

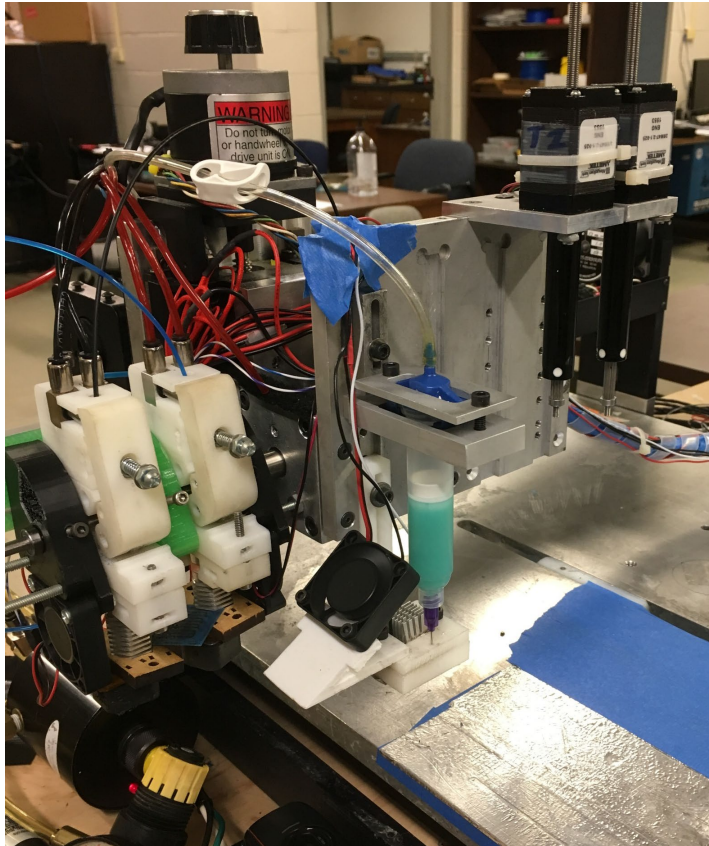
Mechanical Design Portfolio

1. Designs developed to support Masters and PhD research
2. Hobby based designs

Mechanical Designs for Research Projects

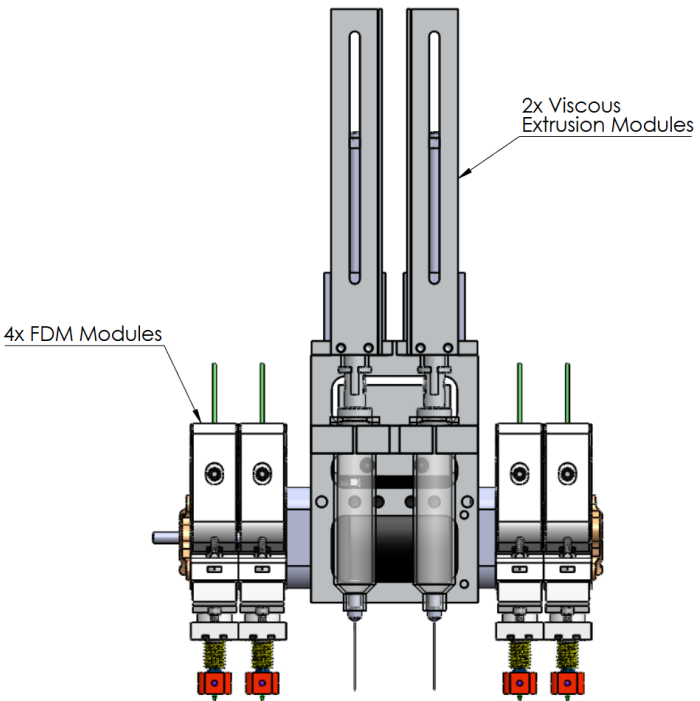
