Recent Advances in Computational Fluid Dynamics for Hypersonic Flows

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Computational fluid dynamics is rapidly changing due to advances in computer performance, numerical methods, grid generation approaches, and turbulence modeling. It is now becoming possible to resolve unsteady flow physics at relevant Reynolds numbers for complicated geometries. In this talk, I highlight some recent improvements to computational methods for high Mach number flows. Of particular importance is a new numerical flux function that drastically reduces numerical dissipation and enables high-accuracy simulations on non-trivial grids. This method promises to help solve a number of long-standing problems in hypersonic flow physics. Several examples of large-scale simulations will be discussed, including direct numerical simulations of transition to turbulence due to a discrete roughness element, fuel-air mixing in a supersonic combustion ramjet engine, and high Mach number unsteady capsule base flows.

Bio Graham Candler is the McKnight Presidential Professor of Aerospace Engineering and Mechanics at the University of Minnesota. He received his B.Eng. from McGill University in 1984 and his graduate degrees from Stanford University in 1985 and 1988. He worked as an Aerospace Engineer at the NASA Ames Research Center, then as an Assistant Professor at the North Carolina State University, until he moved to the University of Minnesota in 1992. He works in the area of computational fluid dynamics, high-temperature gas dynamics, and re-entry aerothermodynamics. He has published over 200 journal and conference papers in these areas. He is a Fellow of the American Institute of Aeronautics and Astronautics, he received the AIAA Thermophysics Award in 2007, and he was named a National Security Science and Engineering Faculty Fellow by the Department of Defense in 2009.