Abstract Submitted
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Resolvent-mode-based Reconstruction of Wall-bounded Turbulent Flows From Non-time-resolved PIV Measurements[1] C VAMSI KRISHNA, University of Southern California, MENGYING WANG, MAZIAR HEMATI, University of Minnesota, MITUL LUHAR, University of Southern California — Turbulent flows are characterized by broadband spatio-temporal fluctuations, which makes the acquisition of fully-resolved velocity measurements challenging. The goal of this study is to use a physics-based model—projecting the velocity field onto resolvent modes—to reconstruct velocity field from non-time resolved 2D PIV measurements in turbulent channel flow. The resolvent modes are generated via a gain-based decomposition of the governing equations, ensuring physical consistency. A large database of resolvent modes is generated. The Forward Regression with Orthogonal Least Squares algorithm is then used to identify the dominant resolvent modes and to calibrate their amplitude and phase. After calibration, the velocity field can be reconstructed at arbitrary spatiotemporal resolution using the weighted resolvent modes. The weighted resolvent modes also enable estimation of out-of-plane components of velocity and pressure. For proof-of-concept tests of this method, we use DNS data of turbulent channel flow from the Johns Hopkins Turbulence Database. Reconstruction error is quantified and compared with previous studies using Rapid Distortion Theory and Taylors Hypothesis for reconstruction.

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