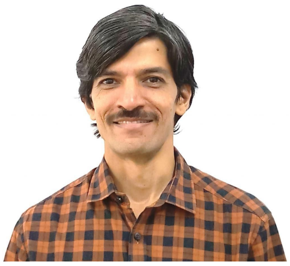
Executive Summary



Prasanna Subhash Gandhi
Professor, Department of Mechanical Engineering, IIT Bombay

1. Title of the Project: Productization and field trials of ***Spanda1***: India's first 3D SLA microprinter based on resonant displacement amplification of compliant mechanisms

2. Date of Start of the Project:_1st Oct 2022______________

3. Aims and Objectives:

- Development of resins for high-speed laser scanning to produce high-resolution parts with desired mechanical properties
- Layer detachment and tank levelling system refinement.
- Making the product ready for field trials with GUI and embedded development.
- Carry out field trials with 3D printing service providers.
- User feedback-based modifications.

4. Significant achievements (not more than 500 words to include a List of patents, publications, prototypes, deployment, etc)

- **Embedded hardware and software development along with GUI**: This is major step towards productization to replace DAQ system with embedded hardware for job loading and print monitoring, along with crucial safety features. The embedded hardware design and development has been completed. Embedded software is currently under development. The first version of the embedded board has been assembled, and preliminary testing has been successfully conducted. This board will be integrated into ***Spanda1*** and subjected to further testing for potential future modifications. The fig.1 below is the assembled embedded board.

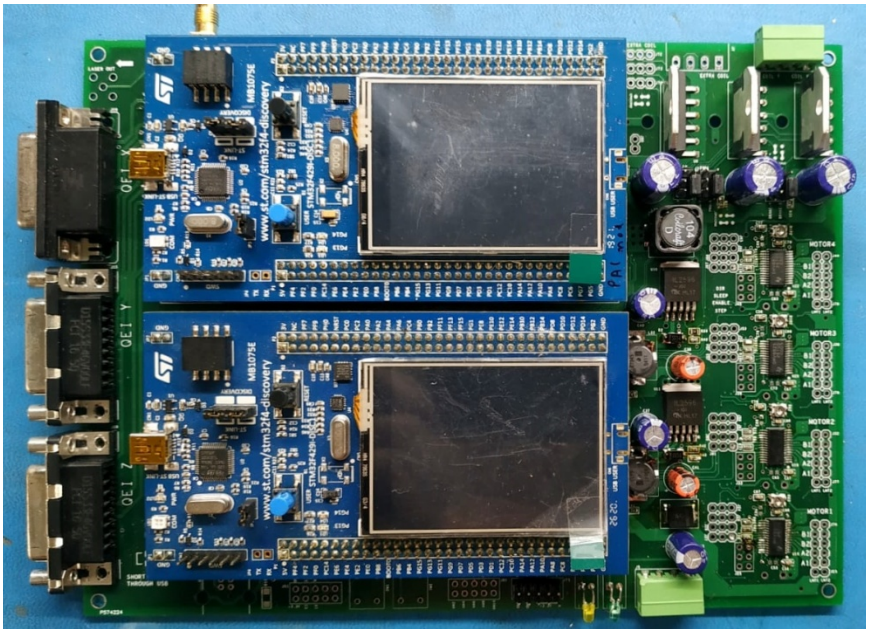


Fig.1 Embedded Board

- **Development of industry-grade resins for printing**: Few resins have been created to cater to the needs of high-speed, high-power 406 nm wavelength lasers. In addition, we have identified a number of commercial resins that align with our required specifications. These resins can be adjusted or customized to achieve the desired output.
- **Preliminary Testing of *Spanda1*:** The preliminary fabrication of micro-components in various sizes and shapes using Spanda1 has been carried out. This testing was conducted utilizing DAQ system of dSPACE. Subsequent testing involving printing with embedded hardware and software is scheduled for the upcoming months. The newly developed micro 3D printer exhibits the capability to produce large-volume components measuring 75 mm x 75 mm x 75 mm. The components printed so far are of single layer with a thickness of 300 microns. Currently optimizing the separation of layers from the VAT surface for printing multi-layer components using the Z-axis motion stage is ongoing. Hence the printing of larger-sized multilayered components is not done. The issues and complexities associated with separating single-layered components and planarity alignment are being addressed. While the positioning accuracy of the stages demonstrates precision within **2 µm**, the accuracy of the printed components is currently affected by delays in laser switching after detecting the switch point. Delays would get removed when embedded hardware is used for printing.

