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Leveraging Dynamics for Near-Optimal, Ultra-Sparse Sensor Placement[1] SAMUEL OTTO, CLARENCE ROWLEY, Princeton University — Optimal sensor placement in high-dimensional nonlinear dynamical systems like fluid flows remains a challenging problem. Most current methods identify an overly large number of sensors because they do not make use of the time histories at each sensor location. Our work begins by constructing a POD subspace capturing the finite-time state trajectories of interest. The sensors must be able to robustly reconstruct trajectories in this subspace, leading to an objective function that has "nice" mathematical properties (namely, it is normalized, monotone, and submodular). These properties guarantee that an accelerated greedy algorithm for sensor placement has performance within a constant factor of the optimal performance. In addition to reconstructing trajectories in POD subspaces, our method can be extended to identify even fewer sensors that enable nonlinear reconstruction of trajectories on curved manifolds (which we call "ultra-sparse" sensor placement). We illustrate these methods with examples including a cylinder wake flow and Burgers equation.

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