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Data-driven sensor placement from coherent fluid structures KRITHIKA MANOHAR, EURIKA KAISER, BINGNI W. BRUNTON, J. NATHAN KUTZ, STEVEN L. BRUNTON, University of Washington — Optimal sensor placement is a central challenge in the prediction, estimation and control of fluid flows. We reinterpret sensor placement as optimizing discrete samples of coherent fluid structures for full state reconstruction. This permits a drastic reduction in the number of sensors required for faithful reconstruction, since complex fluid interactions can often be described by a small number of coherent structures. Our work optimizes point sensors using the pivoted matrix QR factorization to sample coherent structures directly computed from flow data. We apply this sampling technique in conjunction with various data-driven modal identification methods, including the proper orthogonal decomposition (POD) and dynamic mode decomposition (DMD). In contrast to POD-based sensors, DMD demonstrably enables the optimization of sensors for prediction in systems exhibiting multiple scales of dynamics. Finally, reconstruction accuracy from pivot sensors is shown to be competitive with sensors obtained using traditional computationally prohibitive optimization methods.

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