PURDUE UNIVERSITY
Mechanical Engineering

DESIGN AND IMPLEMENTATION OF A HYBRID MICROSCALE OPTICAL 3D PRINTER

Capstone Senior Design Project • Spring 2023

Micro but Mighty

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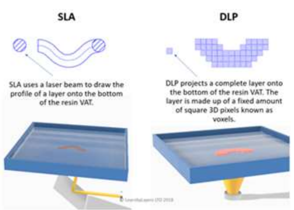
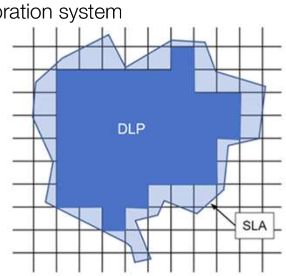
Vision Statement

To provide a cutting-edge, microscale 3D printing technology that seamlessly incorporates all the advantages of a hybrid operation between DLP and SLA printing.

Problem Definition

- Combine SLA and DLP to create a fast, high resolution resin 3D printer
- Moving bed and resin vat
- Have microscale movement in every axis
- Utilize cameras to create a calibration system





Engineering Requirements

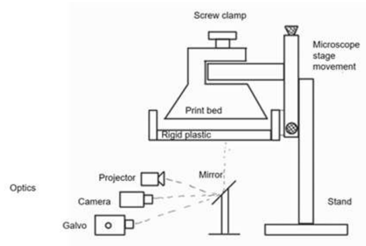
1. Be able to print in both SLA and DLP seamlessly
2. Movable print bed and vat during printing
3. Printing at 100 µm resolution or finer
4. Stitching accuracy at 25 µm resolution or finer
5. Stitching at least a 2x2 area to demonstrate scaling capabilities
6. Create calibration routine for SLA and DLP alignment

Value Proposition

Because this hybrid operation will be able to create both fast and high resolution prints, it can be utilized in a variety of applications such as the following:

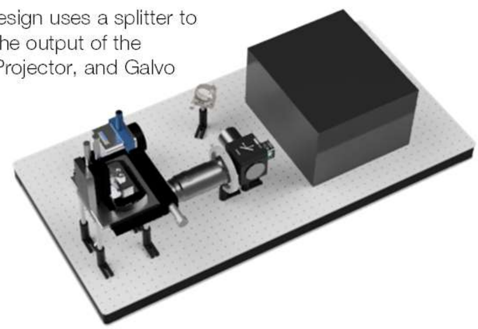
- Micro-scale Research
- Medical - medical devices, dental, etc.
- Microelectronics
- Optics - Lens Mounts, Tools, Holders
- Automotive - Sensors and In-Cabin Elements
- Aerospace & Defense - Pressure Sensors, Air flow devices, & Accelerometers

Mechanical Design

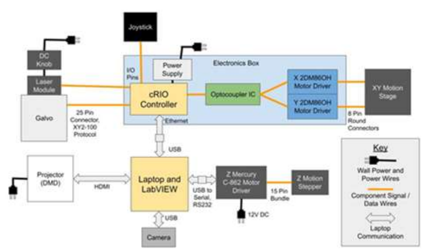


Original Design included Projector, Camera, and Glavo next to each other

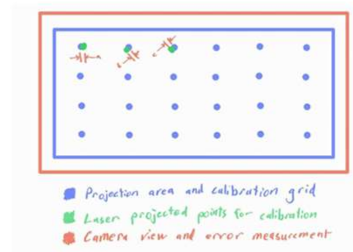
Current Design uses a splitter to combine the output of the Camera, Projector, and Galvo



Controls and Electronics



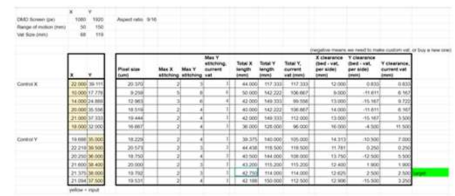
Testing & Validation



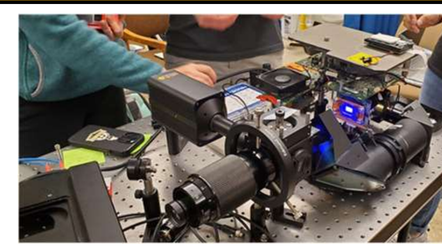
Current validation plan is to project a grid of dots using the DLP camera. Then the SLA laser aligns its beam onto where the dot is. We then use a camera and a LABVIEW code to create a mesh that offsets any discrepancies between the SLA and the DLP.

Resolution Calculator:

- Able to calculate print size based on resolution of projector and distance



Further Improvements



- Further improve the accuracy of the validation plan
- More tests for effectiveness of SLA and DLP to decrease print time
- Increase resolution of printer to function better within Microscale
- Make design more compact to decrease foot area needed to run

Acknowledgments and References

- **Professor Liang Pan - Help on all aspects of the project**

- LearnByLayers. (2023). *SLA v DLP 3D Printing*. [Infographic]. LearnByLayers.com. https://www.learnbylayers.com/product/sla-v-dlp-and-resin-materials/
- FormLabs. “SLA vs. DLP: Guide to Resin 3D Printers.” FormLab Guides,FormLabs,https://formlabs.com/blog/resin-3d-printer-comparison-sla-vs-dlp/. Accessed 18 Jan. 2023.