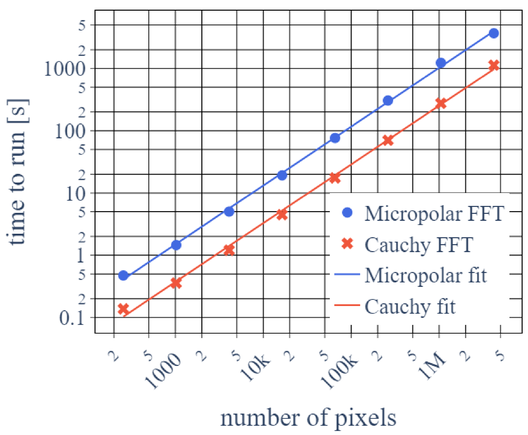
An FFT Solver for Elastoplastic Micropolar Composites

PRESENTER:
Noah M. Francis

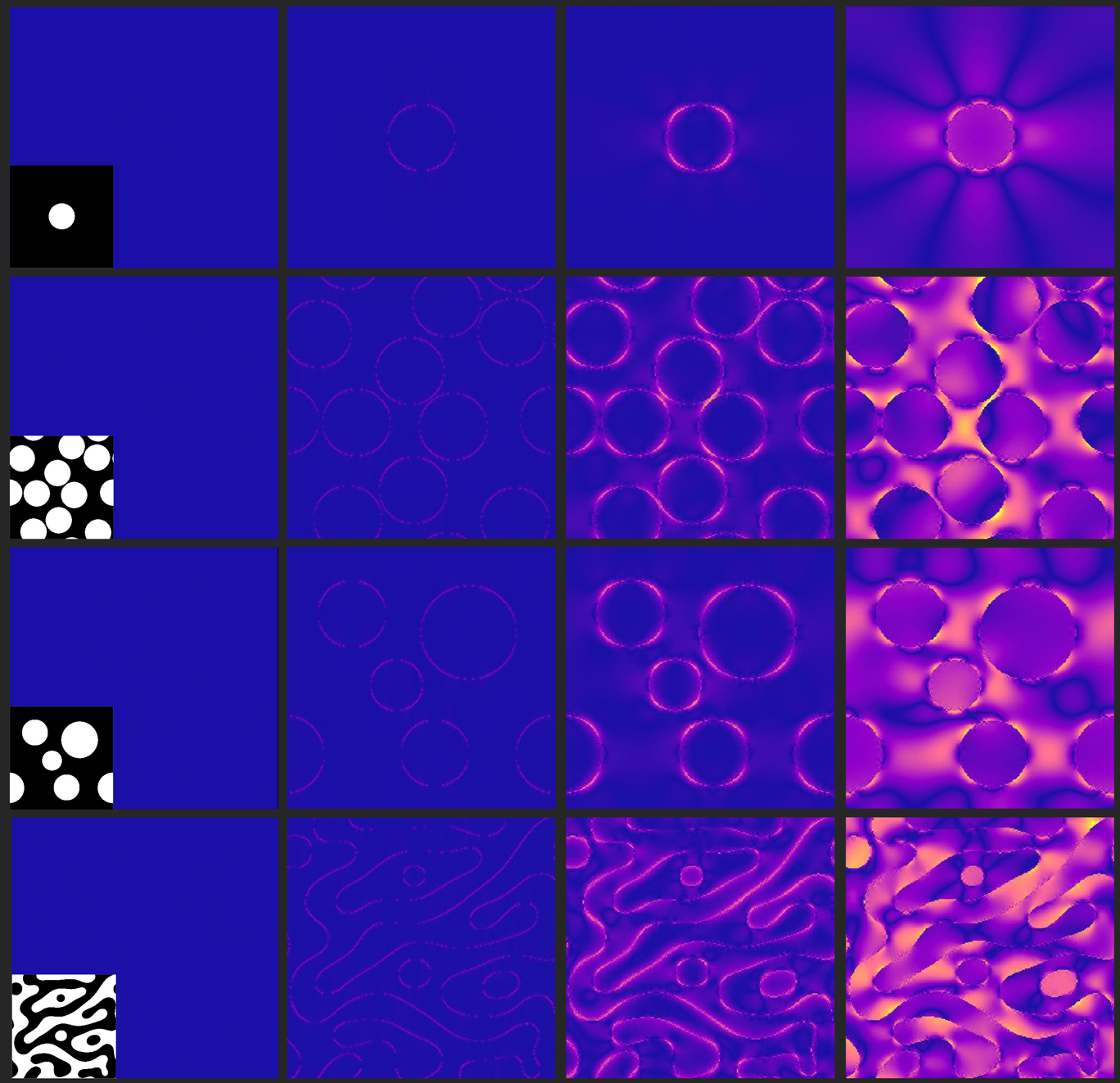
BACKGROUND: Real materials have size-dependent mechanical responses that classical solid mechanics fails to model. “Micropolar” solids capture this effect. Popular numerical methods like FEM can be slow and require complicated meshes for non-trivial geometries. This work extends a fast and meshless numerical solver to small deformation Micropolar solids that are constitutively elastoplastic.

