ME Seminar

Exploring Turbulence Using Exact Coherent States

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ABSTRACT

Turbulent flows are ubiquitous in natural and human-made systems, such as the oceans, transcontinental pipelines, the human aorta, just to name a few. Due to their large spatial extent and the presence of a wide range of spatiotemporal scales, a tractable low-dimensional description of (even moderately) turbulent flows is very challenging. In this talk we demonstrate that a special class of unstable flows, called Exact Coherent States (ECSs), can serve as the building blocks of low-dimensional, predictive models of turbulence. Specifically, we present a combined numerical and experimental study of a moderately turbulent quasi-two-dimensional flow. We discuss the dynamical relevance of ECSs and validate their utility in forecasting turbulent evolution. We also explore the statistical significance of ECSs and demonstrate how statistical averages (e.g., energy dissipation rate) of turbulent flows can be estimated using ECSs. Lastly, we show that ECSs constrain long-term turbulent dynamics through a network of dynamical connections.

ABOUT THE SPEAKER

Balachandra Suri is currently a postdoctoral researcher in the nonlinear dynamics and turbulence group at the Institute of Science and Technology, Austria. In 2017, he received a Ph.D. in Physics, with a minor in mechanical engineering, from the Georgia Institute of Technology-Atlanta USA. Prior to that, he received a 5-year integrated Master's in physics from IIT-Kharagpur. Suri's research lies at the intersection of nonlinear dynamics and fluid dynamics, focusing on problems in the areas of dynamical systems description of turbulence, hydrodynamic stability, hydrodynamic-quantum analogs, topological characterization of chaotic flows, and (more recently) friction in highly turbulent fluid flows.

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