Stereo-lithography is an upcoming, and promising field with incredible applications in everything ranging from medicine to consumer appliances. Stereo-lithography is the process of creating three-dimensional objects by polymerizing liquid resin with a computer-controlled laser, layer by layer until the shape is created. There are typically two methods of additive manufacturing which determine whether the object is built from the bottom up or the top down, though typically the bottom up method is more accurate and efficient. There are amazing advances made in stereo-lithography these past few years, such as the development of bio-printers, being able to print a composite object with two or more materials, and printing objects with varying electrical properties. This is truly a field with great potential, and growth would surely be explosive in the coming years.

**Objective & Impact of Professor’s Research**

Dr. Wei Wu’s extensive research in the field have yielded great results in terms of resolution and efficiency for the additive manufacturing process. His goals, as stated above, are focused on improving the efficiency and resolution of these additive manufacturing devices by enhancing the optical segment of the process, i.e. modifying the UV light source (lasers). He has been able to vary the beam diameter of the laser, in order to save time when printing complex objects with a mix of both simple and complex designs. The current project of his is focusing on allowing the printing of light objects, so that the device can print patterns, saving time and making the process more efficient. Both these projects have already had shown significant promises in terms of augmenting the performance of these devices, and the brilliant use of optical filters to block certain wavelengths of the UV lights have proven an effective methods for varying beam diameter and printing light arrays.

**Introduction**

These past few weeks Dr. Wu had been working on creating an additive manufacturing setup which would be capable of varying beam diameter/resolution and be able to print light arrays.

**Creation of a New Additive Manufacturing Device**

The setup was relatively simple: two lasers with different wavelengths of 405 and 445 nanometers were to be our UV source, placed behind dichroic mirrors which would direct the beam of light towards the filter and towards two small mirrors which rotate at small angles to project the laser onto the resin directly above it in a scanning motion, which cures the resin and results in one layer being printed. The dichroic mirrors serve the purpose of allowing the light of one frequency to pass through completely, almost acting transparent while reflecting other wavelengths. This allows for the positioning of the laser so that both don’t have to be directly aligned towards the scanning mirrors (scanning module). The build of this printing setup took approximately five weeks, with testing beginning on the fourth week.

**Filters**

The most defining part of Dr. Wu’s research would be the ability of the installment of filters which could block certain wavelengths in order to vary resolution or create patterns, requiring two different filters. These filters are created by creating gratings in a titanium oxide material, which is then fused with silicon oxide, and when there is need to vary resolution or print array, all that is required is to turn on the laser with the corresponding wavelength which would be filtered. The filters are tested by printing structures with a “woodpile” structure, which would allow the experimenter to easily determine whether the filters are indeed varying resolution and printing arrays.

**Results and Next Steps**

The results were impressive, as tests revealed that resolution varying could save up to 87.6% of original printing time without the filter. It is also concluded that a cost-effective approach to 3D Printing with variable resolution and shaped beams was invented. While these filters are certainly impressive, the next steps would be to increase resolution even further, the speed, and even the scale of these filters. These filters currently operate on a micrometer scale, so expanding that further would certainly open up a world of possibilities. It would also be possible to conduct research on other patterns that could be created by these filters, instead of only light arrays. Efforts can also be made to further reduce material waste, though the current process is already quite efficient.

**Acknowledgements**

A large thank you to Professor Wu; PhD Student mentor Yuanrui Li; SHINE Coordinator Katie Mills; SHINE liaison Ian; Tracy Charles, the SURE Coordinator; and my SURE mentor William Zhou.