Success Story
COMET

Advanced Engineering Design Automation

AEDA
Advanced Engineering Design Automation
Programme: COMET – Competence Centers for Excellent Technologies
Programme line: K-Projects
COMET subproject, duration and type of project:
MFP4 – Integrated Techniques for Design Model Analysis,
10/2016 - 10/2018, multi-firm

Automated model transformation for mid-surface generation

The transformation of CAD models to CAE models for design analysis is a bottleneck faced in many engineering companies. The AEDA consortium systematically addressed this topic with respect to (semi-)automated model transformations of volume models to mid-surface representations required for efficient structural analysis and automated update of models after changes in the volume model. The project developed and benchmarked different methods that are based on commercial applications as well as platform independent solutions. Particular focus was put on the level of automation that best supports practitioners.

Goal, Challenges, and Results

As the transformation of CAD models to CAE models for design analysis is a bottleneck faced in many engineering companies, the target of this project is to automate this time-consuming and error-prone task. More particularly, the focus within this project is on the transformation of the volume model of 3D geometries into a mid-surface model which serves as a basis for generating mesh models for structural analysis. Figure 1 illustrates both the volume model and the mid-surface of a part. The mid-surface is highlighted in red.

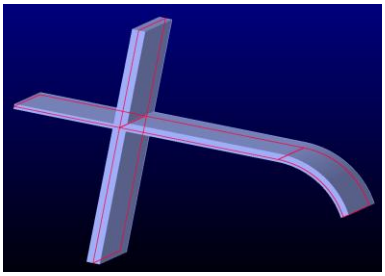


Fig. 1: Mid-surface model (red)

Generally, mid-surfaces are generated by creating a face in the centre between two parallel faces. Yet, special settings can occur where the mid-surface is placed non-centered but rather in line with a neighbouring mid-surface. For example, in Figure 1 the sheet metal on the right side of the vertical plate is thicker than the one on the left side. Therefore, its mid-surface needs to be positioned as an extension of the left mid-surface despite different geometric centres. Due to such irregularities and engineering change management issues, e.g, as to parameterized model adaptions, the automated generation of mid-surfaces is a challenging task causing difficulties with existing commercial tools.

To address this bottleneck, different approaches were investigated in collaboration of multiple scientific partners: first, a fully automated method building upon existing functionalities of the CAD software, second, a fully automated and platform independent method which relies on neutral and open source data formats and, third, a semi-automated method closely integrated to the existing engineering workflows and related applications. The needs analysis of company partners showed that the automated update of mid-surface models due to changes in geometries is a must. Hence, particular focus was put on this aspect when developing the methods.

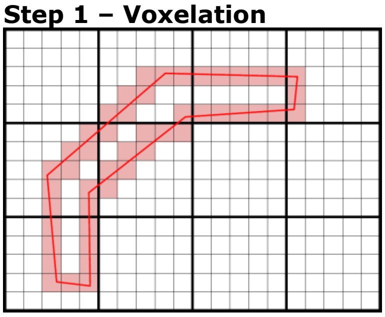
Federal Ministry for Digital, Business and Enterprise

Austrian Ministry for Transport, Innovation and Technology

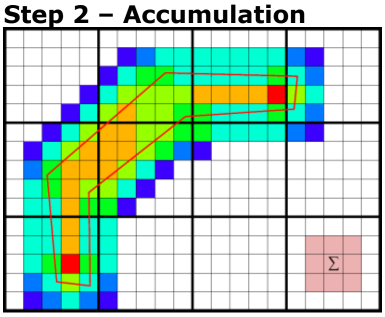
Platform independent approach

Additionally, a platform independent approach was developed to address the topic of automated model transformations for the creation of idealized, dimensionally reduced meshes for preliminary design, optimization and simulation purposes. From an end-user's point of view, the developed algorithm takes a tessellated, triangulated boundary representation of a solid CAD model together with related parameters as input, and produces a finely tessellated output mesh consisting of the mid-surface. The multi-step algorithm works on 3D cells of a grid structure and offers a rule-based, local reduction algorithm. Figure 2 illustrates the four steps of the algorithm. The method is particularly useful when considering multi-CAD environments in design.

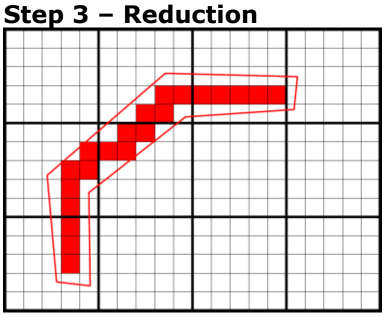
Step 1 – Voxelation



Step 2 – Accumulation



Step 3 – Reduction



Step 4 – Topology

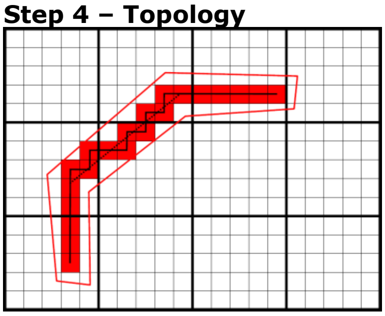


Fig. 2: Outline of the steps of the new mid-surface generation algorithm

Impact and effects

The methods developed for model transformations of CAD models were validated in industrial test beds with company partners. In particular, focus was put on benchmarking fully automated and semi-automated methods. In this respect, both efficiency (time) and effectiveness (model quality) were assessed. The results indicate that due to the geometric complexity of the model transformation, a semi-automated, i.e. interactive approach is desirable so that the strengths of human and computational analysis can be jointly exploited. Therefore, the developed methods contribute to an increase of both the efficiency and effectiveness of this engineering task and enable to keep the models up-to-date after engineering changes.

Contact and information

K-Project AEDA

V-Research – Industrial Research and Development
CAMPUS V, Stadtstraße 33, 6850 Dornbirn, Austria
T +43 5572 394159
E office@v-research.at, http://www.v-research.at/

Project coordinator
Dr. Heinz Seyringer

Project partners

Organisation	Country
Fraunhofer Austria Research GmbH	Austria
V-Research GmbH	Austria