Multiphysics model for rapid 3D printing at the microscale.

Overview

The team of Photosynthetic is developing a radically new approach to microfabrication. We are developing an Additive Manufacturing system that makes use of precomputed light patterns to control the chemical reaction of photopolymerization in 3D space. It allows to generate microstructures in a fraction of a second. Our team combines the knowledge of computer science, optics and polymer chemistry to build the fastest "3D printer" that can print at the scale of a single light-wavelength or smaller than a micrometer.

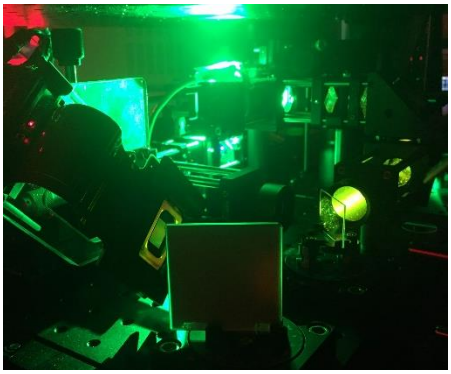

Figure 1. Our optical system that allows to build polymer 3D micro-structures using pre-computed light patterns. A.k.a. "3D Printer".

Candidate

We are looking for candidate with at least Bachelor's degree in *physics*, *applied math* or *computer science*, having experience with *inverse problems*, *algebraic methods*, or *optimization problems*. Experience with programming in Python would be highly appreciated.

Available Projects

We have three type of projects we would like our candidate to work on:

1) **Forward modeling of the polymerization reaction driven by light**. Our current model of the printing process includes elements of the Fourier Optics (light propagation) and basic reaction rate kinetics (ODEs). We would like to get a better understanding of the properties of that model, the influence of various approximations and eventually improve the accuracy the forward model.
2) **Solving the inverse problem / optimization of light patterns**. When the forward problem is formulated, we can solve the inverse problem to precompute the light patterns that are required to produce a particular 3D structure. This is done using so-called Algebraic Reconstruction algorithms similar to the ones used in X-ray Tomography and Seismic data processing. We would like to understand the effects of using different inversion algorithms in terms of accuracy and computational efficiency.
3) **Computational engine for the real time monitoring and 3D image reconstruction**. During the printing process we can have a real time microscope video stream. We can use this data to reconstruct a 3D image of the structure that is being build. We would like to create a data pipeline that enables fast reconstruction of 3D images for quality control and monitoring.

Timeline

The project can start anywhere between January and March 2022. We prefer 6+ months project duration.

Facilities

Our lab is located at the Vrije Universiteit, Amsterdam. While we encourage our candidates to minimize the risks related to the spread of CORONA virus, we are still providing a regular access to our lab facilities.

Contact

If you would like to participate in any of our projects, please send us your CV to the email address:

hello@photosynthetic.nl