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Dimensionality Reduction and Reduced Order Modeling for Traveling Wave Physics[1] ARIANA MENDIBLE, ALEKSANDER ARAVKIN, University of Washington, WES LOWRIE, ARA, STEVEN BRUNTON, J. NATHAN KUTZ, University of Washington — Large scale spatiotemporal data are ubiquitous across many fields of science and engineering, especially in fluids. Standard dimensionality reduction techniques based on the singular value decomposition (SVD) often fail to provide a compact representation of traveling waves because the SVD is inherently a space-time separation of variables. This necessitates a data-driven method to decompose and reduce spatiotemporal systems with multiple traveling waves. In this work, we investigate alternative approaches to dimensionality reduction that are designed specifically to separate and represent interpretable traveling wave structures in a low-dimensional form Using a shifted SVD, we formulate an unsupervised, optimization-based framework for identifying parsimonious wave speed models from many candidate models. We demonstrate our method on example systems which pose challenges of non-periodicity, nonlinearity, and changing wave speed.

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