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Model Order Reduction
or
How to make everything as simple as possible but not simpler

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Abstract. *Large complex mathematical models are regularly used for simulation and prediction. However, in control design it is common practice to work with as simple models as possible, because they are easier to analyse and evaluate.*

There is a strong need for methods and tools that can take a complex model and deduce simple models for various purposes such as control design. A simple but good model captures much knowledge. It points out the basic properties and can give good insight about the process.

For simple linear time-invariant models there is a well-established theory and commercially available tools for design of controllers with given specifications. Real experiments or simulations using more complex models are then used to verify that the designed controller really works well. For nonlinear models the methods are much less developed. It is simple to derive a linearization on symbolic form from a nonlinear model. It is much more difficult to give explicit expressions for stationary operating points since these calculations involve nonlinear equation systems.

The main idea in model reduction is that a high-dimensional state vector

is actually belonging to a low-dimensional subspace [1, 2, 4]. Provided that the low-rank subspace is known, the original model can be projected on it to obtain a required low-dimensional approximation [3]. The goal of every model reduction method is to find such a low-dimensional subspace.

In this talk I will introduce model reduction and I will overview some of the most used methods.

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