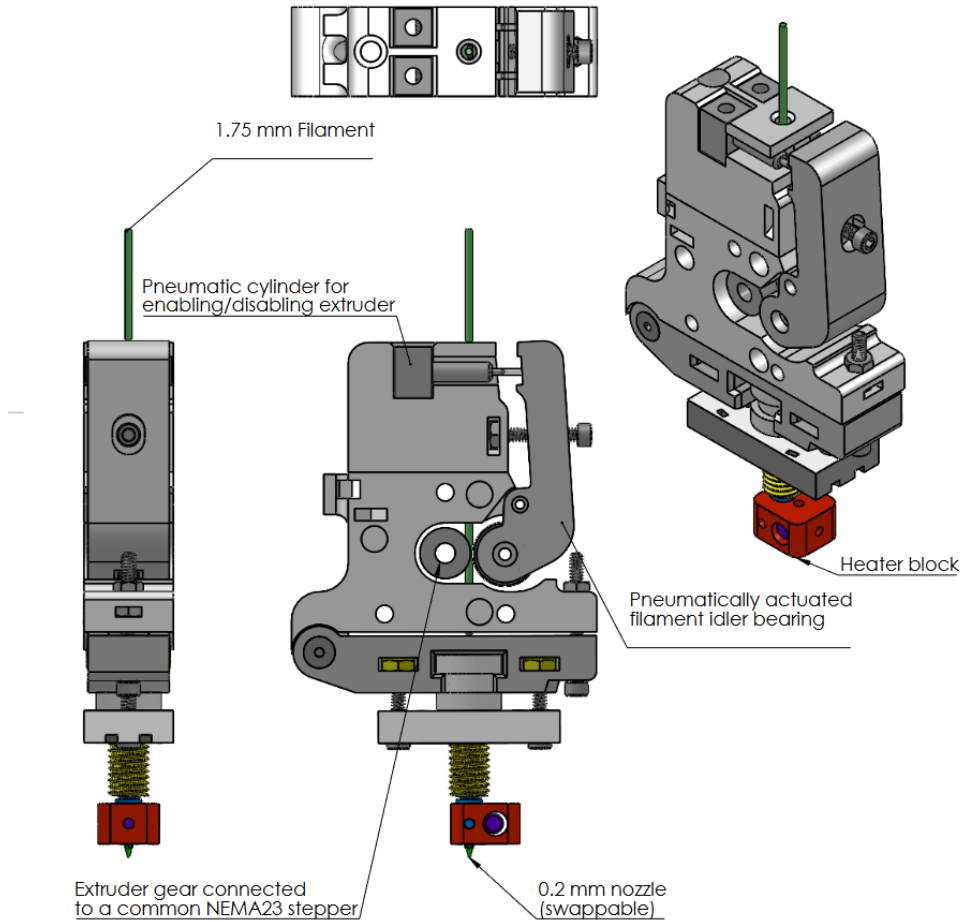
- Designs developed in SOLIDWORKS
 1. Custom MultiModality Bioprinter (CMMB)
 - Stackable FDM Module
 2. Custom Computer Vision Fixture
- These designs have been published as part of publications

