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Physics-informed Autoencoders for Operator-theoretic decomposition and Model reduction of Complex Flows KARTHIK DURAISAMY, SHAOWU PAN, University of Michigan, Ann arbor — We explore the design of physics-informed autoencoders for operator-theoretic decomposition and reduced order modeling of complex flow dynamics. Focus is on enforcing additional physical and mathematical structure into Convolutional Neural network-based Autencoders. The autoencoders are used to extract the lower-dimensional manifold of the latent variables, and parameterized to yield provably stable predictions and is constrained by the governing equations of the full order dynamics that we aim to represent. Further, the latent space is explicitly endowed with a specific structure to promote interpretability and to extract Koopman modes. Variational inference is used in a hierarchical Bayesian setting to quantify uncertainties in the characterization and prediction of the spatio-temporal dynamics. The framework is evaluated on a range of problems involving strong gradients, wave propagation, and coherent structures.

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