

A Systematic Study of Data-Driven Dynamics Discovery in Ordinary Differential Equations

10. February 2026

Thesis BA/FA
Supervisor Yang Yang
Examiner Prof. Dr.-Ing. Bin Yang

Motivation

Discovering governing equations from data is a fundamental problem in dynamical systems, with implications for understanding, prediction, and control. Recently, a variety of data-driven methods have been proposed to infer system dynamics directly from observed trajectories. Among them, Sparse Identification of Nonlinear Dynamics (SINDy) has attracted attention due to its sparse and interpretable formulation.

Despite promising results, the practical capabilities and limitations of SINDy and related approaches remain insufficiently understood. In this work, we use ordinary differential equations (ODEs) as a controlled testbed to systematically evaluate the ability of these methods to recover underlying dynamics and to identify their failure modes. Insights from this analysis provide guidance for assessing the feasibility of extending data-driven discovery methods to more complex systems, including partial differential equations (PDEs).

Objectives

- Implement and evaluate SINDy and related methods on a range of ODE and PDE systems with varying complexity and noise levels.

Prerequisites

- Good programming skills in Python
- Experience in ML-frameworks (Preferably PyTorch)
- *Optional*: Took the Deep Learning exam with good results
- *Optional*: Took the Advanced Mathematics for Signal and Information Processing exam with good results
- *Optional*: Participated in the ISS Deep Learning Lab

If this topic has sparked your interest, write me an email and we can discuss the proposal in more detail. Please include your current transcript and CV.