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Identification of spatially-localized flow structures via sparse proper orthogonal decomposition NEIL DHINGRA, MIHAILO JOVANOVIC, University of Minnesota, PETER SCHMID, Ecole Polytechnique — Proper Orthogonal Decomposition (POD) has become a standard tool for identification of the most energetic flow structures in fluid flows. It relies on the maximization of a quadratic form subject to a quadratic equality constraint, which can be readily accomplished via a singular value decomposition. For spatially homogeneous (or nearly homogeneous) flows, the resulting flow structures are global (or have large support) in the spatial domain of interest. By augmenting the optimization problem with an additional penalty term that promotes sparsity in the physical space, we are able to obtain energetic flow structures that become increasingly localized as our emphasis on sparsity increases. The resulting optimization problem, formulated in terms of an augmented Lagrangian functional, is solved using the Alternating Direction Method of Multipliers followed by a postprocessing step. The sparse POD algorithm is applied to the linearized Navier-Stokes equations for a plane channel flow, and the emergence of spatially localized structures is observed for increasing penalty terms. This test case and the underlying optimization techniques build the foundation for further studies into the relevance and role of localized perturbations on the overall behavior of general shear flows.

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