

Reflection

Graduation process

Comparing this graduation topic with the different expertise in the Building Technology Chairs, it is best positioned in the Design Informatics Chair together with the Structural Design Chair. Mainly because of the amount of parametric modelling included in the research.

Up to this point there have not yet been mayor setbacks in the process, the approach and methodology did not change significantly. However, some parts of the methodology are stronger than others. The panelization based on the topological skeleton of a surface seems to be a good working solution to convert any surface topology into a quad mesh. And the theory from different research about this method gives it the scientific support. On the contrary, the redesign of the panels based on the Variational Shape Approximation methods found in the literature are not completely implemented in the algorithms yet. Significant time was spent on finding ways to indirectly modify surface normal vectors in order to align them with the desired plane. Despite the approach is not implemented flawlessly or on the scale of a complete shape, the approximation results of a single panel – as well as for a few panels – show that the objectives that are derived for the dynamic relaxation are correct and significantly increase the developability within a panel.

Research and design are very closely related in this project. Since the goal is to set up this parametric framework which has all sorts of different aspects included – such as quadrangular subdivision, mesh to NURBS conversion, shape approximation and structural analysis – research is done into these different aspects and results are implemented in the methodology and therefore as well in the design of the framework.

Societal impact

The result of this research is a framework partly implemented in a prototype design tool. Parts of the method that are proved to be working, such as the algorithm to construct a quad mesh based on the surface topology, could be used in practise to skip the manual steps of drawing grids on these kind of surfaces. This also applies to the structural analysis part, which could be a practical definition for a preliminary structural analysis. However, further research needs to be done in order to implement reliable ways for analysing wind loads. The objectives in the shape approximation significantly increase the developability of the panels and are therefore proved to be working, however, full developability is not reached with the currently used objectives. Further research might lead to additional or different objectives in order to reach different results.

In a way the approach followed by this framework contributes to a sustainable development. Currently steel loadbearing structures developed by AIP Partners, and possibly other companies as well, consist out of thick steel plates. Replacing these by sandwich panels to reach the same structural efficiency with less material, contributes to sustainable development in this sector. Besides this, the method to create the panels does not use the heavy machinery that is currently used in the curving of thick sheets.