MS18: Optimal Control, Optimization, Inverse Problems and Numerical Simulations with Applications II

Curved Meshing for High Reynolds Flows Solved Using High Order Framework

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When high order schemes are used for compressible simulations, the subparametric discretization used for geometry's representation (usually piecewise-linear) may lead to errors dominating errors related to the variable field discretization. To solve this problem, we need to generate curved meshes with the same order of the numerical schemes. That means curved elements are compulsory for approximations of order more than three.

Our strategy to generate simplicial curved mesh is the following: we consider the initial straight mesh as a deformable elastic solid and we impose a displacement on its boundaries to obtain a curved mesh representing the curved geometry. The validity of the curved volumic mesh is obtain thanks to linear elasticity equation and some properties of Bezier curves/surfaces.

Several examples are performed in 2d and 3D, in particular for several turbulent simulations such a M6 wing, a RAE 2827 airfoil and a 2D wing-flap configuration.

Two Discontinuous Galerkin Spectral Element Cut-Cell Methods for the Stefan Problem

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The Stefan problem is a moving boundary problem used to model phase change. A key issue is that the boundary domain is not known in advance, which requires one to compute the unknown domain as a part of the solution. We present two discontinuous Galerkin spectral element cut-cell methods for the Stefan problem. One uses the transformation technique. The other one involves extrapolation. Both methods can be shown to be spectrally accurate in space.

Uniform Stabilization to a Nontrivial Equilibria of a Fluid Structure Interaction Model

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We consider uniform stability to a nontrivial equilibrium of a nonlinear fluid structure interaction (FSI) defined on a two or three dimensional bounded domain. Stabilization is achieved via boundary and/or interior feedback controls implemented on both the fluid and the structure. The main technical difficulty is the mismatch of regularity of hyperbolic and parabolic component of the coupled system. This is overcome by considering special multipliers constructed from Stokes solvers. The uniform stabilization result reported here is global for the fully coupled FSI model.