Three-Dimensional Dynamic Cohesive Fracture Simulation Using Adaptive Topological Operators

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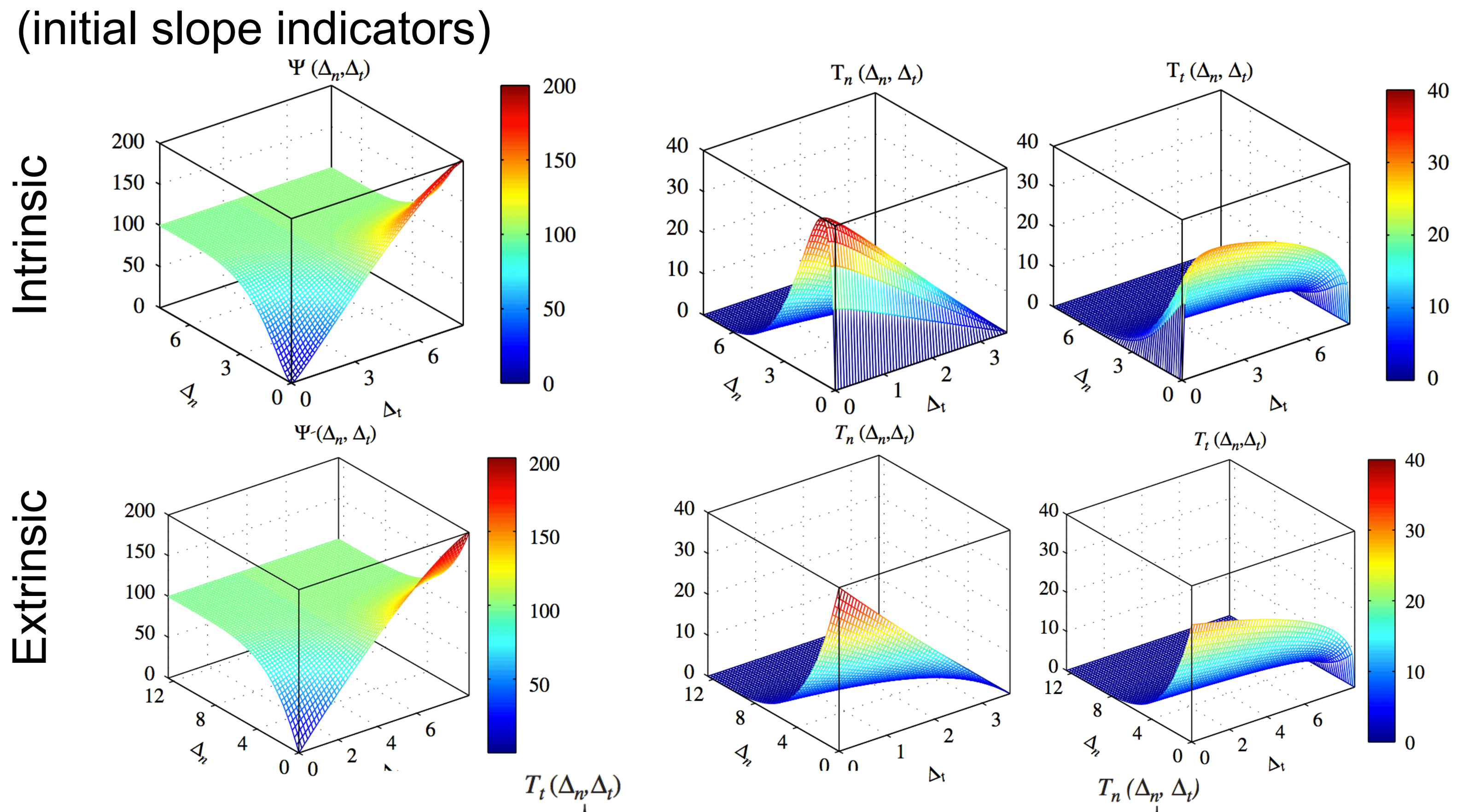
Research Objectives

- Develop an integrated, multiscale computational framework for dynamic fracture, microbranching, and fragmentation
- Employ the potential-based constitutive model for mixed-mode cohesive zone modeling
- Develop systematic adaptive mesh refinement and coarsening schemes for dynamic cohesive fracture simulation

