ERROR ESTIMATE OF ENERGY STABLE FLUX RECONSTRUCTION METHODS

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ABSTRACT

Energy stable flux reconstruction is a high-order numerical method used for solving partial differential equations in computational fluid dynamics. This method is designed to preserve the energy stability of the underlying partial differential equation system with respect to a broken Sobolev norm. This property makes this method particularly suitable for simulating problems that involve strong shocks or discontinuities. First a class of one-parameter schemes has been identified to be stable for the one-dimensional linear advection equation by Vincent, Castonguay and Jameson in 2011. This class includes some well-known high order methods such as the discontinuous Galerkin method and spectral difference method. The main advantage of the energy stable flux reconstruction is to allow for an increase in the maximum admissible time step while retaining the stability and accuracy properties of the underlying scheme. However numerical experiments have shown that beyond a certain value of the parameter, optimal order of accuracy is lost. This work introduces an L²-error estimate for energy stable flux reconstruction scheme applied to the one-dimensional advection equation following the outlines of Cockburn’s proof for discontinuous Galerkin method.

Keywords: High-order methods, Flux reconstruction, Error estimate, Order of convergence