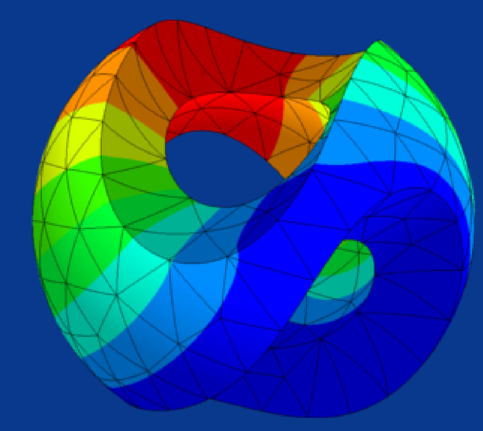
Showcase: Cutting Soft Biological Tissue

F. Heimann, A. Massing, further members of ESGI 156
Institute for Numerical and Applied Mathematics
University of Göttingen



Idea

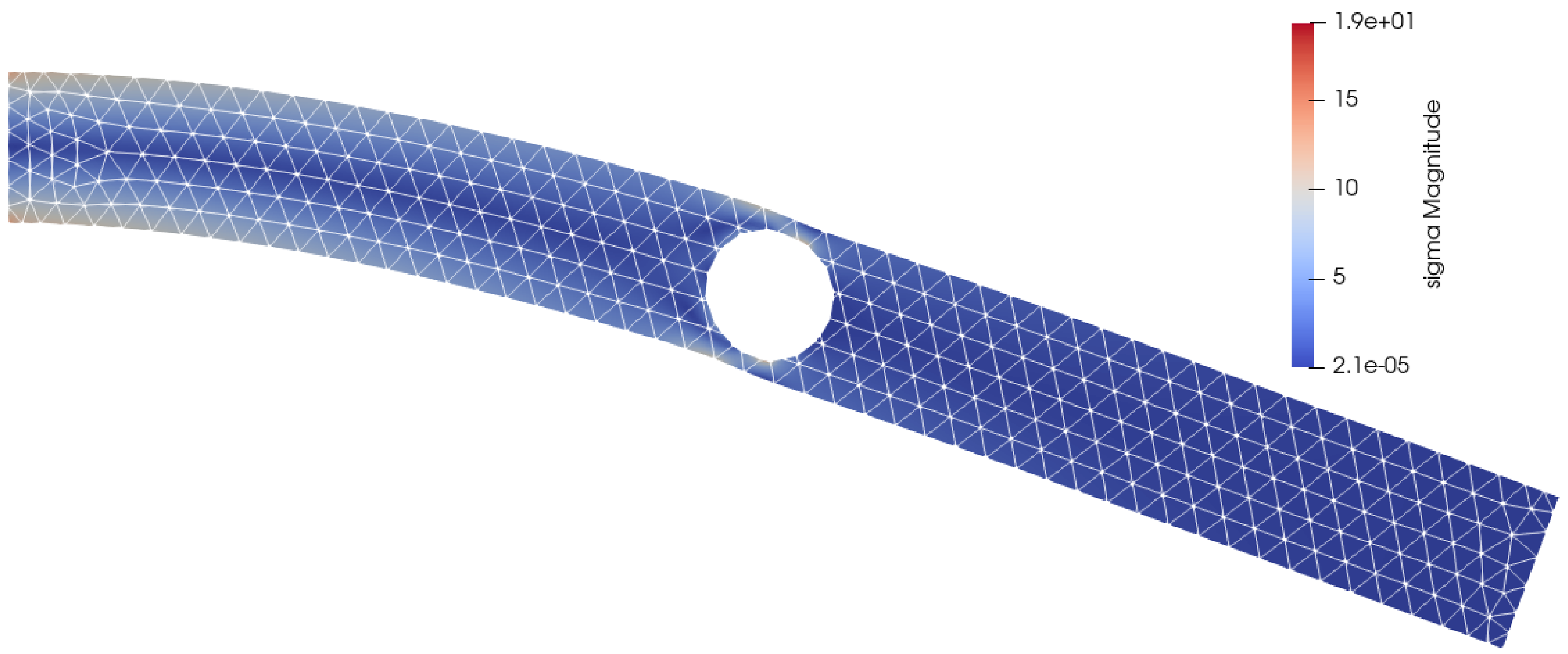
- Surgeons are trained with simulators before patients are involved.
- Computer simulations of the behaviour of cut tissue are needed.
- Many components are involved. We focus on a linear elasticy model of cut tissue to showcase Unfitted Finite Element calculations.

Motivation for unfitted method

- The cut might have a computationally challenging structure.
- Mesh (re)generation in accordance with that is hard.
- In the unfitted method, the cut can be represented independent of mesh configuration.

Test case: Hanging bar with hole

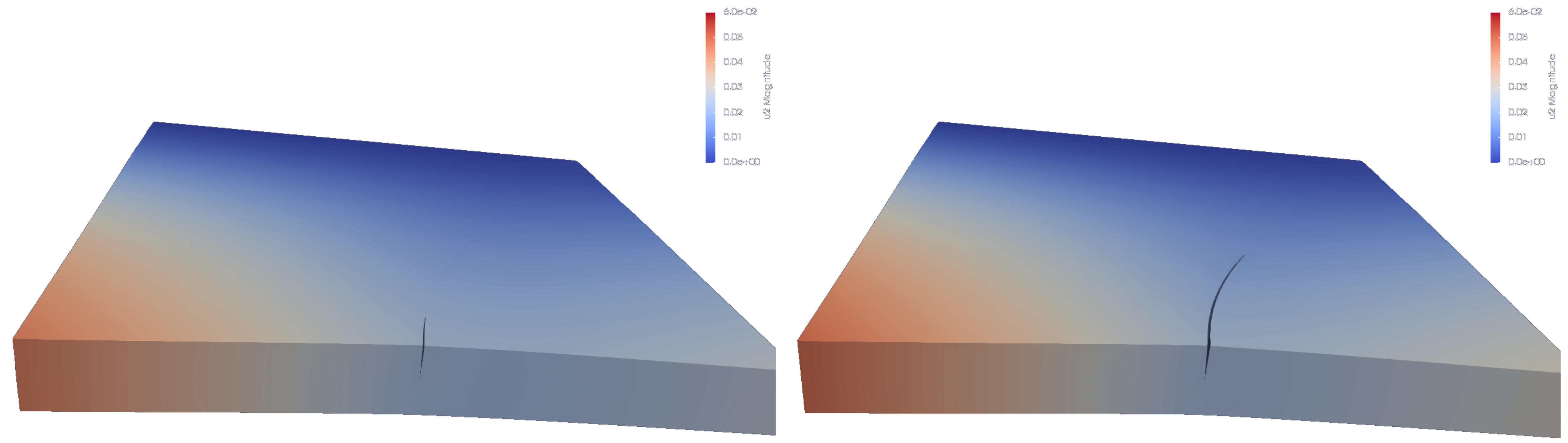
- As a first test, we consider a bar with a hole, which is modelled unfitted:



- Simulation results are benchmarked against Abacus fitted simulation (common software in engineering).

Case 1: Cut in a bar

- First, we consider a bent bar and cut to a temporally changing depth.
- This results in a realistic quasi-time-dependent simulation.



Case 2: Cut in Meniscus geometry

- The Meniscus is a tissue in the knee joint. We simulate the cut of such a geometry.
- Boundary condition: Tissue lies on a table except for a hanging end, where we cut.