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A LOCAL/NONLOCAL PLASTICITY MODEL FOR UPSCALING MICROSTRUCTURAL EFFECTS

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ABSTRACT

Despite its importance, why is mesoscale plasticity advancing so slowly? The fundamental equations of equilibrium used for mesoscale modeling have not changed in centuries. In this talk, I will present an innovative idea for combining nonlocal/local models to upscale effects of microstructures on plastic deformations. A local Von Mises plasticity model is evolved using a nonlocal and peridynamics[1] inspired yield condition [2]. The application area is the analysis of additively manufactured metal parts.

Additive manufacturing produces heterogeneous and poorly understood material microstructures. Practical macroscale models that reflect the nature of AM microstructures do not currently exist: length scale effects, grain shape morphologies, grain orientations, intragrain defects, grain boundary heterogeneities, aggregate textures. For the purpose of engineering design and qualification, it is essential that we develop and advance models for AM built parts.

REFERENCES

- [1] S.A. Silling, Reformulation of elasticity theory for discontinuities and long-range forces, *Journal of the Mechanics and Physics of Solids* **48(1)** (2000), 175-209.
- [2] J.A. Mitchell, A nonlocal, ordinary, state-based plasticity model for peridynamics. *Sandia National Laboratories*, tech report SAND2011-3166, May, 2011.

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