Turbulence Generation Using Localized Sources of Energy: Direct Numerical Simulations and the Effects of Thermal Non-equilibrium

Doctoral Dissertation Defense

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Chair of Advisory Committee: Dr. Diego Donzis
Committee members: Drs. R. Bowersox, S. Girimaji & S. North

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Abstract

Turbulence in high-speed flows is an important problem in aerospace applications, yet extremely difficult from a theoretical, computational and experimental perspective. A main reason for the lack of complete understanding is the difficulty of generating turbulence in the lab at a range of speeds which can also include hypersonic effects such as thermal non-equilibrium. This work studies the feasibility of a new approach to generate turbulence based on laser-induced photo-excitation/dissociation of seeded molecules. A large database of incompressible and compressible direct numerical simulations (DNS) has been generated to study the evolution of the flow towards realistic turbulence. Governing parameters and the conditions necessary for the establishment of turbulence, as well as the length and time scales associated with such process are identified.

Agustin Maqui is a PHD candidate in the Aerospace Engineering Department working under the supervision of Professor Diego Donzis. His research interests are in the areas of fluid mechanics and high performance computing. He will be employed as a research analyst at Quantum Reservoir Impact.