Abstract Submitted
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A Semi-Implicit, Fourier-Galerkin/B-Spline Collocation Approach for DNS of Compressible, Reacting, Wall-Bounded Flow TODD OLIVER, RHYS ULERICH, VICTOR TOPALIAN, NICK MALAYA, ROBERT MOSER, The University of Texas at Austin — A discretization of the Navier-Stokes equations appropriate for efficient DNS of compressible, reacting, wall-bounded flows is developed and applied. The spatial discretization uses a Fourier-Galerkin/B-spline collocation approach. Because of the algebraic complexity of the constitutive models involved, a flux-based approach is used where the viscous terms are evaluated using repeated application of the first derivative operator. In such an approach, a filter is required to achieve appropriate dissipation at high wavenumbers. We formulate a new filter source operator based on the viscous operator. Temporal discretization is achieved using the SMR91 hybrid implicit/explicit scheme. The linear implicit operator is chosen to eliminate wall-normal acoustics from the CFL constraint while also decoupling the species equations from the remaining flow equations, which minimizes the cost of the required linear algebra. Results will be shown for a mildly supersonic, multispecies boundary layer case inspired by the flow over the ablating surface of a space capsule entering Earth's atmosphere. This work is supported by the Department of Energy [National Nuclear Security Administration] under Award Number [DE-FC52-08NA28615].

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