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Randomized Dynamic Mode Decomposition N. BENJAMIN ERICHSON, STEVEN L. BRUNTON, J. NATHAN KUTZ, University of Washington — The dynamic mode decomposition (DMD) is an equation-free, data-driven matrix decomposition that is capable of providing accurate reconstructions of spatio-temporal coherent structures arising in dynamical systems. We present randomized algorithms to compute the near-optimal low-rank dynamic mode decomposition for massive datasets. Randomized algorithms are simple, accurate and able to ease the computational challenges arising with 'big data'. Moreover, randomized algorithms are amenable to modern parallel and distributed computing. The idea is to derive a smaller matrix from the high-dimensional input data matrix using randomness as a computational strategy. Then, the dynamic modes and eigenvalues are accurately learned from this smaller representation of the data, whereby the approximation quality can be controlled via oversampling and power iterations. Here, we present randomized DMD algorithms that are categorized by how many passes the algorithm takes through the data. Specifically, the single-pass randomized DMD does not require data to be stored for subsequent passes. Thus, it is possible to approximately decompose massive fluid flows (stored out of core memory, or not stored at all) using single-pass algorithms, which is infeasible with traditional DMD algorithms.

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