Chair for Computation in Engineering
Chair of Computational Modeling and Simulation

Software Lab:

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

Curved all Quad/Hex mesh generator based on frame fields

Setting

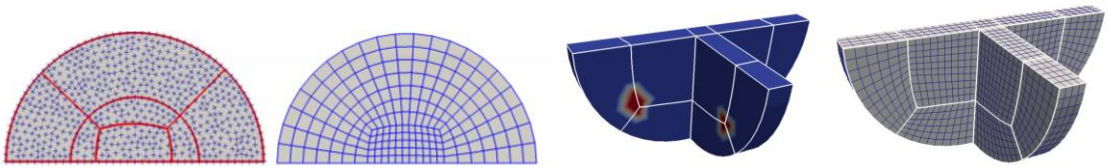
The question of generating a pure quadrilateral mesh in 2D or a hexahedral mesh in 3D is a difficult task attracting a lot of research interest in the computational mechanics community. It is especially important for practical p-FEM applications, where a good mesh is usually considered to be composed of large, smooth, boundary conforming quad/hex elements.

Recent years´ research effort has brought promising approaches aiming to cope with the challenge of mesh generation. Amongst other methods, a possible technique is based on propagating the geometric properties of the boundary into the internal parts of the domain by solving a PDE, leading to a directionality (frame) field, which can be utilized to partition the domain into quad/hex-like regions.

Task

Implement a mesh generator based on the frame field concept that delivers curved quad/hex elements for p-FEM computations. Therefore, you will

- Implement the 2D version of the algorithm described in [1], using the popular Python scripting language
- Extend the mesh generator to 3D, following the concept explained in [2]



The figures are taken from [1] and [2]

Supervisors

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

References

[1] Kowalski, Nicolas, Franck Ledoux, and Pascal Frey. "A PDE based approach to multidomain partitioning and quadrilateral meshing." Proceedings of the 21st international meshing roundtable. Springer Berlin Heidelberg, 2013. 137-154.

[2] Kowalski, N., F. Ledoux, and P. Frey. "Block-Structured Hexahedral Meshes for CAD Models using 3D Frame Fields." Procedia Engineering 82 (2014): 59-71.