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A Data-Driven Low-Rank Approximation of Time-Dependent Stochastic Flows HESSAM BABAEE, University of Pittsburgh — We present a non-intrusive and data-driven method for constructing a low-rank approximation of time-dependent stochastic flows. This method requires a snapshot sequence of samples of the stochastic field in the form of $\mathbf{A} \in \mathbf{R}^{\mathbf{n \times s \times m}}$ where n is the number of observable data points, s is the number of samples and m is the number time steps. These samples may be generated using deterministic solvers or time-resolved PIV experimental measurements. In this methodology, the time-dependent data is approximated by an r-dimensional reduction in the form of: $\mathbf{A^r(t)} = \mathbf{U(t)Y(t)^T}$ where $\mathbf{U(t)} \in \mathbf{R}^{\mathbf{n \times r}}$ is a set of deterministic time-dependent orthonormal basis and $\mathbf{Y(t)} \in \mathbf{R}^{\mathbf{s \times r}}$ are the stochastic coefficients. We derive explicit evolution equations for $\mathbf{U(t)}$ and $\mathbf{Y(t)}$ and use the data to solve these equations. We demonstrate that this reduction technique captures the strongly transient stochastic flows with high-dimensional random dimensions. We present the capability of this method for two classical fluid dynamics problems: (1) flow over a cylinder, and (2) three-dimensional jet in a crossflow.

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