Weekly CEAFM Seminar: Spring 2017

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Date:	**Friday, April 28, 2017**
Time:	11:00 AM
Location:	Gilman Hall # 132
Speaker:	**Prof. Diego A. Donzis** (Texas A&M University)
	"Extreme Events and Turbulence: Scaling, Universality and Direct Numerical Simulations"

Abstract

Turbulence at high Reynolds numbers is replete with strong fluctuations in vorticity, dissipation and other features of small-scale motion, which can be thousands times their respective mean values, a phenomenon called intermittency. Even at low Reynolds numbers, gradients can be extreme due to the appearance of shock waves in compressible flows. In order to study these very localized fluctuations in space and time, sufficient resolution is required if all the details are to be captured faithfully in direct numerical simulations (DNS) to study fundamental issues in turbulence and turbulent mixing. This poses extraordinary challenges in simulations at high Reynolds or Mach numbers.

In this talk we first discuss computational challenges in current simulations and introduce a novel concept for simulations at extreme levels of parallelism which exploits relaxed synchronizations between processing elements.

In the second part, we use a large DNS database of incompressible and compressible turbulence at very high resolutions to study different aspects of extreme events in flows of increasing complexity, from incompressible isotropic turbulence to shock-turbulence interactions. We start by addressing the nature of extreme fluctuations, especially of velocity gradients, in high-Reynolds-number incompressible turbulence. We then extend the analysis to compressible turbulence especially as it relates to large fluctuations of thermodynamic variables and shocklets.

Finally we discuss shock-turbulence interactions to unveil the relation between extreme incompressible gradients and shocks. This leads to new scaling laws that collapse and explain data in the literature.

We conclude with an outlook of potential unifying principles in the scaling of incompressible and compressible turbulence.