MAE Seminar SERIES

Rethinking compressible turbulence: from isotropic flows to shock-turbulence interactions

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Knox 14

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ABSTRACT

Compressible turbulence is much more common than incompressible turbulence, and it plays a critical role in countless natural and engineering systems such as astrophysical flows, high-speed aerodynamics, turbulent combustion, among many others. However, much less is about compressible turbulence due to its larger parameter space, the additional complexity associated with coupling between hydrodynamics and thermodynamics, and the greater challenges to develop theory, attain realistic conditions in simulations, and conduct carefully controlled experiments.

In this talk I will review recent work that highlight the qualitative differences observed in compressible turbulence using a massive database of very well-resolved direct numerical simulations of canonical flows. We will briefly mention some of the computational challenges in these computations. After some illustrations of specific compressibility effects on turbulent flows, I will show why current approaches as "corrections" to well-known laws in incompressible turbulence present fundamental problems and provide a new alternative interpretation of statistical equilibria in an expanded parameter space in which new compressible universal scaling laws can be found. Part of the qualitatively different behavior observed in these flows is the appearance of shock waves which may be self generated and short lived (shocklets) or imposed by external conditions such as geometry (large scale shocks). New results on understanding these interaction between turbulence and shocks will also be presented.

BIO SKETCH

Dr. Diego A. Donzis is associate professor in the Department of Aerospace Engineering at Texas A\&M University where he directs the Turbulence and Advanced Computations Lab (TACL). He received his PhD from the Georgia Institute of Technology and continued his research at the University of Maryland and the International Centre for Theoretical Physics, Italy. His main interests are in high-performance computing at extreme scales, and the physics of turbulence and turbulent mixing in incompressible and compressible flows. Among his major recognitions Dr. Donzis received an NSF CAREER award, the Francois Frenkiel Award from the American Physical Society, two TEES Young Faculty Award for research, the McElmurry Teaching Excellence Award, and is a best graduate from Argentina by the National Academy of Engineering. In 2018, he was named a Presidential Impact Fellow by Texas A&M for his scholarly influence. He is an AIAA Associate Fellow.

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