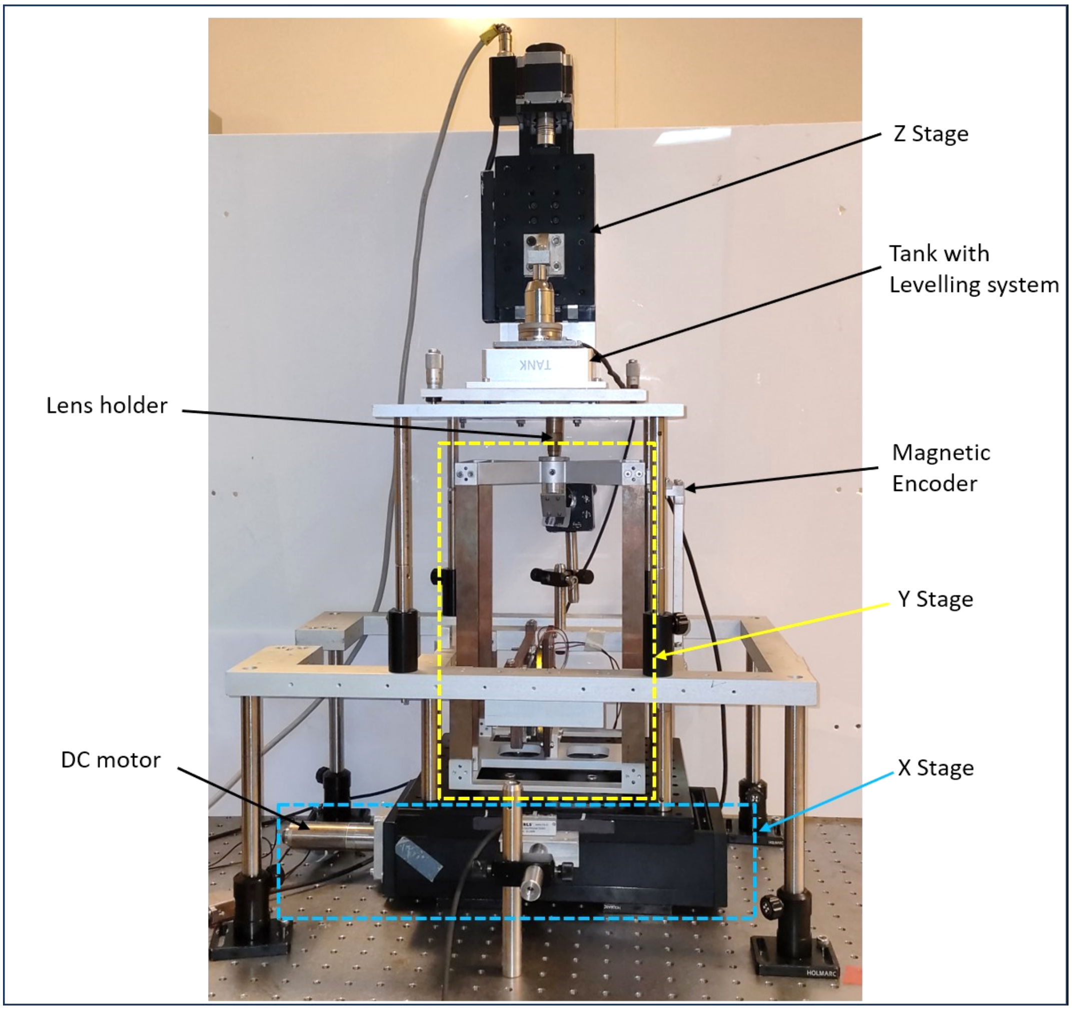


Fig 2. Spanda1 Experimental Setup

Figure 2 shows the experimental setup of Spanda1. In Figure, all X, Y, and Z stages have been shown clearly along with the tank, leveling system, encoder arrangements, and actuators.

- **Compact Desktop version 2nd Prototype**: The development of the second prototype is currently in progress. Figure 3 illustrates the initial design of this prototype. All essential components, including the laser, VAT, scanning stage, electronics, power supply, and embedded electronics, have been integrated into a single unit. Notably, the arrangement of the Y scanning stage has been revised to enhance compactness and robustness. The laser, mirror, and acousto-optic modulator (AOM) have been seamlessly integrated beneath the scanning stage compartment. For this prototype, we have adopted an innovative compliant-based design for the laser alignment, enhancing both compactness and robustness. The design of the mirror holder for alignment will be a collaborative effort with our industrial partner, Flex Motion Technologies. The embedded electronics system for this second prototype will remain the same as that used in the first prototype.