Linear Elastic Micropolar FFT Paper Link:

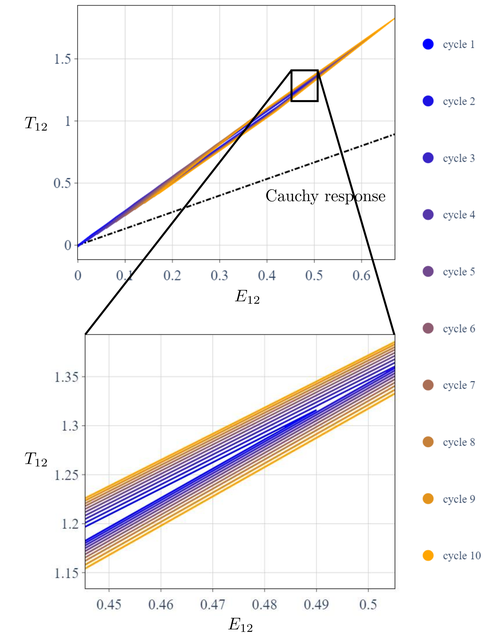
Linear Elastic Micropolar Time Complexity:

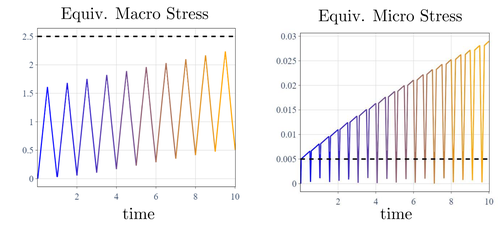


Fast, **meshless** simulation of **size-dependent** material responses

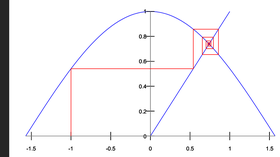


Microplasticity/Microratcheting:





FFT Basic Scheme for Micropolar:



$$x = \cos(x) \quad \rightarrow \quad x_{n+1} = \cos(x_n)$$

$$\begin{aligned} \mathbf{e} &= \mathbf{f}_1(\mathbf{e}, \boldsymbol{\gamma}) \\ \boldsymbol{\gamma} &= \mathbf{f}_2(\mathbf{e}, \boldsymbol{\gamma}) \end{aligned} \quad \rightarrow \quad \begin{aligned} \mathbf{e}^{n+1} &= \mathbf{f}_1(\mathbf{e}^n, \boldsymbol{\gamma}^n) \\ \boldsymbol{\gamma}^{n+1} &= \mathbf{f}_2(\mathbf{e}^n, \boldsymbol{\gamma}^n) \end{aligned}$$

Noah M. Francis
Fatemeh Pourahmadian
Ricardo A. Lebensohn
Rémi Dingreville

University of Colorado **Boulder**
Los Alamos NATIONAL LABORATORY
Sandia National Laboratories