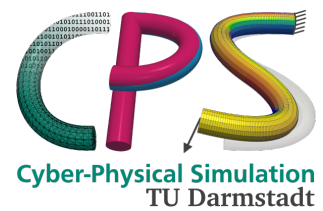
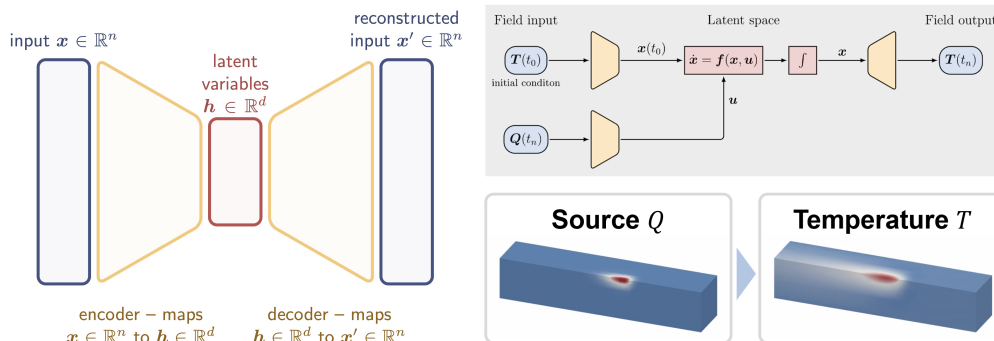


Physics-aware variational auto-encoders



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Introduction

Auto-encoders are a powerful machine learning method with various applications such as dimensionality reduction, clustering, and denoising, to name but a few. A fundamental part of auto-encoders is the projection of a high-dimensional input space to a low-dimensional latent space. With variational auto-encoders, the structure of the latent space can be improved, e.g., by biasing it towards a specific probability distribution. This can improve the performance of the auto-encoder, and more than that, enables its application in generative AI, i.e., generating new content based on the data the model has been trained on.

Potential topics

The aim of this thesis is to formulate variational auto-encoder that consider prior physical knowledge, e.g., in the form of invariances and symmetries. Possible fields of application include continuum mechanical constitutive modeling, generation of mechanical microstructures, or reduced-order modeling of dynamical systems. For this, suitable architectures for variational auto-encoders shall be developed and implemented in Python.

Requirements

This thesis is suitable for students from engineering, computer science, and mathematics studies. The student should have a sound mechanical or mathematical understanding and good programming skills in Python and preferably a machine learning library such as TensorFlow or JAX.

