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Recovering mean flow quantities from limited time-resolved PIV measurements through a data assimilation framework SEAN SYMON, California Institute of Technology, PETER SCHMID, Imperial College, DENIS SIPP, ONERA, BEVERLEY MCKEON, California Institute of Technology — Data assimilation combines experimental and numerical realizations of the same flow to produce hybrid flow fields. These have the advantages of less noise contamination and higher resolution while simultaneously reproducing the main physical features of the measured flow. This study investigates data assimilation of the mean flow around an idealized airfoil (Re = 13500) obtained from time-averaged PIV data. The experimental data, which represents a low-dimensional representation of the full flow field due to resolution and field of view limitations, is incorporated into a simulation governed by the incompressible RANS equations with an unknown momentum forcing. This forcing, which corresponds to the divergence of the Reynolds stress tensor, is calculated from a direct-adjoint optimization procedure to match the experimental and numerical mean velocity fields. The simulation is projected to the low-dimensional subspace of the experiment to calculate the discrepancy and a smoothing procedure is used to recover adjoint solutions on the higher-dimensional subspace of the simulation. The study quantifies how well data assimilation can reconstruct the mean flow and the minimum experimental measurements needed by altering the resolution and domain size of the time-averaged PIV.

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