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**On Optimal Model Identification in Hydrodynamics** BARTOSZ PROTAS, McMaster University, VLADISLAV BUKSHTYNOV, Stanford University, BERND NOACK, Institut PPRIME, CNRS – Universite de Poitiers, MAREK MORZYNSKI, Poznan University of Technology — This work is motivated by two classes of problems, namely, identification of temperature–dependent material properties in complex thermo–fluid phenomena and identification of inertial manifolds in reduced–order models of hydrodynamic instabilities. It is demonstrated that these two problems can be framed in terms of the reconstruction of constitutive relations and we propose a robust computational approach to solve such problems using an optimization formulation based on some measurements. A special property of this formulation is that the control variable is a function of the state (i.e., the dependent variable), rather than the independent variable, and the main novelty is that the constitutive relation is determined in a very general form with no a priori assumptions other than smoothness. The optimization problem is solved using a gradient–descent method in which the cost functional gradients exhibit structure quite different than in typical optimization problems for differential equations. As an application, the proposed identification technique will be used to determine corrections to well–known models such as the Landau equation and the mean–field model so that they capture more accurately the behavior of actual hydrodynamic systems.

Bartosz Protas
McMaster University

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