Chair of Computational Modeling and Simulation
TUM Department of Civil, Geo and Environmental Engineering
Technical University of Munich

Modeling:
Mathematics:
Programming:
Science:

Software Lab:

Ontology-aware Reverse Engineering of FEM Meshes

Description

In the field of component development, finite element models provide a basis for mechanical design optimization. Once the FE geometry has been modified, many downstream tasks (e.g. further design adaptions) require CAD geometry as their input. Therefore, the meshes need to be traced back to a CAD geometry.

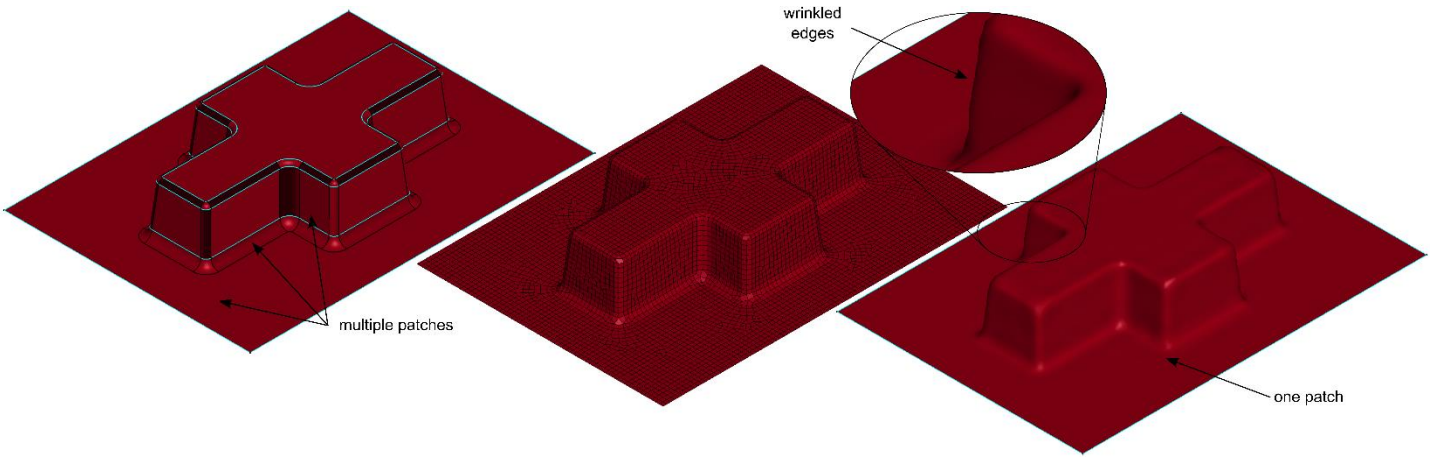

Fig. 1: Three different representations of geometry.
a) Original CAD model b) Finite Element Mesh c) Surface reconstructed model

Simple surface fitting leads to two problems. Firstly, surface reconstruction algorithms tend to approximate complex components insufficiently and are not guaranteed to converge. Secondly, a surface fit yields a single surface patch (see Fig. 1c) instead of an arrangement of multiple surface patches (see Fig. 1a).
To overcome this loss in design history, additional information (e.g. curvatures, symmetry properties, component composition) can be utilized to develop an ontology-aware Reverse Engineering.

Task

Develop a workflow that imports Finite Element meshes and transfers the geometry to a patch-based CAD model:

- Get to grips with Python and helper modules [1]
- Execute a Data Analysis to make design features automatically detectable
- Derive component substructures and generate ruled surfaces
- Test and adapt existing algorithms for the generation of NURBS surfaces

Supervisor

Tobias Lehrer (M.Sc), TUM School of Engineering and Design, ge23raj@mytum.de
Arne Kaps (M.Sc), TUM School of Engineering and Design, arne.kaps@tum.de

References

[1] Kitware Inc., “python-examples,” 2022. https://kitware.github.io/vtk-examples/site/Python/