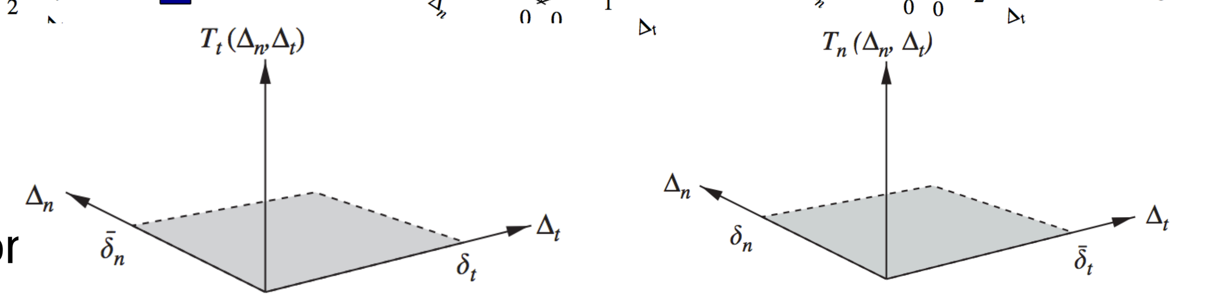
PPR: Potential-based cohesive model

Constitutive Relationship

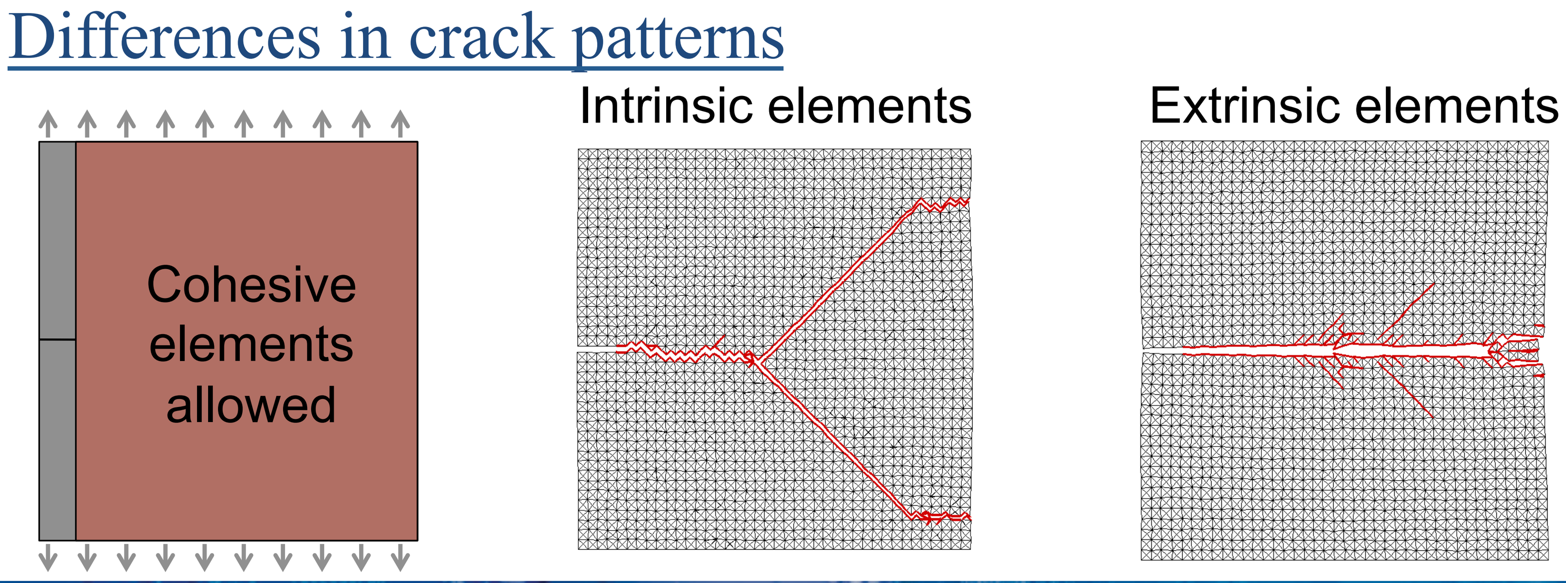
- Traction-separation relation is given by the potential, which is formulated such that boundary conditions are enforced
- Inputs: Fracture energies, cohesive strengths, shape parameters, (initial slope indicators)



