Moving meshes for shocks in *p*-adaptive flow simulations

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Abstract We present a new approach for handling shocks in high-order flow simulations, based on moving meshes. *p*-adaptive strategies are ideal for smooth flow fields where an exponential decay rate of the error is expected. Polynomial basis functions are however unable to represent jump functions accurately, with the so-called Gibbs phenomenon leading to solver instability.

The community has traditionally used *h*-adaptation to alleviate this problem. Instead we propose to use a moving mesh approach, also called *r*-adaptation, based on a variational framework. *r*-adaptation allows us to cluster degrees of freedom (DOFs) in the region of the shock while keeping the global DOF count constant. Preserved mesh connectivities also make the approach ideal for High-Performance Computing (HPC) systems where node-to-node communication is prohibitively expensive.

We illustrate our new approach on a well-know NACA0012 profile in transonic regime at low angle of attack. We show that we are able to identify both the strong shock on the suction surface and the weak shock on the pressure surface, using a lightweight error indicator, and cluster elements by *r*-adaptation to obtain a sharper jump profile. We then apply a traditional *p*-adaptive strategy, with most added DOFs located in the under-resolved leading and trailing edge areas. This proof of concept demonstrates an ability to increase accuracy in both smooth and discontinuous flow regions.

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