1. Custom MultiModality Bioprinter (CMMB)



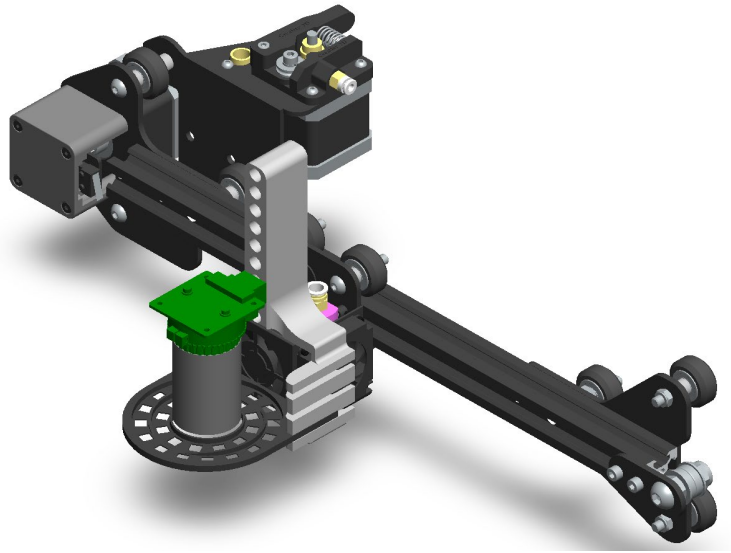
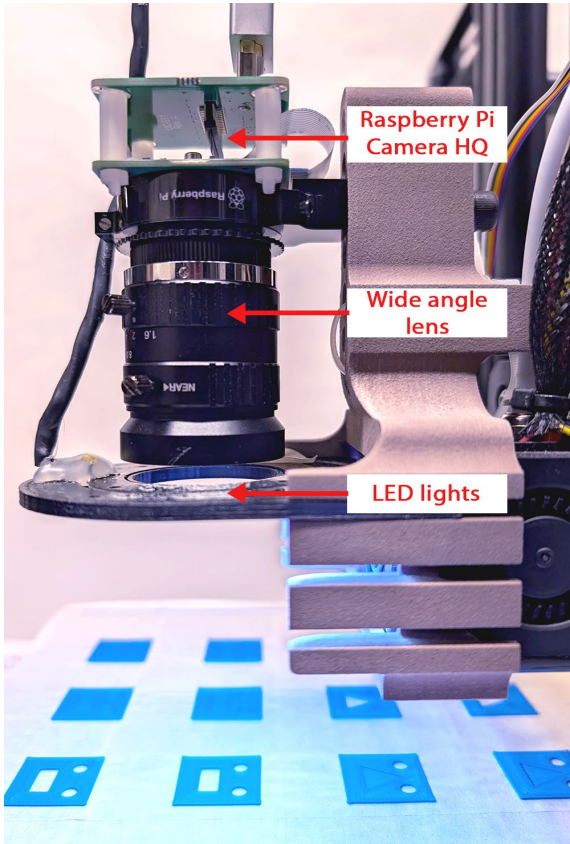
1. A custom multi modality bioprinter was developed as a part of Masters and PhD research which consisted of multiple additive processes:
 - i. Upto 4 FDM modules
 - ii. Upto 4 viscous extrusion modules
 - iii. 1 Inkjet module
2. Stackable FDM modules are powered by a single NEMA 23 motor for synchronized operation.
3. Research published in journals and conferences:
 1. **T. Saini**, P. Shiakolas, and K. Dhal, **In-Situ Fabrication of Electro-Mechanical Structures Using Multi-Material and Multi-Process Additive Manufacturing** in Contributed Papers from MS&T18, 2018. DOI: 10.7449/2018/MST_2018_49_55.
 2. P. Patel, **T. Saini**, T. Welch, P. Ravi, and P. Shiakolas, **Additive Manufacturing of Heterogeneous Bio-Resorbable Constructs for Soft Tissue Applications** in Contributed Papers from MS&T18, 2018. DOI: 10.7449/2018/MST_2018_1496_1503.
 3. **T. Saini**, **Additive Manufacturing Methodologies for Multi Process and Multi Material Scenarios**, The University of Texas at Arlington, 2015 <http://hdl.handle.net/10106/27128>
 4. P. Ravi, P. S. Shiakolas, T. Welch, **T. Saini**, K. Guleserian, and A. K. Batra, **On the Capabilities of a Multi-Modality 3D Bioprinter for Customized Biomedical Devices** in Volume 2A: Advanced Manufacturing, Houston, Texas, USA: American Society of Mechanical Engineers, Nov. 2015. DOI: 10.1115/IMECE2015-52204.

CMMB - Stackable FDM Module



1. Stackable, modular units utilize a single NEMA 23 motor to drive the entire assembly.
2. Custom G-code toggles control valves, using pneumatic pressure to engage or disengage specific modules.