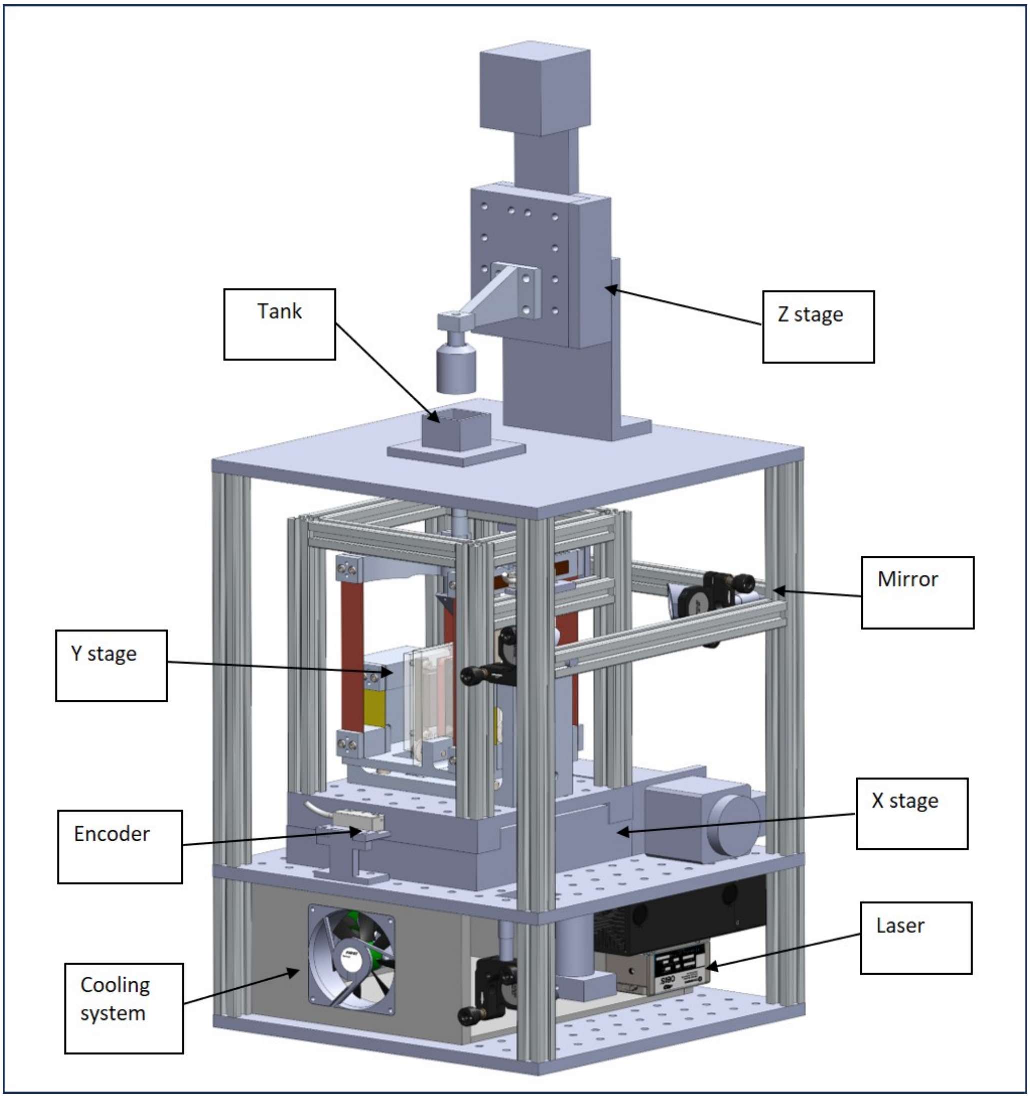


Fig 3. CAD design of the desktop prototype.

List of Publication:

1."Design and Analysis of Ultra-Precise Large Range Linear Motion Platforms Using Compliant Mechanism" Tanksale Abhijit and Gandhi Prasanna, IEEE Access, Volume 10, Page 94321 -94336 , Year-2022

5. Concluding remarks

Overall we are progressing towards productization of Spanda1 and we are hoping to resolve challenges along way soon. We are targeting demonstrations of product at multiple exhibitions in the upcoming year.