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# Variable Voxel and Shaped Beam 3D Printing

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### Introduction

We invented the technology to realize stereolithography with variable voxel sizes and shapes at higher reliability and much lower cost. The variable voxel sizes and shapes (laser beam spot sizes and shapes) are realized by simply switching the wavelength of the light source. The key component to enable this technology is an optical filter. For one wavelength, the filter is almost transparent which gives a larger spot size, while for other wavelengths, the filter works as an aperture and only part of the area is transparent, which gives a much smaller or complex shaped beam spot. The optical filter we are using is based on subwavelength resonance grating which is one of the best options.

### Concept

#### The Need for Variable Voxel



model

slicing

### Experiment

#### **SEM Image of Grating Structure**





Stereolithography

- easier

In this example,

- Common 3D printing resolution is about 0.1mm
- Far from optical limit

#### A trade off between resolution and speed



Increasing resolution 10 times will increase time consumption 10<sup>3</sup> times!

- Filter selectively reflects certain wavelength
- Different wavelength  $\rightarrow$  Different beam shape

#### **Sub-wavelength Resonance Grating**



- Physics: Resonance, Re-radiation, Interference
- Advantage: Optically thin. Several layers can be stacked to give multiple aperture shapes



a 5 by 5 beam array is 25 times faster than a single beam.



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