Numerical simulations of the interaction of shock waves and turbulence

Abstract:
Interactions between shocks and turbulence are relevant to the design of hypersonic propulsion systems, including scramjet engines, as well as to the understanding of supernova explosions in astrophysics. This presentation will address our recent numerical simulation efforts in two different supersonic flow configurations: first, the canonical interaction of isotropic turbulence passing through a nominally planar shock, including the effect of passive scalar mixing, will be considered; second, the interaction of oblique shock waves reflecting off the turbulent boundary layers that develop along rigid walls in a supersonic duct flow will be evaluated. Particular attention will be devoted to the study of confinement effects brought by the duct side walls, strength of the incident shock, mean flow separation and low-frequency unsteadiness. Simulations methodologies with different levels of fidelity will be considered: shock-capturing Direct Numerical Simulation will be used in the canonical shock-turbulence interaction, whereas Wall-Modeled Large-Eddy Simulations will be utilized for the confined oblique shock reflection. Comparisons with available experimental data will be presented.

About the Speaker:
Ivan Bermejo-Moreno received his Ph.D. in aeronautics (2008) from the California Institute of Technology. Afterwards, he held a postdoctoral research fellowship at the Center for Turbulence Research, Stanford University/NASA Ames Research Center (2009-2014). He joined the Aerospace and Mechanical Engineering Department at the University of Southern California in 2015. His research combines numerical methods, physical modeling and high performance computing for the simulation and analysis of turbulent fluid flows involving multi-physics phenomena. He is a recipient of the Fulbright Fellowship, the Rolf D. Buhler Memorial Award, the William F. Ballhaus Prize and the Hans G. Hornung Prize.