

rp-adaptation for compressible flows

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ABSTRACT

We propose a *rp*-adaptation method for the simulation of compressible flows with shocks. The flow solver used is the inviscid version of the compressible module of the high-order *hp*/spectral framework `Nektar++` [1].

To improve the accuracy and efficiency of simulations, we combine the best features of *r*-adaptation and *p*-adaptation. The *r*-adaptation is used to move nodes and cluster degrees of freedom near the shock whilst keeping the polynomial order low in those elements that contain it. Outside the shocks, where we expect the solution to be smooth, we apply *p*-adaptation, i.e. we increase or decrease the polynomial order to optimize mesh resolution.

Our mesh adaptation method constructs a new mesh with improved resolution through the analysis of the existing solution via an error indicator, the definition of a suitable criterion for achieving and “optimal mesh,” and the development of a strategy to refine and coarsen the mesh.

A sensor, which compares the solution at different polynomial degrees, is used for both shock detection and error indication [2]. Shock resolution is enhanced through mesh deformation via minimization of the energy [3] where elements in the vicinity of shock waves contract. This improves the representation of the shock wave without increasing the number of degrees of freedom. The resolution of the smooth parts of the flow is increased by increasing the polynomial order when required.

We will present its application to the simulation of transonic flow.

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