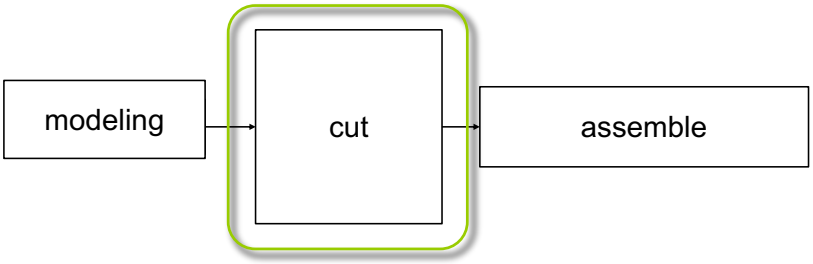
Human Computer Interaction
Prof. Dr. Patrick Baudisch
Masterprojekt Wintersemester 2021

The Last Mile to Laser Cutting

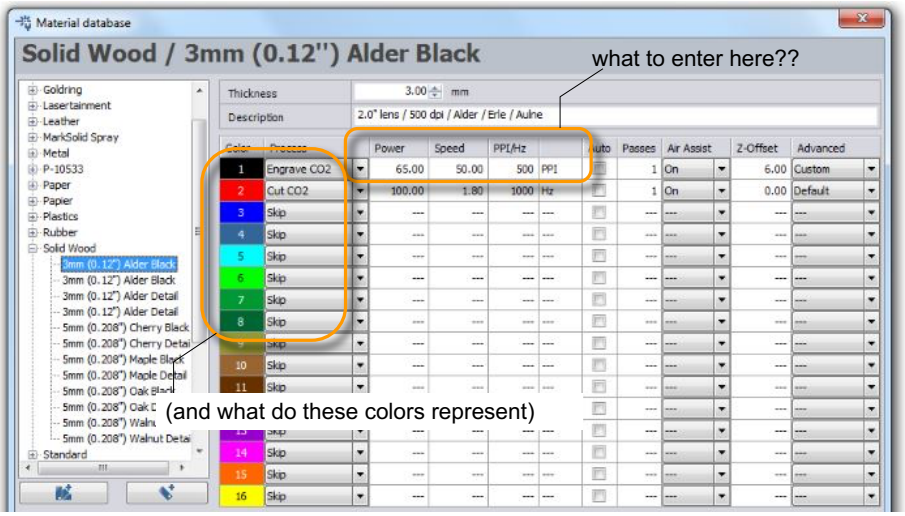
tl;dr: In this project, you will write software in javaScript/typescript, work on a medium-size software system (kyub), implement database-based tools traditionally used to implement recommender systems, and, if you are interested build custom hardware.

Laser cutting, technology invented in the 1960s, has been experiencing a lot of interest recently, as it allows creating physical models up to 100x faster then 3D printing. Recent advances in 3D modeling and techniques simplifying assembly have made laser cutting fast and in large parts enjoyable.



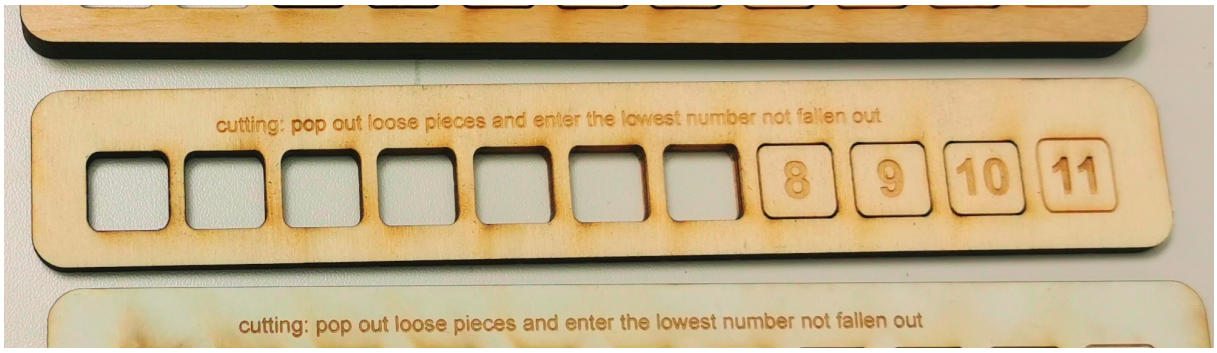
If it were not for the actual cutting that is, or more precisely, the involved **calibration**. The calibration process is slow, poorly understood, and most of all error-prone, thereby forming the bottleneck to laser.

The laser cutter hardware industry has largely been sitting on their hands for the past 40 years, relying on interface that require users to somehow *know* the (ever changing) magic parameters that allow for a successful cut (power, speed, ppi/hz…). Other parameters, such as the power required to produce a black line or engrave a line to 1mm depth are not considered at all.

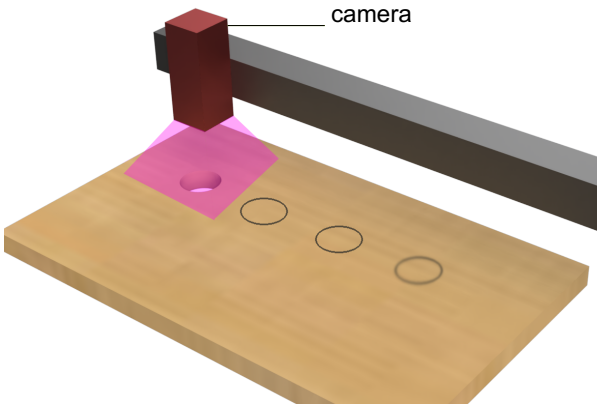


This is how industry has tried to solve the calibration problem is the past 40 years, but how are users supposed to know what values to enter for power, speed, and ppi/hz?

In this project, you will tackle the calibration problem by (1) extrapolating settings from past sessions. We think that you may want to apply algorithms from recommender systems/collaborative filtering here. (2) You will automatically generate simple laser cut models, aka gauges, such as the one shown below, that make certain invisible parameters of the cutter visible. The trick is to use insights from step 1 to generate the smallest possible set of gauges that produces the necessary data.



(3) And, if time permits, create a hardware solution to the problem, i.e., mount a camera and a force sensor to the laser head and run binary search it in a closed-loop fashion, allowing the cutter to calibrate *itself*.



Technologies involved in this project

1. write JavaScript/Typescript
2. interface with physical machines
3. data driven search and inference algorithms
4. medium-size software system (120.000 lines of code)

Contact

Email me at Shohei.Katakura@hpi.de for a zoom call or, if Covid permits, to meet in person at my office on the 2nd floor of the main building (H-2.9).