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Approximating a Low-Dimensional Nonlinear Dual to the Schrodinger Equation Using Neural Networks[1] HUSTON WILHITE, University of Wisconsin - Eau Claire, Brigham Young University, MITCHELL CUTLER, JAMES LARSEN, JACOB NUTTALL, MARK TRANSTRUM, SEAN WARNICK, JEAN-FRANCOIS VAN HUELE, Brigham Young University — According to the Schrodinger equation, a quantum system evolves linearly in time and is (in general) infinite-dimensional. Koopman operator theory uses an infinite-dimensional operator to evolve a finite-dimensional, nonlinear system linearly in an infinite-dimensional space. We propose that the Schrodinger equation is in fact the Koopman operator of some finite-dimensional, nonlinear dual to the Schrodinger equation. Since the Koopman operator does not have an analytic inverse in general we instead find an approximate inverse using neural networks. This inverse evolves the quantum system nonlinearly in a compressed representation of the quantum state space, which is also learned by neural networks. We test this idea for the case of the Bloch sphere, which we compress from four real dimensions to three real dimensions in which the neural networks learn the dynamics. We examine how well the nonlinear dynamics of the compressed space replicate the linear dynamics of the quantum sate space after being transformed back to four real dimensions.

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