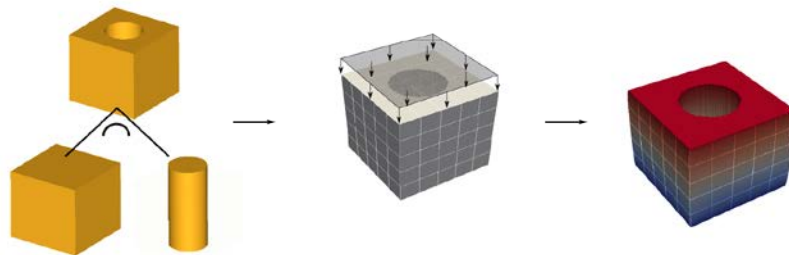## Software Lab:

Modeling: ★★★☆☆
Mathematics: ★☆☆☆☆
Programming: ★★★★★

From CAD to FCM: A CSG-based library for implicit inside-outside queries

Setting

One major problem of today's FEM-simulation practice is the high effort to generate a high-quality discretization for complex real-life applications. For this reason, the Chair for Computation in Engineering developed the Finite Cell Method (FCM), which circumvents this problem by embedding the physical domain into a fictitious domain, such that their union can be discretized easily. This approach has proven to work well for both linear and non-linear applications (see [1] for a detailed explanation and various examples).

The challenge of this approach, however, is to provide an efficient and accurate inside-outside test for complex geometries, possibly consisting of various sub- and trimming-geometries. The Constructive Solid Geometry (CSG) approach is well suited for this aim, as it can naturally handle such features. The aim of this Software-Lab project is thus to bridge the gap between CAD-models and FEM-simulation by developing a CSG-bases library, which allows for fast inside-outside queries for complex geometric models.

Task

In this Software-Lab you will:

- write a CSG-based library in C++ and link it to the chair's FCM-code
- provide a graphical front-end for the library by either writing an own GUI using OpenCascade and/or by writing a plug-in for a commercial CAD-system (e.g. AutoCAD or Siemens NX)
- Provide a post-processing environment by writing an own post processor or by utilizing existing frameworks such as Paraview.

Supervisors

László Kudela, Simulation in Applied Mechanics Group, laszlo.kudela@tum.de
Nils Zander, Simulation in Applied Mechanics Group, nils.zander@tum.de
Tino Bog, Simulation in Applied Mechanics Group, tino.bog@tum.de

References

[1] D. Schillinger and M. Ruess, "The Finite Cell Method: A Review in the Context of Higher-Order Structural Analysis of CAD and Image-Based Geometric Models," Archives of Computational Methods in Engineering, pp. 1–65, May 2014