PHOTOSYNTHETIC

Computational Science Challenge

Company: Photosynthetic.
Location: Vrije Universiteit, Amsterdam.
Duration: 3-6 months (depending on the availability).

About us
Photosynthetic is a deep-tech startup (spin-off of CWI, Amsterdam) developing a novel micro- and nano-scale 3d printing method that has the potential to outperform the existing technologies in speed by several orders of magnitude. If successful, we will be able to create a high-tech fabrication tool for biomedical applications, chemistry, optics and semiconductor industry.

We have patented our invention, created the hardware and software prototypes and are going to finish our first product in the coming 12 months.

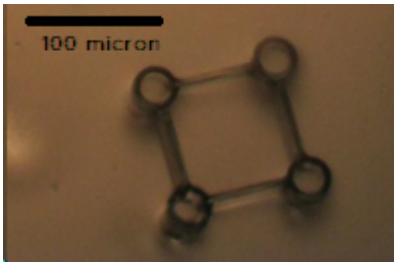

Figure 1. 3D printed “castle” 100x100x100 micron (0.1x0.1x0.1mm) in size.

The challenge
You can think of our technology as a reverse-microscope that is used to project hundreds of light patterns into a small volume to trigger curing (solidifying) the photopolymer in space. The patterns are precomputed by a numerical model that simulates the optical system and the reaction of the photopolymer to light.

The result of the print directly depends on the accuracy of the model parameters, the approximations and the type of solver used to solve the inverse problem.

The project
We are looking for candidates with background in inverse problems and numerical simulations to work on one of the following sub-projects:

1) **Model of the optical system**. We need to find the most suitable model of the so-called Point Spread Function of the optical system and ensure that it fits the experiment. We should be able to capture the resolution, contrast and aberrations of the real system. Non-linear effects, such as refraction should be explored.

2) **Model of the chemical system.** Chemical reactions that are triggered by light can be represented in various ways: system of differential equations (rate equations), heuristic approximations, look-up table. We need to explore the accuracy and the limitations of each of these models comparing them to the experiment. The best approach suitable for solving the inverse problem should be found.

3) **Inverse problem.** Since the “forward” model of the polymerization process can be defined, we can attempt to solve the inverse problem and compute the light patterns that can be used to print a certain 3D shape. We need to explore various choices of approximations in the forward model and ways to calculate the inverse and find which approach provides the best result in a practical setting.

4) **3D Imaging.** Since the hardware system can be used as a microscope, we can collect the data that allows us to reconstruct the shape of the 3D object that is being printed. If such reconstruction is possible, we can use it as a feedback for our printing method. We are developing methods like 3D Structured Imaging Microscopy to be used for 3D image reconstruction. Imagine a system where we can print, measure and compute a 3D image of the print and use it to improve the next print right away.

If you are interested, please let us know at:

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