- Valid in the cohesive interaction region

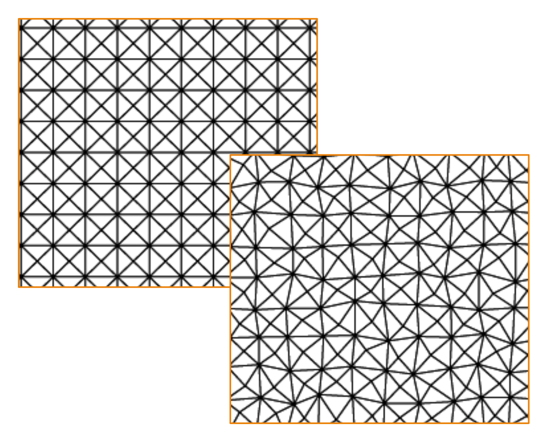


Differences in crack patterns

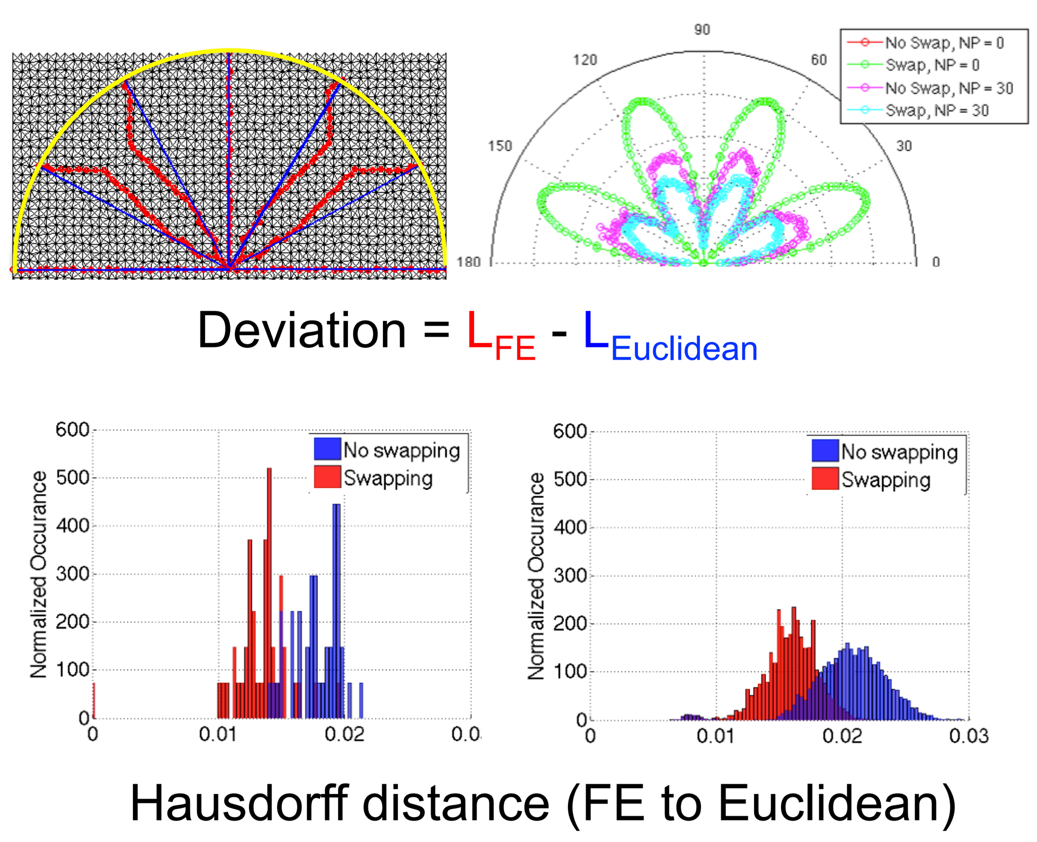


Adaptivity with topological data structure

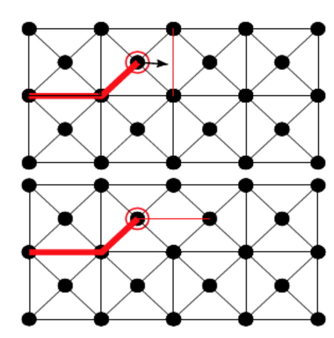
Nodal Perturbation



