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Determining the Global Dynamics of the Two-dimensional Navier-Stokes Equations by a Scalar ODE

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Abstract

One of the main characteristics of infinite-dimensional dissipative evolution equations, such as the Navier-Stokes equations and reaction-diffusion systems, is that their long-time dynamics is determined by finitely many parameters – finite number of determining modes, nodes, volume elements and other determining interpolants. In this talk I will show how to explore this finite dimensional feature of the long-time behavior of infinite-dimensional dissipative systems to design finite-dimensional feedback control for stabilizing their solutions. Notably, it is observed that this very same approach can be implemented for designing data assimilation algorithms of weather prediction based on discrete measurements. In addition, I will also show that the long-time dynamics of the Navier-Stokes equations can be imbedded in an infinite-dimensional dynamical system that is induced by an ordinary differential equations, named *determining form*, which is governed by a globally Lipschitz vector field. Remarkably, as a result of this machinery I will eventually show that the global dynamics of the Navier-Stokes equations is be determining by only one parameter that is governed by an ODE. The Navier-Stokes equations are used as an illustrative example, and all the above mentioned results equally hold to other dissipative evolution PDEs, in particular to various dissipative reaction-diffusion systems and geophysical models.

Date : Friday, February 16, 2018

Time: Lecture 1: 10:30 - 11:30 & Lecture 2: 13:00 - 14:00

Place: IMBM Seminar Room, Boğaziçi University South Campus