2. Custom Computer Vision Fixture

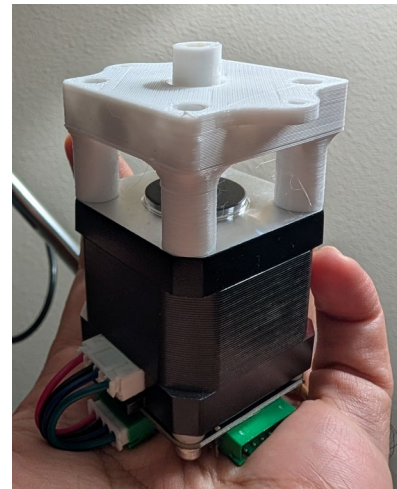
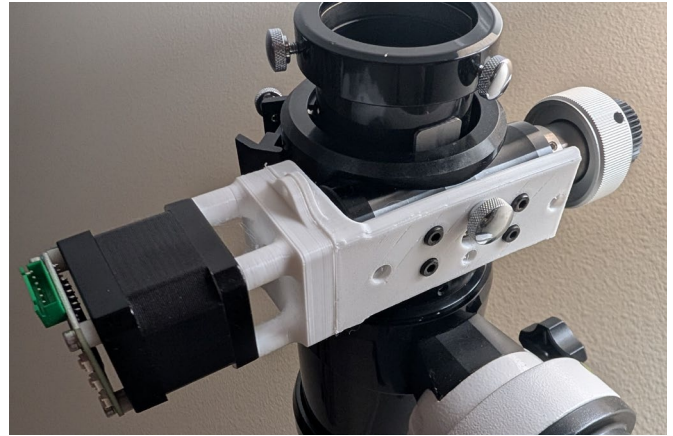
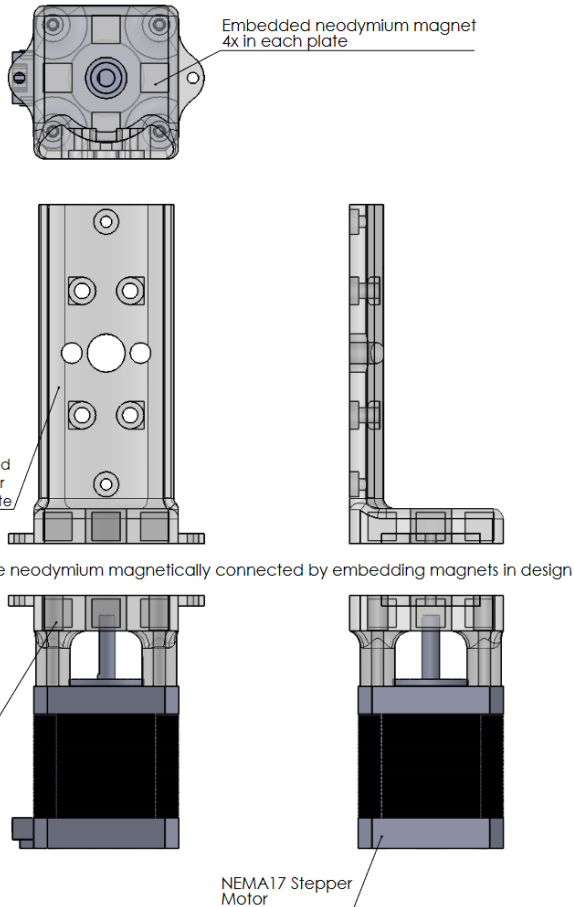


1. A custom modular SOLIDWORKS-designed fixture enables in-situ defect detection of the final printed layer without interfering with the extruder.
2. A Raspberry Pi running custom Python scripts controls a wide-angle camera to capture and analyze layer-by-layer imagery
3. Research published in journals and conferences:
 1. T. Saini, P. Shiakolas. **In Situ Active Contour-Based Segmentation and Dimensional Analysis of Part Features in Additive Manufacturing**. *J. Manuf. Mater. Process.* 2025, 9, 102. DOI: 10.3390/jmmp9030102
 2. T. Saini, P. Shiakolas, and C. McMurrough. 2024. **Evaluation of Image Segmentation Methods for In Situ Quality Assessment in Additive Manufacturing** *Metrology*, 4: 598-618. DOI: 10.3390/metrology4040037
 3. T. Saini and P. S. Shiakolas, **A Framework for In-Situ Vision Based Detection of Part Features and its Single Layer Verification for Additive Manufacturing** in ASME International Mechanical Engineering Congress and Exposition, Volume 3: Advanced Manufacturing. Oct. 2023. DOI: 10.1115/IMECE2023-113763

Mechanical designs supporting hobbies and co-curricular activities

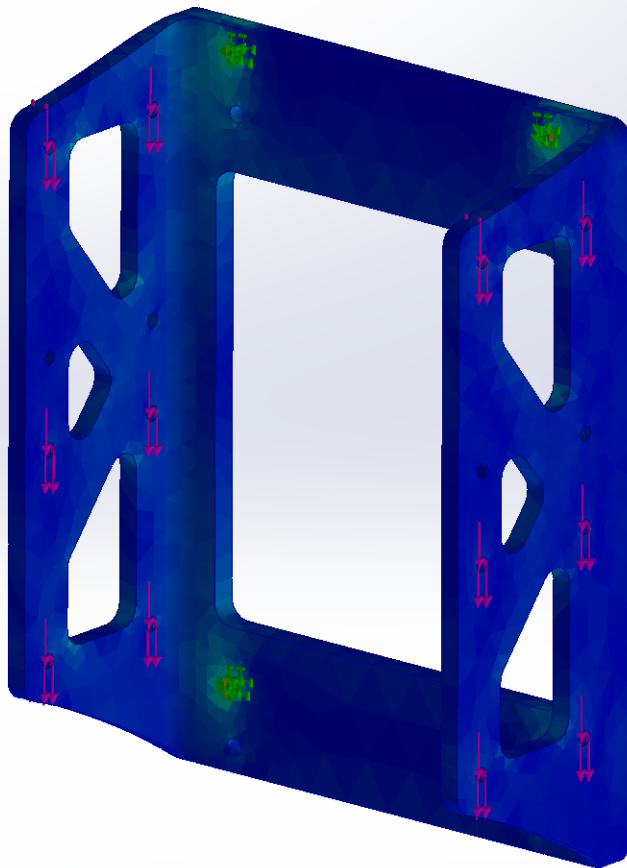
- These designs are made as part of setting up my home-lab or for astrophotography needs
 1. DIY electronic focuser conversion for telescope
 2. Custom HDD mounts for homelab
 3. Custom DIY dual KVM system for home-lab (WIP)

