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Sparsity-promoting algorithms for the discovery of informative Koopman invariant subspaces SHAOWU PAN, University of Michigan, KARTHIK DURAISAMY, University of Michigan, Ann arbor — Koopman analysis is becoming increasingly popular in a variety of scientific contexts. Algorithms to approximate the Koopman operator, such as the dynamic mode decomposition (DMD) and sparsity-promoting variants therein are being applied to many fluid problems routinely. However, even with a rich dictionary of nonlinear observables, its nonlinear variants, e.g., extended/kernel dynamic mode decomposition (EDMD/KDMD) are less popular and seldom applied to large-scale fluid dynamic systems primarily due to the difficulty in discerning the Koopman invariant subspace among numerous resulting Koopman triplets: eigenvalues, eigenvectors, and modes. To address these issues, we propose an algorithm based on mode-by-mode error analysis and multi-task feature learning to extract the most informative Koopman invariant subspace by removing redundant and spurious Koopman triplets from EDMD/KDMD. Effectiveness of the algorithm is demonstrated on several classical problems in fluid mechanics.

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