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Automating constitutive modeling with LLMs

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Extended Abstract

Abstract

State-of-the-art approaches in constitutive modeling, such as constitutive artificial neural networks (CANNs), achieve high accuracy, strong generalization, and guaranteed adherence to physical constraints [1]. However, when modeling new materials, these methods often require deep expertise: Choosing the right approach, configuring the model, and performing effective hyperparameter optimization can be tedious and time-consuming for experts, and a significant barrier for non-experts. This talk addresses this challenge by exploring the integration of large language models (LLMs) with CANNs. We present results on real-world datasets that capture strain–stress relationships for multiple hyperelastic materials under diverse loading scenarios [2]. These results demonstrate that CANNs generated and optimized autonomously by LLMs can match human-designed models in accuracy, generalizability, and physical consistency. Our approach not only accelerates constitutive modeling but also makes it accessible to a wider range of users.

Keywords:

Machine learning Large language models (LLMs) Constitutive modeling Hyperelasticity

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