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## Neural Network-Based Koopman Operator: Learning Linear Representations for Optimal Control of Nonlinear Systems

### Communication Info

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### Abstract

Data-driven transformations using Koopman operator theory offer a principled way to reformulate strongly nonlinear dynamics into a linear framework. However, identifying optimal observable functions for complex systems remains an analytical challenge. We propose leveraging deep neural networks and autoencoder-style architectures to learn these transformations directly from system trajectory data. By mapping nonlinear states into a high-dimensional latent space governed by a linear transition matrix, our method enables the seamless application of linear optimal control techniques to intrinsically nonlinear systems. This approach preserves the mathematical rigor of linear systems theory while offering a scalable and computationally effective way to steer complex dynamical systems toward desired objectives.

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### References

- [1] Robin Strässer, Karl Worthmann, Igor Mezić, Julian Berberich, Manuel Schaller, Frank Allgöwer, An overview of Koopman-based control: From error bounds to closed-loop guarantees, *Annual Reviews in Control*, Volume 61, 2026, 101035
- [2] M.korda, I.Mezić, Linear predictors for nonlinear dynamical systems: Koopman operators meets model predictive control *Automatica*, Volume 93, 2018, pages 149-160
- [3] S. L. Brunton, M. Budišić, E. Kaiser, and J. N. Kutz. Modern Koopman theory for dynamical systems. *SIAM Review*, 64(2):229–340, 2022.
- [4] Stefan Klus, Feliks Nüske, Sebastian Peitz, Jan-Hendrik Niemann, Cecilia Clementi, Christof Schütte, Data-driven approximation of the Koopman generator: Model reduction, system identification, and control, *Physica D: Nonlinear Phenomena*, Volume 406, 2020,