

Laser Parameters Optimization

Baptiste RUHOFF

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Computer Science and Communication Systems – Data Engineering

Professor : Stefano CARRINO

Expert : Célien DONZE

Description

This thesis has been made in partnership with GRAVITY.SWISS SA. It's a company active in the watchmaking industry. They are creating stylised dials using laser ablation to make 3D surface.

A new laser machine is currently being developed, and productivity is one of the main challenges. The goal of this project is to reduce the processing time of pieces. To do so, two axis are explored in this project.

Better parameters : The machine laser have a lot of parameters that can be tweaked. The idea is to create an algorithm to easily find good set of parameters that will keep a good quality while reducing the processing time.

Better trajectories : By reducing the amount of time the laser is moving without firing, we can reduce the total time needed to create a piece.

Process

Better parameters :

The algorithm used is called «Bayesian Optimization». It's an algorithm that will loop multiple times. During these loops, it will try to find how the machined piece evolves depending on the parameters by creating new piece with new parameters. The more the algorithm loop, the better it will get.

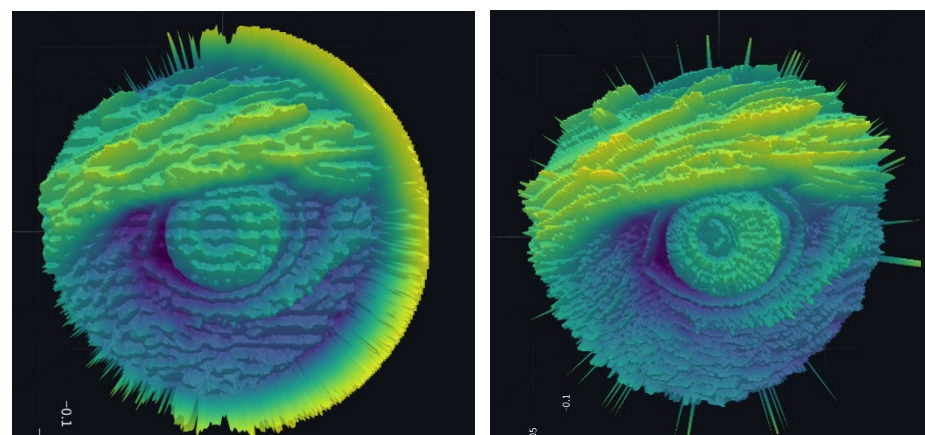
Better trajectories :

Originally, pieces are machined layer by layer, removing everything on the highest layer before going to the next layer. The idea of the implemented algorithm is to remove completely through all the layers a cavity before switching to the other, removing unnecessary jump.

Results

Better parameters :

The piece used to test the parameters was a 3D eye. After 30 tests of different parameters, it resulted in a piece processed 5 times faster, with an acceptable level of quality. Under, the two image show on the left what was the result of the 30th test, and on the right what the test should look like.



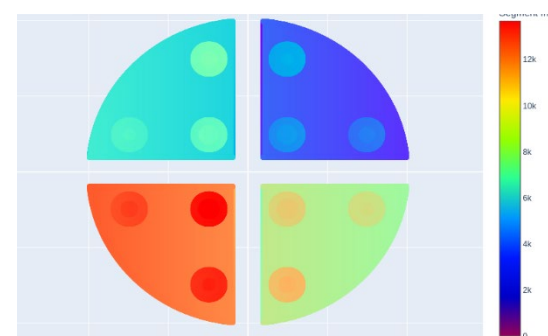
30th test appearance

Targeted appearance

Better trajectories :

The best results for the trajectory reduced the production time by 15%. On the image, the plot show an optimization of a piece trajectory. The color shade is the order in which the piece is processed. It can be observed that it first process a whole quadrant before doing the next.

For now, only specific pieces can be easily optimized.



Optimization of a piece

Conclusions and outlook

The results are quite encouraging, showing some increase in productivity.

The parameters can be found in an automated way, and quicker than when an operator is looking for them manually.

The trajectories optimization is functional for a specific type of pieces by finishing cavities before starting a new one.

For the future, this work only explored one solution. This algorithm likely deserves some optimization, and the trajectories require to be generalized.