Chair of Computational Modeling and Simulation
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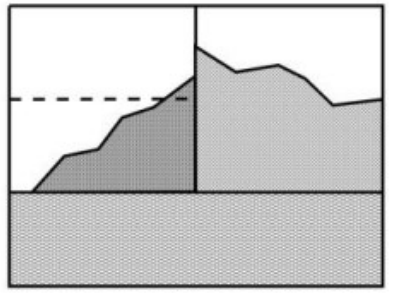
Transition 2D implementation of the Discontinuous Finite Cell Method to 3D

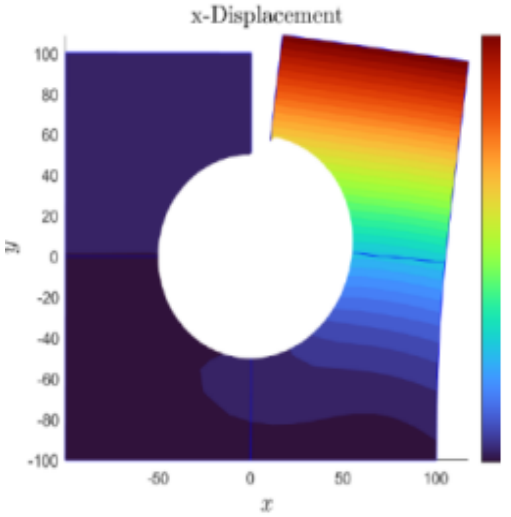
Project Characteristics

Modeling:
Mathematics:
Programming:
Science:

Finite Cell Method is a p-version FEM method in which the elements do not conform to the physical boundaries of the domain [1,2]. Currently, we are developing a new version of FCM in which the elements are connected to each other through the internal fluxes. Therefore, they can have different orders, and different material properties. This will increase the flexibility of FCM in modelling problems with moving boundaries, such as additive or subtractive manufacturing.
A group of 2-4 students are expected to work on leveraging the 2D codes to 3D codes and check them by benchmark examples.



- Objective: Transition the current 2D implementation of the Discontinuous Finite Cell Method (DFCM) to 3D, enabling simulations of more complex physical problems and geometries.
- Expected Outcome: A fully functional 3D DFCM solver capable of handling arbitrary geometries and physical do-mains. This is of course an Open End Task!



Tasks

- Extend the existing 2D mesh generator to 3D.
- Update shape function implementations to support high-order 3D cells
- Modify the integration schemes to handle 3D domains, including adapting Gauss quadrature to higher-dimensional spaces.
- Redefine data structures to store 3D geometry, nodes, connectivity, and boundary information.
- Update visualization tools for 3D domains and results.

1. Parvizian, J., Düster, A. & Rank, E. Finite cell method. Comput Mech 41, 121–133 (2007).
2. A. Düster, J. Parvizian, Z. Yang, E. Rank, The finite cell method for three-dimensional problems of solid mechanics, Computer Methods in Applied Mechanics and Engineering (2008).