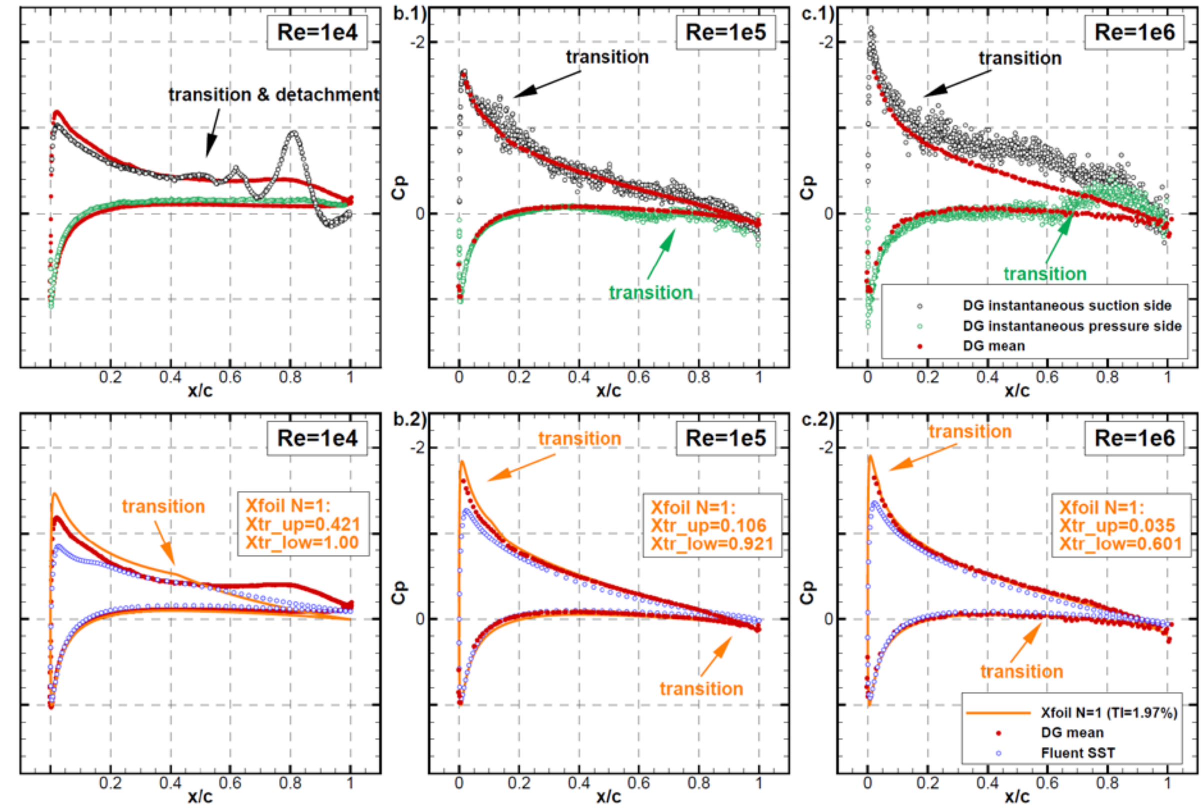

Figure 2 NACA0012 airfoil at AoA: 5 deg for a) Re = 1x10^4 b) Re = 1x10^5 and c) Re = 1x10^6. Top row show instantaneous and mean Cp for DG-Fourier solver, and bottom row shows comparison of mean Cp values to other solvers: Xfoil and Fluent SST (fully turbulent simulation).

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