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System reduction strategy for Galerkin models of fluid flows¹ MICHAEL SCHLEGEL, TU Berlin, Germany, BERND R. NOACK, Institut Pprime, Poitiers, France, MAREK MORZYNSKI, Poznan University of Technology, Poland, GILEAD TADMOR, Northeastern University, Boston, USA — We propose a system reduction strategy for control-oriented, spectral and Galerkin models of incompressible fluid flows. Key enabler is a finite-time thermodynamics (FTT) closure for the first and second moments. This FTT-based approach leads to dynamic models of lower order, based on a partition in slow, dominant and fast modes. In the reduced models, slow dynamics are incorporated as nonlinear manifold consistent with mean-field theory. Fast dynamics are stochastically treated and can be lumped in nonlinear eddy viscosity approaches. The employed interaction models between slow, dominant and fast dynamics respect momentum and energy balance equations in a mathematically rigorous manner — unlike unsteady Reynolds- averaged Navier-Stokes models or Smagorinsky-type reductions of the Navier-Stokes equation. The proposed system reduction strategy is employed to shear flows.

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