Lehrstuhl für Baustatik und Baudynamik

RWTH AACHEN UNIVERSITY

Master thesis

Development and implementation of Voronoi meshes on 2D and 3D manifolds

Background

A time-consuming aspect in the framework of the finite element method is the generation of a proper and well-conditioned mesh. In case of complex structural geometries, quadrilateral meshing may be hardly achievable, whereas efficient triangulation algorithms are easily accessible. Still, finite element formulations are prone to show *locking*, which is caused by the use of lower-order interpolation functions and, in some cases, the material. To avoid an overstiffening of the element due to locking, several approaches exist. We herein focus on the alleviation of volumetric locking by mixed methods. Triangular elements, however, show several computational deficits, especially when used in mixed formulations. For this reason, a *polygonization* of the structural domain is desired. Polygonal element geometries allow for an easy and flexible mesh generation. Moreover, polygonal discretizations can successfully be used in mixed formulations.

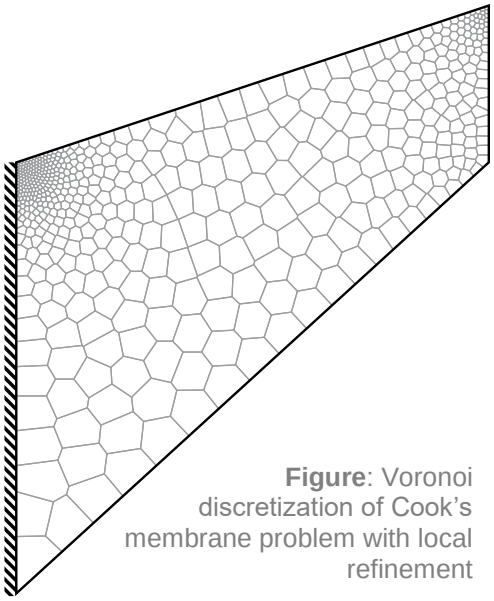

Figure: Voronoi discretization of Cook's membrane problem with local refinement

Task

The main task of this thesis is the development and implementation of two- and three-dimensional Voronoi discretization algorithms in Python. For this, the *scipy Voronoi library* can be used. A proper handling of the domain geometry should be considered. To this extent, handling of arbitrary system geometries with both curved and straight boundaries, is desired.

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