

# Data Driven Model Learning for an Actuated Double Pendulum



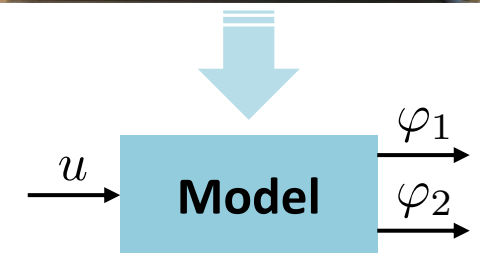
TECHNISCHE  
UNIVERSITÄT  
DARMSTADT

## Proposal for a Bachelor Thesis

In order to describe physical systems, engineers use mathematical models. These models can take on different forms, such as white box models based on physical insights and having high interpretability, or black box models that are solely data-driven. Furthermore, models can be distinguished based on their usage, such as in simulation and controller models.

The aim of this bachelor thesis is to find a model for an actuated double pendulum. This will be done in two different ways. First, an existing white box model should be refined by explicitly considering backlash in the gearbox and optimizing the model parameters. Second, neural networks should be used to learn a black box model. This can be achieved using either a nonlinear autoregressive exogenous (NARX) model or a recurrent neural network (RNN).

A crucial step in model identification/learning is the collection of an appropriate dataset. To achieve this, a well-suited input signal is critical. Thus, another main aspect of this thesis is to research and test different excitation strategies. Finally, the developed models can be used to calculate an upswing trajectory and a trajectory tracking controller, which can be tested on the physical device.



## Useful Skills:

Knowledge: SDRT 1  
Programming: Python  
Language: English or German

## Contact:

Supervisor:                      Email:  
Andreas Höhl                      andreas.hoehl@iat.tu-darmstadt.de  
Lukas Theiner                      lukas.theiner@iat.tu-darmstadt.de