



Software Lab:

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

A Finite Cell Method Plugin for FreeCAD

Setting

The FCM is an embedded domain approach for high order finite elements [1]. As such, it embeds the physical domain in a simple Cartesian mesh. The original geometry is recovered at the integration level using adaptive methods, which are easy to implement for Cartesian grids. This makes the FCM very attractive for engineering simulations, where currently most of the time is spent in mesh generation. The FCM thus allows for a fully integrated *Design-through-Analysis* workflow [2].

Task

Create a plugin for the open source CAD modeler FreeCAD, which allows users to perform a 3D linear structural analysis. Therefore, you will

- implement a FCM simulation code based on quadratic Lagrange bases using the programming language Python and the Open CASCADE library.
- create a visualization for basic results, such as displacements and stresses using the VTK library.



Supervisors

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References

- [1] A. Düster, J. Parvizian, Z. Yang, and E. Rank, "The finite cell method for three-dimensional problems of solid mechanics," *Computer Methods in Applied Mechanics and Engineering*, vol. 197, no. 45–48, pp. 3768–3782, Aug. 2008.
- [2] D. Schillinger, L. Dedè, M. A. Scott, J. A. Evans, M. J. Borden, E. Rank, and T. J. R. Hughes, "An isogeometric design-through-analysis methodology based on adaptive hierarchical refinement of NURBS, immersed boundary methods, and T-spline CAD surfaces," *Computer Methods in Applied Mechanics and Engineering*, vol. 249–252, pp. 116–150, 2012.