Nov. 19 at 9:30 am

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Title: Entropy-dissipation/stability and local linear stability

Abstract:
In recent years, a strong push to construct novel entropy-stable schemes based on the summation-by-parts property has occured in the high-order community. These schemes mimic the second law of thermodynamics, by incorporating the entropy contraction property of the continuous PDE into the discretisation. A key ingredient is summation-by-parts, which mimics integration-by-parts and the definition/condition of Tadmor for entropy-conserving flux functions, which discretely mimics the chain-rule necessary for an entropy pair to contract the PDE. These novel methods gain more and more succes, as they offer great robustness for highly non-linear problems such as compressible turbulence. We will however report in this talk on recently observed stability issues of entropy-conservative/stable high order schemes. We investigate the local linear stability of the schemes when approximating non-linear conservation laws such as the simple Burgers equation and the compressible Euler equations. We demonstrate that local linear stability is not guaranteed, even when the scheme is (non-linearly) entropy stable, as parts of the high-order scheme might be anti-diffusive in relation to a central discretisation. We show in numerical tests that the lack of local linear stability might have a severe impact on the simulation, as exponential growth of spurious solution modes might occur leading to potential fatal crashes of the run.