Physics-Augmented Neural Networks for Modeling Inelastic Material Behavior

Bachelor or Master's thesis (Computational Methods in Engineering, Maschinenbau, Mathematik)
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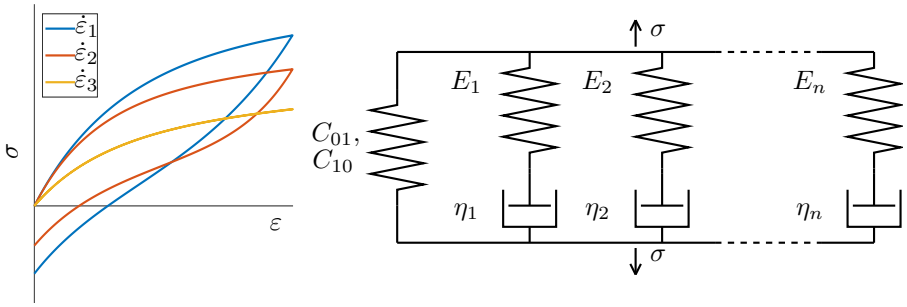
Scope of Work

The work focuses on the extension of Physics-augmented Neural Networks (PANNs) to describe inelastic material behavior, such as viscoelasticity and plasticity. Building on their success in modeling hyperelastic materials, PANNs offer significant advantages, including flexibility, stability and simplified parameter identification. The aim of the research is to combine the strengths of neural networks with the principles of classical material models and physical laws. The developed models are trained using real experimental data to accurately capture complex material behaviors. This work aims to advance material modeling by combining data-driven approaches with fundamental physics.



During the project you will have the opportunity to learn more about inelastic material behavior, PANNs and the `Python` programming language (especially `PyTroch`).

Tasks

- Review of the existing literature on PANNs
- Exploring the possibilities of integrating physical laws into the structure of NNs
- Fitting material models (classical and AI) to experimental data
- Computation of benchmark problems

Prerequisites

- Neural Networks
- Computational mechanics (e.g., Finite Element Method)
- Programming skills (preferably Python)

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