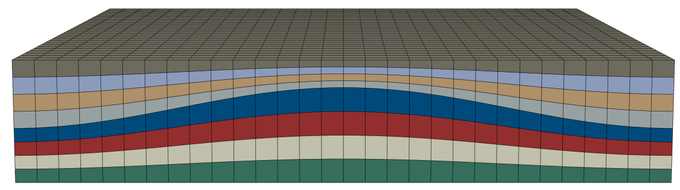
Peridynamic Simulation Platform to Determine Virtual Allowables of Manufacturing Deviations



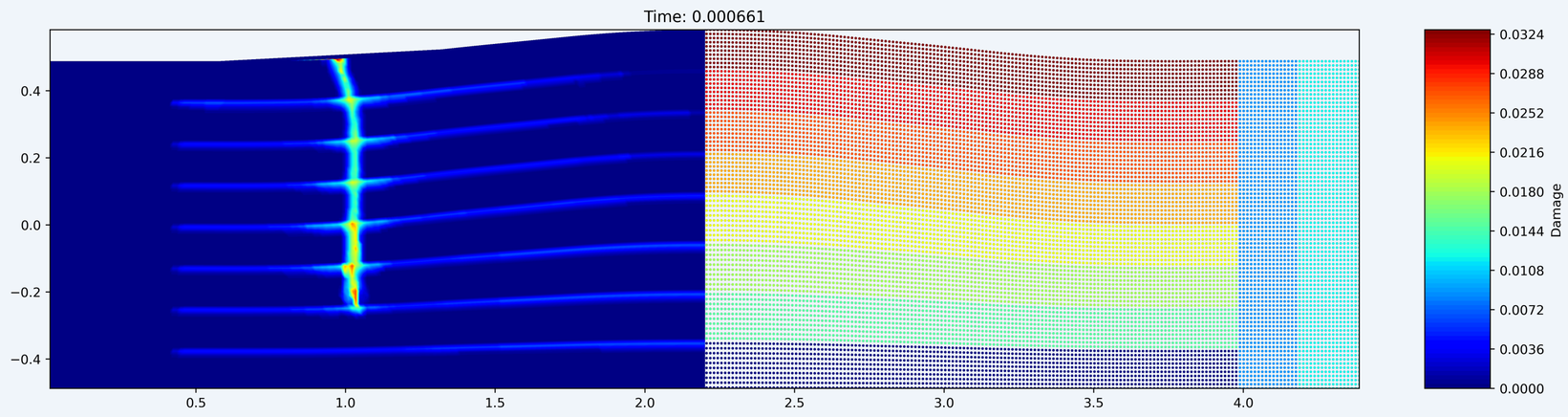
Motivation

Effects of Defects / Composites:

- Large variation of defect types
- Time- and cost-intensive test campaigns
- Complex classical continuum mechanics simulation

Benefits:

