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PHYSICS INSPIRED NEURAL NETWORK PLASTICITY MODELING

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Research in modeling cyclic plasticity has been ongoing for many decades. Currently, data-driven mechanics [1] emerges, showing promising results when incorporating large datasets to model material behavior. However, this so-called model-free approach requires very dense datasets to give accurate results. The present contribution combines traditional models with machine learning, incorporating neural networks into the material model. There are two main goals: first, the trained model can be analyzed and form the basis for more accurate phenomenological models. Secondly, this analysis may shed more light on how different processes in the material are related, considering isotropic, kinematic, and distortional hardening.

We train and validate the model with multiaxial cyclic data of R260 railway steel. In contrast to regular material models, complicated loading histories appear advantageous for efficient training. Furthermore, the proposed neural network augmentation is suitable for small and finite strain plasticity. The presentation will focus on three main areas: Model formulation, training approaches, and model validation. Figure 1 shows preliminary training results with experimental data from [2] and a comparison with a standard plasticity model.

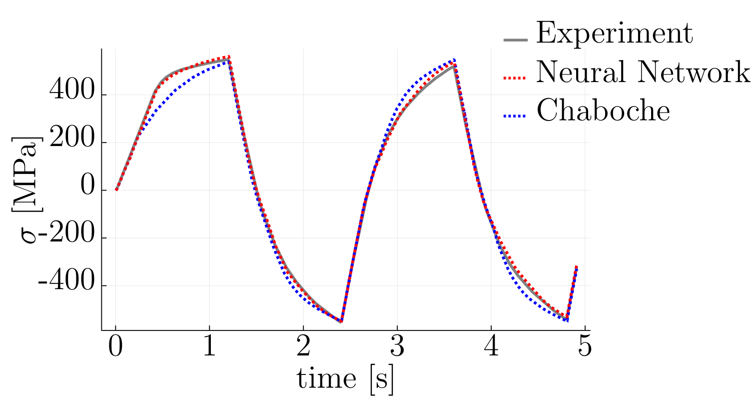

Figure 1: Trained models on cyclic data with 0.6 % strain amplitude.

References

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