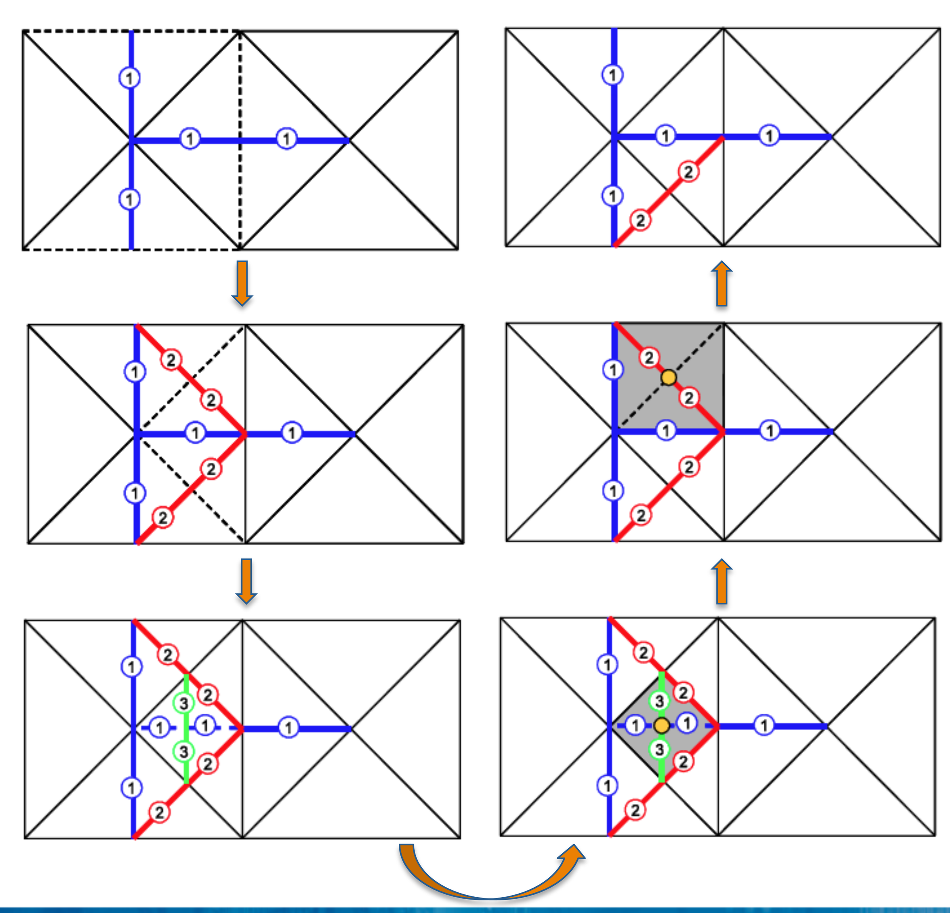
Reduction in mesh bias



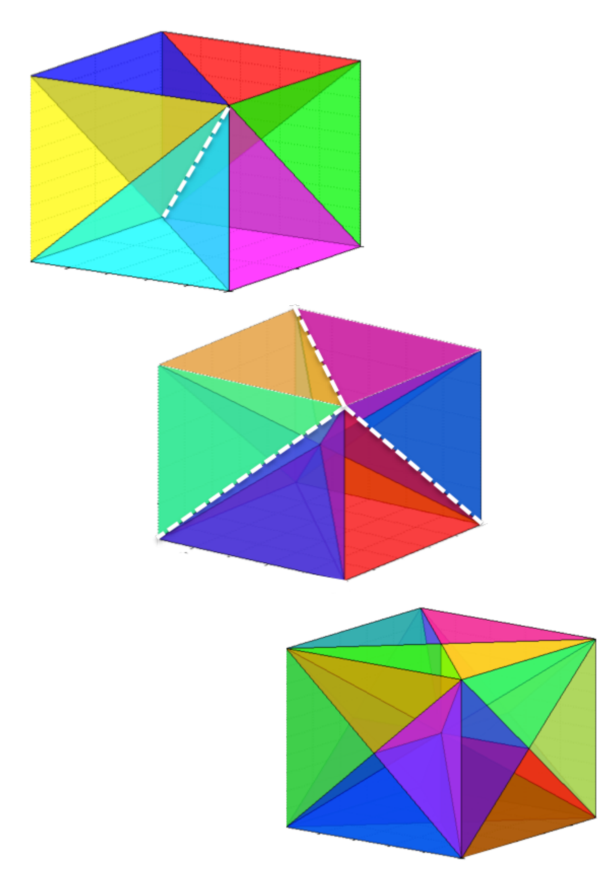
Edge swap



2D Mesh Refinement and Coarsening



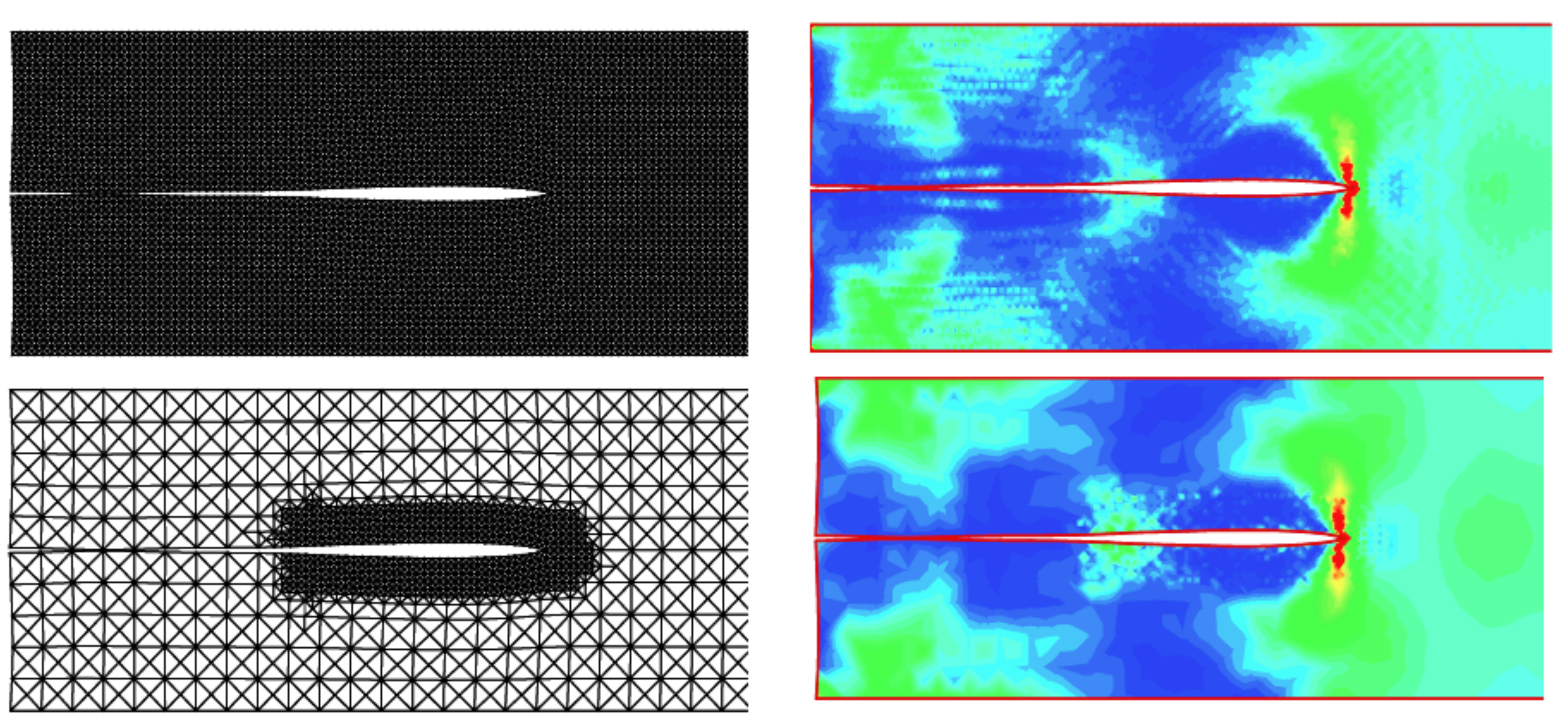
3D Mesh Refinement



Extension from 2D to 3D dynamic fracture simulation

