

Beyond PCA by explicitly taking into account system symmetries

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Linear principal component analysis (PCA) experiences an increase in the dimensionality of the latent space when it is applied to configurations that exhibit symmetries. In this study, we introduce a novel machine learning embedding, which uses spatial transformer networks and siamese networks to account for continuous and discrete symmetries, respectively. This embedding, which we term symmetry-aware PCA, will be applied to three configurations: Burger's equation exhibiting a continuous translation symmetry, flow in sudden expansion, a discrete reflexional symmetry, and Kolmogorov Flow which combines discrete shift-reflect and continuous translation symmetries. We will show a drastic increase in the number of modes required to represent given trajectories.

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