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STABILITZATION TECHNIQUES FOR NUMERICAL METHODS IN CFD

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ABSTRACT

Solutions to convection dominated problems in computational fluid dynamics can develop discontinuities in finite time. When solving these problems numerically, these discontinuities cause oscillations in the numerical solution due to the Gibbs phenomenon. Without some form of stabilization, the oscillations can lead to numerical instabilities that either pollute the solution or cause solution blow-up.

We propose to organize a mini-symposium devoted to this active research area. Despite much progress made on this topic, much effort is still devoted to improving existing techniques especially for multidimensional problems, high-order approximations, adaptive computations and computations in complex geometries.

Many approaches have been proposed to stabilize the numerical solution, e.g., applying limiters or adding artificial viscosity. Limiters reduce, or limit, the numerical solution's slope, i.e., they introduce diffusion that counteracts the development of oscillations in the numerical solution. There are several aspects of limiters that are of interest to the mini-symposium. For example, it is often required that the numerical solution satisfy a positivity constraint, e.g., positive density and pressure for gas dynamics simulations. Limiters can be used to guarantee that nonphysical solutions will not be computed by the numerical method. Robust limiters for high-order methods are difficult to construct. The use of limiters on domains with complex geometries can be challenging, e.g., at boundaries and on Cartesian grids with embedded boundaries, or on adaptively refined meshes with nonconforming elements. Artificial diffusion is another stabilization technique that introduces viscosity into the numerical solution such that solution is stabilized without loss of accuracy. Shock detection is often coupled with limiters or artificial diffusion in order to only modify the solution in the neighborhood of discontinuities.

This mini-symposium is targeting researchers that have worked on the wide range of stabilization techniques in the context of finite volume or discontinuous Galerkin methods. We hope to bring together those who have made recent progress in this area and to establish the current state-of-the-art of this subject.