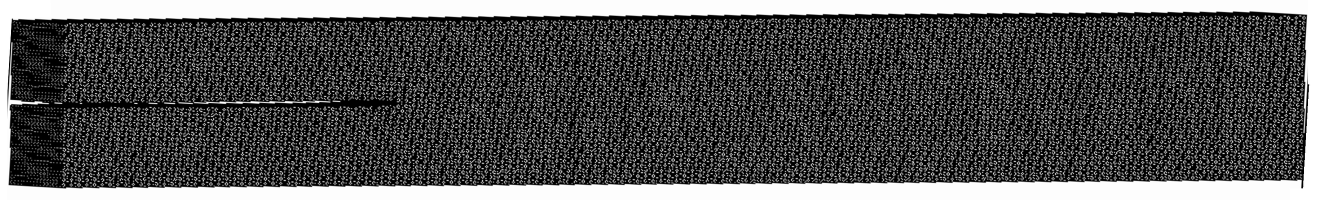
Mode I Predefined Crack in 2D

- Agreement between full refinement and adaptive refinement & coarsening

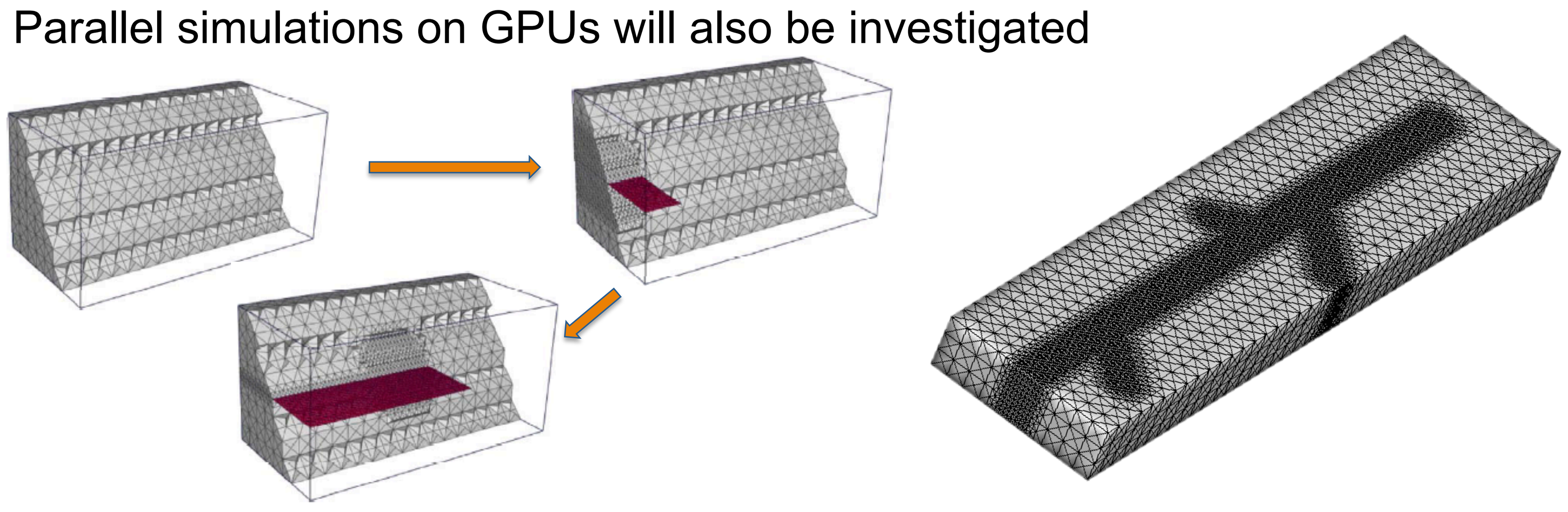


Extension to 3D

- Predefined crack on fully refined and adaptively refined meshes is in progress
- SDSC Trestles super computer used for large memory requirements



- Mesh adaptivity will make problems of multiple crack tips that are not predefined possible
- Parallel simulations on GPUs will also be investigated



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