Using dynamical systems ideas to combine in a principled way data-driven models and domain-driven models

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(Joint work with Benjamin Erichson,
Michael Muehlebach, Omri Azencot, and others.)

Outline

Introduction and Overview

Physics-informed Autoencoders for Lyapunov-stable Fluid Flow Prediction (Benjamin Erichson and Michael Muehlebach)

Forecasting Sequential Data using Consistent Koopman Autoencoders (Omri Azencot, Benjamin Erichson, and Vanessa Lin)

Conclusions

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Summary

- Ideas from dynamical systems theory can help to develop novel algorithmic tools.
- We need to rethink DNNs in order to improve interpretability and explainability.
- Should we expect rigorous mathematical analysis of deep learning? Maybe, but...

We also wish to allow the possibility than an engineer or team of engineers may construct a machine which works, but whose manner of operation cannot be satisfactorily described by its constructors because they have applied a method which is largely experimental – Alan M. Turing