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MACHINE LEARNING TECHNIQUES FOR MULTI-PHYSICS AND MULTI-SCALE PROBLEMS IN SOLID MECHANICS

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ABSTRACT

Material deformation often involves multiple physical mechanisms, which may take place simultaneously in response to applied loading. These mechanisms typically involve disparate time and length scales. Moreover, the interaction between these mechanisms can be complex and difficult to model. Examples include thermo-mechanics, elasto-plasticity with damage accumulation, dislocation-mediated crystal plasticity coupled with twinning and/or phase transformations, dynamic recrystallization, and hydrogen embrittlement, to name a few.

Machine learning (ML) techniques can provide effective strategies for addressing the challenges that the coupled multi-physics/multi-scale character of such problems present, and also may be useful in alleviating difficulties associated with the high computational cost of alternative, more conventional solution strategies.

The purpose of this MS is to provide a forum for discussion of advancements in ML techniques for multi-physics and multiscale problems in solid mechanics. The topics of interest include, but are not limited to the development and application of machine learning methods for: scale bridging; homogenization of response; incorporation of data-driven constitutive models; inference of constitutive response; surrogate solvers to replace partial differential equation-based models; foundation models for solid mechanics.