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Flow Field Reconstruction and Filtering Using Spectral Proper Orthogonal Decomposition AKHIL NEKKANTI, OLIVER SCHMIDT, University of California San Diego — The spectral variant of proper orthogonal decomposition (SPOD) decomposes a flow field into orthogonal modes that evolve coherently in both space and time, and that are optimally ranked by their energy. Just like in the case of standard proper orthogonal decomposition (POD), SPOD permits the reconstruction of the data from the modes and their expansion coefficients, and benefits from the optimality of the expansion. In this contribution, we show how the fact that SPOD is conducted in the frequency domain can be leveraged to achieve a number of goals. In particular, we use truncated series reconstructions and frequency-dependent scaling to facilitate low-rank approximations, band-pass filtering, pre-whitening and de-noising of experimental data. It is demonstrated, for example, that even a rank-1 SPOD approximation, which retains only one mode per frequency, is capable of capturing the significant dynamics of a fully turbulent flow field. Finally, we show how an iterative procedure can be employed for gappy data reconstruction. Two test cases are considered: large eddy simulation data of a turbulent jet and particle image velocimetry fields of the turbulent wake behind a flat plate at high angle of attack.

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