Chair of Automatic Control

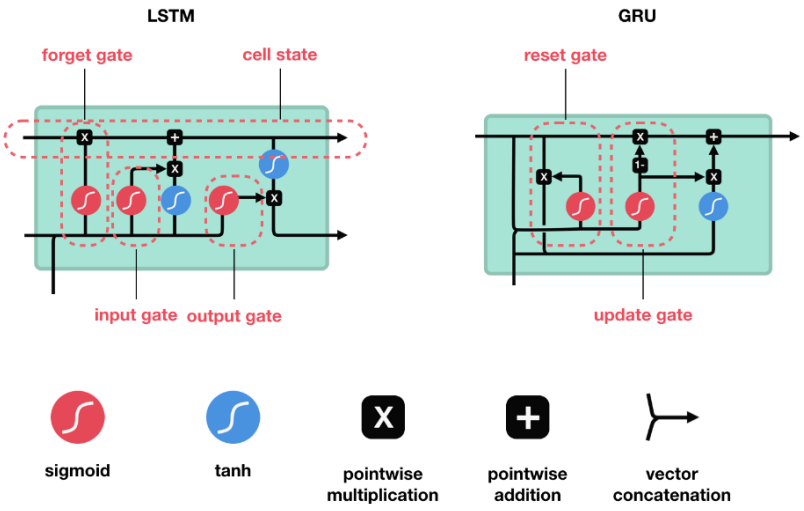
FAU

Announcement for Master/Bachelor Thesis

Potential of LSTM and GRU networks for the modelling of nonlinear thermal ODEs

Motivation

Nonlinear processes, as found in thermal problem statements, often cannot be expressed with ordinary differential equations (ODEs) without great effort. To circumvent complex model building i.e. finite element method (FEM) simulations, recurrent neural networks of the type Long Short-Term Memory (LSTM) or Gate Recurrent Unit (GRU) have proven useful in the task of learning time series data. With the capabilities of remembering and forgetting, the networks are often superior to classical methods and represent the state of the art.



https://towardsdatascience.com/illustrated-guide-to-lstms-and-gru-s-a-step-by-step-explanation-44e9eb85bf21

Task description

In a first step, several academic nonlinear thermal ODE-based models of different complexity are designed in the state space to generate large realistic data sets with measurement noise. Subsequently, different architectures of LSTM and GRU networks are applied to obtain the most accurate model description. The goal is to investigate the limitations and potential of LSTM and GRU networks for nonlinear modeling in control engineering.

Requirements

First experiences with Pytorch or Tensorflow and basic knowledge of Matlab and Python including solving of ODEs.

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