Manifold-Based Reduction of the Navier–Stokes Equations

Yves-Marie Ducimetière[1] and Bálint Kaszás[2]

[1]Courant Institute of Mathematical Sciences, New York University, New York, USA
[2]Center for Turbulence Research, Stanford University, Stanford, USA

Reduced representations of fluid flows have a long history, based on local invariant manifolds, inertial manifolds, normal forms, and multiple-scale analysis. A common aim is to find a low-dimensional manifold that attracts solutions, and to obtain cheap, interpretable reduced dynamics on it. In recent years, manifold-based techniques have experienced a resurgence of interest in the fluid dynamics community. This revival is driven by progress in data-driven approaches that learn invariant manifolds and latent dynamics from observed data, by novel mathematical results, and by efficient computational techniques. The resulting models are used for forecasting and control in laminar, transitional and, increasingly, turbulent regimes.

This minisymposium brings together analytical, computational and data-driven work, and welcomes contributions on invariant solutions and manifolds, latent representations, weakly nonlinear analysis, amplitude equations, and data-driven reduced-order models. We will discuss how different reduction techniques are connected, their range of validity, as well as extensions to highly non-normal flows, bypass transitions, and stochastically driven flows.

