The Flux Reconstruction Approach to High-Order Methods- Theory, Implementation and Application

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The Flux Reconstruction (FR) approach, which was first developed by Huynh in 2007 [1], is a mathematical framework for developing nodal unstructured high-order schemes based the governing system in differential form. As such, unlike many of its unstructured high-order counterparts, the FR approach does not require quadrature rules to be implemented and employed. Consequently FR schemes are particularly straightforward to implement in an efficient manner. It is hoped that the simple and efficient nature of FR schemes will facilitate adoption of unstructured high-order methods amongst a wider community of fluid dynamicists. In this seminar I will discuss various aspects of FR schemes. Particular attention will focus on a new class of energy-stable FR schemes [2]. The theory behind these new schemes will be presented, along with details of how they can be implemented efficiently for graphical processing units. Finally, application areas for the new methods will be discussed, and their ability to perform affordable yet accurate Large Eddy Simulations (LES) of real world turbulent flows will be assessed. The ability to routinely perform such LES could transform the design process of numerous products, including landing gear configurations, flapping wing micro air vehicles, and rotorcraft.

References

[1] Flux Reconstruction Approach to High-Order Schemes Including Discontinuous Galerkin Methods. H. T. Huynh. AIAA Conference Paper, 2007-4079, 2007

[2] New Class of High-Order Energy Stable Flux Reconstruction Schemes. P. E. Vincent, P. Castonguay, A. Jameson. Journal of Scientific Computing, Volume 47, Pages 50-72, 2011