Isogeometric Analysis for Compressible Flows. High-order Solver of Compressible Euler Equations

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ABSTRACT

In this talk we present our Isogeometric Analysis (IGA) based approach for solving compressible inviscid flow problems governed by the compressible Euler equation.

Since its birth in 2005 [1] IGA was succesfully applied to wide range of problems including linear elasticity, heat transfer and incompressible fluid flow problems. Its applications to compressible flows are very rare [2, 3]. On the other hand IGA reveals significant advantages over classical finite element method (FEM) that can be utilised especially in simulation of this class of phenomena. In viscous compressible flows boundary layers play a crucial role and strongly influence the behaviour of the entire flow, therefore an accurate representation of boundary shape is indispensable for robust simulations. In case of IGA, a highly accurate resresentation comes at no cost and is assured by design. The inviscid flow solver that is presented in this talk is a first step towards a tool capable of handling more complex, viscous problems.

The isogeometric counterpart of the standard Galerkin FEM is prone to oscillatory behaviour in the vicinity of shocks and steep gradients of the solution field, similarly to standard FEM. As a remedy the methods from the family of algebraic flux correction [4] were generalized to B-spline basis functions and applied to suppress the unwanted instabilities.

This talk presents an outline of the theoretical background of our approach and an implementation of the IGA based solver for the compressible Euler equation. The numerical results of application of the tool to common benchmark problems are discussed as its validation.

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