University of Stuttgart
Institute for Parallel and Distributed Systems
Analytic Computing

Hauptseminar Winterterm 2021
Machine Learning for Modeling and Control

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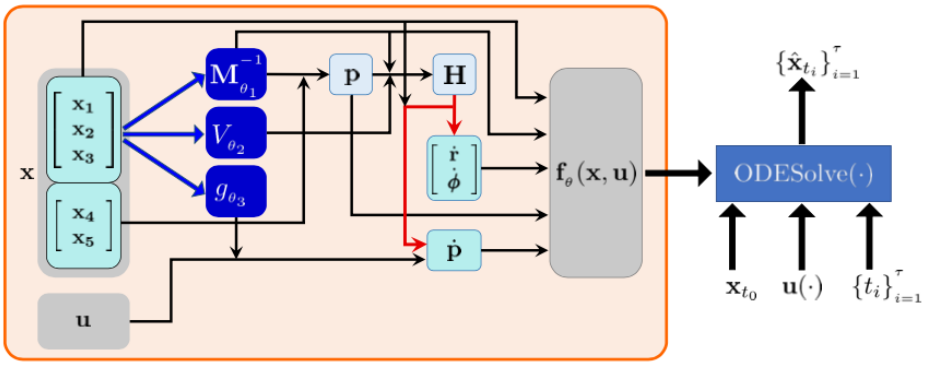

Figure 1: Hamiltonian dynamics in neural ordinary differential equations[1]

Target Group
Students interested in the intersection of control theory and machine learning. Participants are expected have to completed the course "Machine Learning" or a related course in the field of machine learning. Familiarity with system or control theory is a plus.

The Topic
In this Hauptseminar our goal is to explore the role of machine learning in modelling and control of dynamical systems, such as a ship in waves or an autonomous car. Models of dynamical systems allow for the prediction of system states over time like the prediction of vehicle motion. Controllers are tasked with computing control signals to the system to achieve a desired state, such as holding a given velocity under various disturbances.
The combination of control theory and machine learning can result in more transparent systems and enables the learning of robust and stable control systems. By combining machine learning with expert knowledge, we can learn complex non-linear systems from input-output data. For example, by integrating physics information into a neural network architecture, we can ensure physical plausibility of our predictions or allow for accurate models in low data regimes.

Procedure
After an introduction on the topic, participants will work individually on a technical report about a chosen topic. The report will be peer-reviewed by other participants. Students will give a talk about their topic and hand in their technical report.

[1] Zhong, Yaofeng Desmond, Biswadip Dey, and Amit Chakraborty. "Symplectic ODE-net: Learning hamiltonian dynamics with control." ICLR 2020

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