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Phase-consistent dynamic mode decomposition from multiple overlapping spatial domains[1] ADITYA NAIR, BENJAMIN STROM, BINGNI BRUNTON, STEVEN BRUNTON, University of Washington — We develop an extension to dynamic mode decomposition (DMD) to synthesize globally consistent modes from velocity fields collected independently in multiple partially overlapping spatial domains. Using mathematical optimization, we introduce the notion of phase-consistency for data measurements that ensure consistency of underlying physics for various fluid flow problems. The proposed data-assimilation technique improves the quality of experimental PIV measurements and is robust to experimental noise. We validate our approach using data from direct numerical simulations of laminar flow past a cylinder with distinct frequencies as well as the spatially developing mixing layer, which exhibits a frequency spectrum that evolves continuously as the measurement window moves downstream. Then we demonstrate the utility of the approach on experimental velocity fields from PIV in six overlapping domains in the wake of a cross-flow turbine. The approach may dramatically lower the acquisition cost for PIV in fluids, making real-time control a possibility, even for turbulent flows with many size and time scales.

[1]ARO W911NF-17-1-0306, AFOSR FA9550-18-1-0200, AFRL FA8651-16-1-0003, AFOSR FA9550- 18-1-0114

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