- Statistical dispersion
- Test campaign support
- Crack-propagation

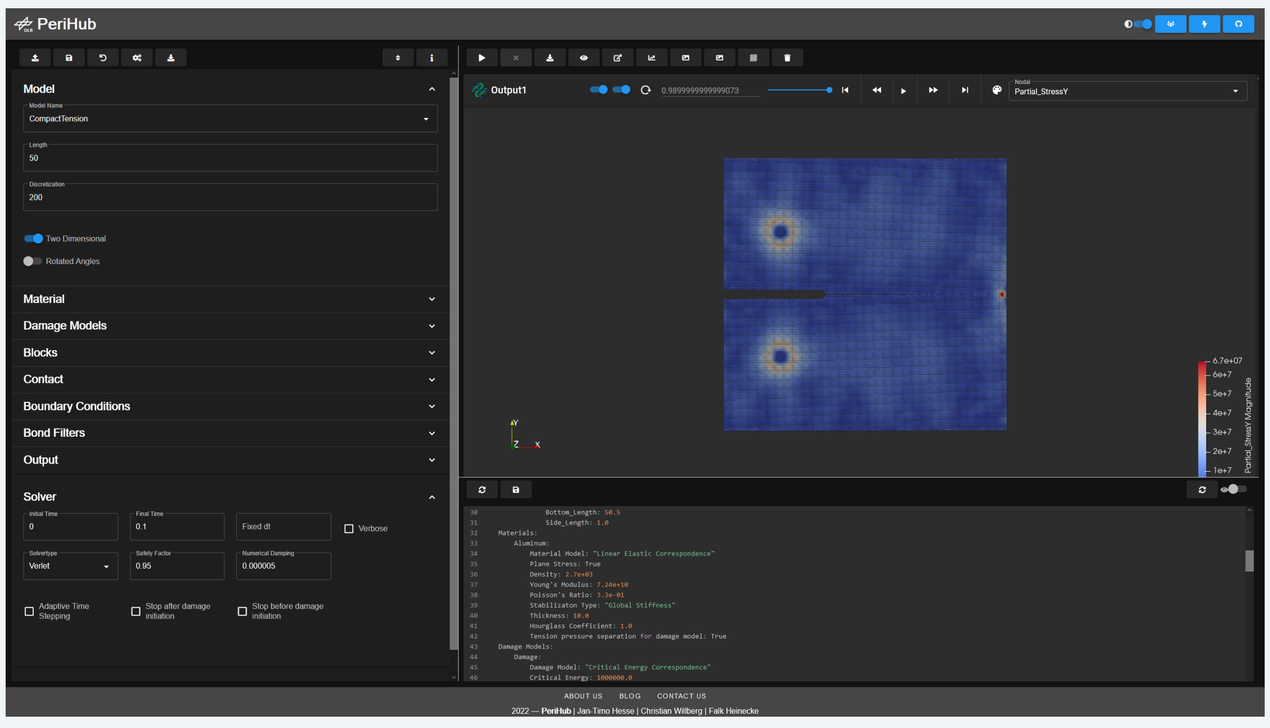


Implementations

- Energy-Based Damage Model[a]:
  $w_c = \frac{4G_0}{\pi\delta^4}$
  $w_b = (\underline{\mathbf{T}}^P(\mathbf{x}, t)\langle \mathbf{x}' - \mathbf{x}\rangle - \underline{\mathbf{T}}^P(\mathbf{x}', t)\langle \mathbf{x} - \mathbf{x}'\rangle) \cdot \underline{\boldsymbol{\eta}}$
  $w_b > w_c$
- Definition of material orientations
- Interlayer energy release rate
- Adaptive time stepping to avoid zero-energy modes

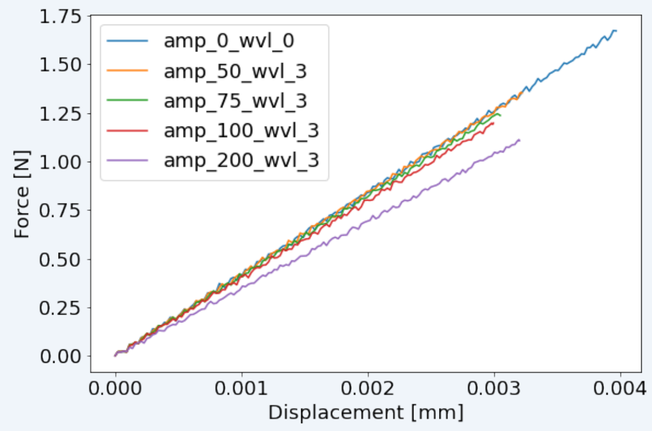
PeriHub: Peridynamic Platform

- Web-based application
- REST API Support
- Preprocessing, simulation and postprocessing
- User-material interface
- FE-Translator

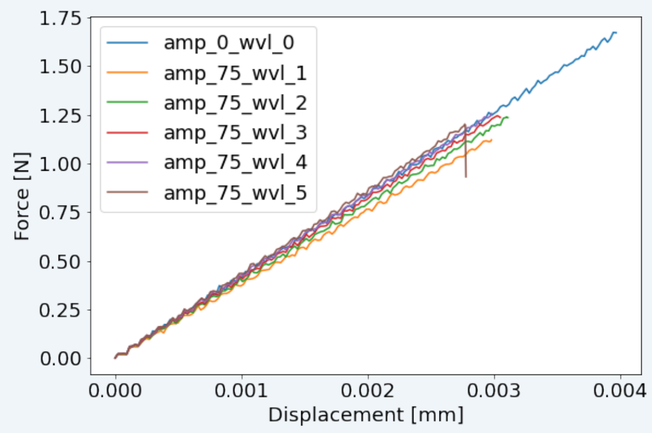


Simulation Example

- Comparison of waviness models with varying wavelength and amplitudes to a reference laminate
- Force-displacement curves show the different load carrying capacity
- Design allowables based on Knock-down-factors



Force-displacement curve for various amplitudes



Force-displacement curve for various wavelengths

[a] John T. Foster, Stewart A. Silling, and Weinong Chen. "An Energy based Failure Criterion for use with Peridynamic States". In: *International Journal for Multiscale Computational Engineering* 9.6 (2011), pp. 675–688. ISSN: 0020-7683. DOI: 10.1615/IntJMultCompEng.2011002407.

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