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Inverse problems in magnetic resonance velocimetry: shape, velocity and boundary condition inference ALEXANDROS KONTOGIANNIS, MATTHEW JUNIPER, University of Cambridge — Magnetic Resonance Velocimetry (MRV) is a non-intrusive experimental technique used for example in medical imaging and porous rock sampling. It provides 3D velocity data in a 2D or 3D box, usually with low signal to noise ratio. Given noisy MRV data, we wish to infer the most likely boundaries of a flow, the boundary conditions, and the velocity of the flow. We do this by assimilating the data into a qualitatively-accurate flow model, such as the Navier-Stokes equations with unknown uniform viscosity, thus rendering the model quantitatively accurate. The revised model is used to infer hidden quantities of the fluid or the flow, which cannot be measured directly (e.g. wall-shear stress). At the same time, we obtain a denoised and higher-resolution version of the original MRV signal. The above methodologies combine fluid mechanics with optimal control and Bayesian inference and can be further applied to other experimental techniques such as PIV.

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