Human Computer Interaction
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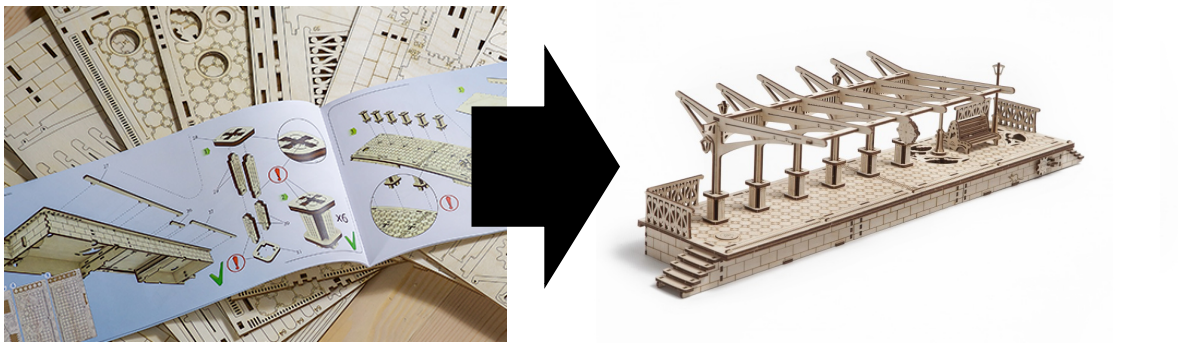
Masterprojekt Sommersemester 2019

3D Assembly from 2D Plates

Making parametric modifications to a 3D model is relatively easy to do and very powerful. However, if you have only a description of 2D plates, it is unclear how these modifications influence each of the individual plates. In this project, we build a system using an algorithm to find out how to assemble such 2D plates in a 3D configuration. We argue that, given that a correct assembly exists, there is a way to backtrack how the pieces fit together. The goal is to achieve this in an automatic fashion. Where this cannot be achieved, we extend with machine learning or user interfaces to guide the algorithm towards the optimal solution.



Your goal is to automatically turn 2D plates into 3D assembled models

Motivation

If we had a 3D model of the 2D plates a model consists of, we could reuse it in meaningful ways, f.e. we could adapt the model to our fabrication machine, modify the model to fit our specific context and more. Unfortunately, we typically do not have that 3D representation. The reason is that people share the 2D plate descriptions directly as this is what they send to their machines (and thus closest to what they actually fabricated). It is hard to do any meaningful editing on those 2D plates directly (each edit influences many other plates). The system we will build in this project allows models to remain fully reusable.

You engineer the algorithm and build a JS pipeline

Each of you will work on one part of the pipeline to make this happen. We will design together on the actual algorithm and the steps, but you will have enough space to work on your own, independent of the team as well. For each of these steps, we have some experimental JavaScript/TypeScript code you can reuse. The pipeline looks like this:

1. Load the 2D file, detect what is inside and what is outside and identify separate plates
2. Identify the joints in the model (where plates can connect)
3. Sort the joints and find out which could match together (with what probability)
4. Construct a graph of these plates and find possible assemblies

5. For different assemblies, build an actual 3D model and detect mechanical collisions
6. If 1 fully assembled model is found without intersections, this is the result. Otherwise present variations to users to pick which one is correct (this may need to happen in any of the other steps already as well) Or verify results semi-automatically using a machine learning approach

We will have a large amount of models available you can use for testing. Given that we have extensive experience building tools for lasercutting, there is a lot of expertise in our group you can benefit from when building this system.

Experience with JavaScript and Graphics is recommended

It really helps if you have looked at Javascript/TypeScript, graph algorithms and 2D/3D modeling before. It is possible to learn throughout the project, but obviously, the more time we can spend building a great system, the better.

Contact

You can swing by any time in our hallway (2nd floor of the main building) to talk more
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