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Issue Call for master's thesis

Topic **A new parametrization ansatz for stop-based Prandtl-Ishlinskii model**

Description Real ferromagnetic materials exhibit complex hysteresis effects, which require memory dependent constitutive mapping between the magnetic field  $\mathbf{H}$  and the flux density  $\mathbf{B}$  for solving low-frequency Maxwell's equations. Operator-based phenomenological approaches, such as the Prandtl-Ishlinskii (PI) model [1], are widely used for this purpose. In these models, the constitutive relation is typically expressed through a vector-valued, rate independent operator  $\mathbf{H} = \mathbf{V}[\mathbf{B}]$ . To effectively integrate such models within a Finite Element (FE) framework, it is necessary to identify beforehand the model's parameters for a given material, such that the model's response provides a better fit to the hysteretic measurements. The aim of this thesis is to investigate and develop a new parametrization procedure, particularly for the generalized stop-type PI models, that improves the accuracy and fittings of the minor and major hysteresis loops. This parametrization, based on the generalized stop-type PI models is carried out for the existing nonlinear stop-type and a newly formulated linear stop-type cases. Initial focus could be given to the parametrization of isotropic materials and further extension to 2d/3d anisotropic cases.

The specific tasks are:

- Literature review on different PI models and understand the existing formulation of stop-based PI model (nonlinear and linear stop-type cases), its current parametrization procedure and implementations.
- Develop the new parametrization procedure to improve the model's fit to the measurements.
- Prototype implementation.
- Verify and validate the new method for the reference hysteresis materials with given B-H and loss measurement values.
- Perform numerical experiments and document the method and the implementation.

References:

[1] J.V. Leite, N. Sadowski, P. Kuo-peng, J.P.A. Bastos, "A New Anisotropic Vector Hysteresis Model Based on Stop Hysterons. Magnetism," IEEE Transactions on Magnetics, vol. 41, no. 5, pp 1500-1503, 2005.