Microscopic Stereolithography Control System

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Client: Dr. Alan Fine

Project Scope

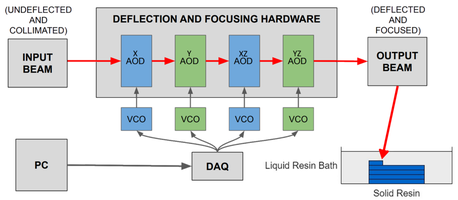
Convert existing laser imaging system to perform 3D stereolithography.

- Must not modify current hardware configuration
- Provide test cases to demonstrate system potential
- Emphasis on future development and customization

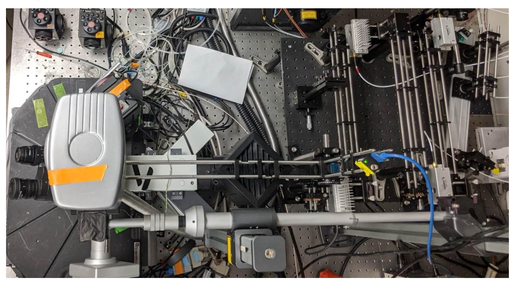
Background

Theory of Operation

- Acousto-Optic Deflectors
- Two-Photon Excitation Microscopy
- 3D Nano-Stereolithography



System Diagram



Design Process

Top Level System Design

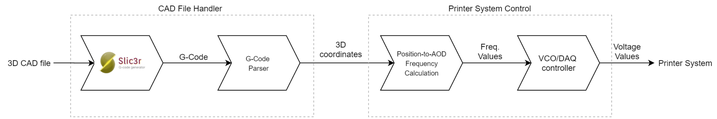
- Components
- Internal Communication

Tandem Development and Testing

Finished Components Integrated Sequentially

Details of Final Design

System Software Model



CAD File Handler

Slic3r Program

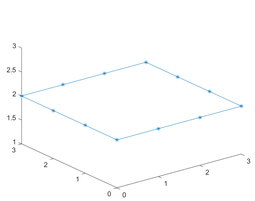
- Identified based on reliability and depth of process customization.
- Integrated using built in command line support.

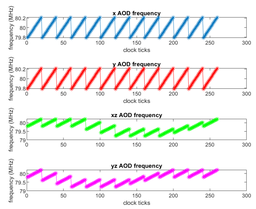
G-Code Parser

- Handles robust input file suite and produces consistent coordinate data.
- Supports expansion to larger object printing.

Printer System Control

- Position to Frequency Conversion
  - Converts a 3D coordinate point into a series of frequencies for each AOD.
  - Computationally expensive, designed to optimize efficiency and speed.



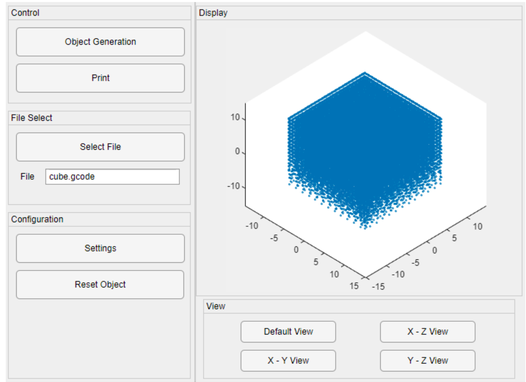


- VCO/DAQ Controller
  - Converts frequencies to voltages that are compatible with each VCO.
  - Controls DAQ device that will drive the VCOs.
  - Maintains and ensures the VCOs are always driven at safe voltages .

User Interface

System contained within simple and intuitive user interface

- Fully interactable display
- All relevant system parameters adjustable through external settings window
- Internal architecture supports future development



Conclusion

A software package capable of handling full conversion from STL files to voltage signals that can drive the system was developed.

Future Work

- Perform full scale hardware tests using bleaching and stereolithography methods.
- Update user interface to include feedback from the DAQ to show printing results in real-time.
- Integrate support for system to print objects that exceed standard sizing limits.
- Further optimize G-Code parsing and frequency conversion processes to reduce time between prints.

References

Lenox, Joseph, and Alessandro Ranellucci. “Slic3r.” *Slic3r: Open Source 3D Printing Toolbox*, 1.30, slic3r.org/.