1. DIY electronic focuser conversion for telescope



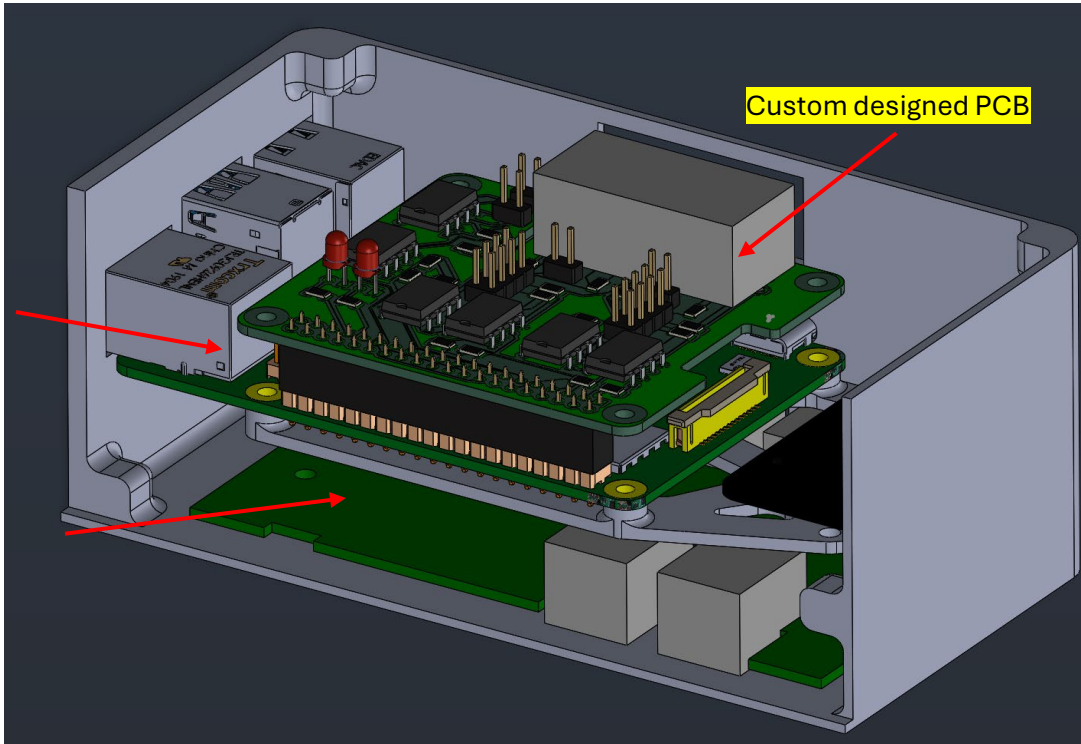
1. An Electronic Automatic Focuser (EAF) is used to automate the process without manual intervention. Manual focuser is converted using this DIY mod.
2. A DIY version is designed in SOLIDWORKS and 3D printed using PETG.
 1. Two-part design which allows quick connect/disconnect in dark skies. Uses neodymium magnets.
 2. Iterative design using SOLIDWORKS Simulation to identify stress magnitude and location. Designed for a FoS = 4
 3. Uses custom firmware (written in C++) and Python backend to control the motor
3. Similar professional EAF kit costs upwards of \$300 (vs \$30 for the DIY solution).

2. Custom HDD mounts for home-lab



1. Designed and printed a custom PETG tray in SOLIDWORKS that repurposes 120mm fan mounts into dual 3.5" HDD bays, bypassing the physical mounting limitations of a mATX case
2. Design is validated using SOLIDWORKS Simulation to minimize strain and ensure a factor of safety (FoS) > 3 , providing a solution unavailable in the commercial market

3. Custom DIY dual KVM system for home-lab (WIP)



- 1. Designed a custom KVM system that allows controlling multiple systems.
- 2. Includes custom PCB hat to interface between PCs, KVM board and Raspberry Pi.
- 3. PCB designed in KiCAD and all components hand soldered. The enclosure is currently being designed in Solidworks.

