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Stabilizing Dynamical Systems in the Scarce Data Regime

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Stabilizing dynamical systems in science and engineering is challenging, especially in edge cases and limit states where typically little data are available. In this work, we propose a data-driven approach that guarantees finding stabilizing controllers from as few data samples as the dimension of the unstable dynamics, which typically is orders of magnitude lower than the state dimension of the system. The key is learning stabilizing controllers directly from data without learning models of the systems, which would require larger numbers of data points. Numerical experiments with chemical reactors and fluid dynamics behind obstacles demonstrate that the proposed approach stabilizes systems after observing fewer than five data samples even though the dimension of states is orders of magnitude higher.

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