

Real-Time Thermal Image Topological-Data Analysis for Quality Control and Defect Detection in Laser Powder Bed Fusion Additive Manufacturing

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Introduction

Laser Powder Bed Fusion Additive Manufacturing (LPBFAM) is a versatile manufacturing technique that can accommodate a wide variety of design needs. Thermal image Topological-Data analysis would allow the detection of irregular topological features such as insufficient melting thermal gradients and unusual melt pool dynamics (spatter, balling).

Method

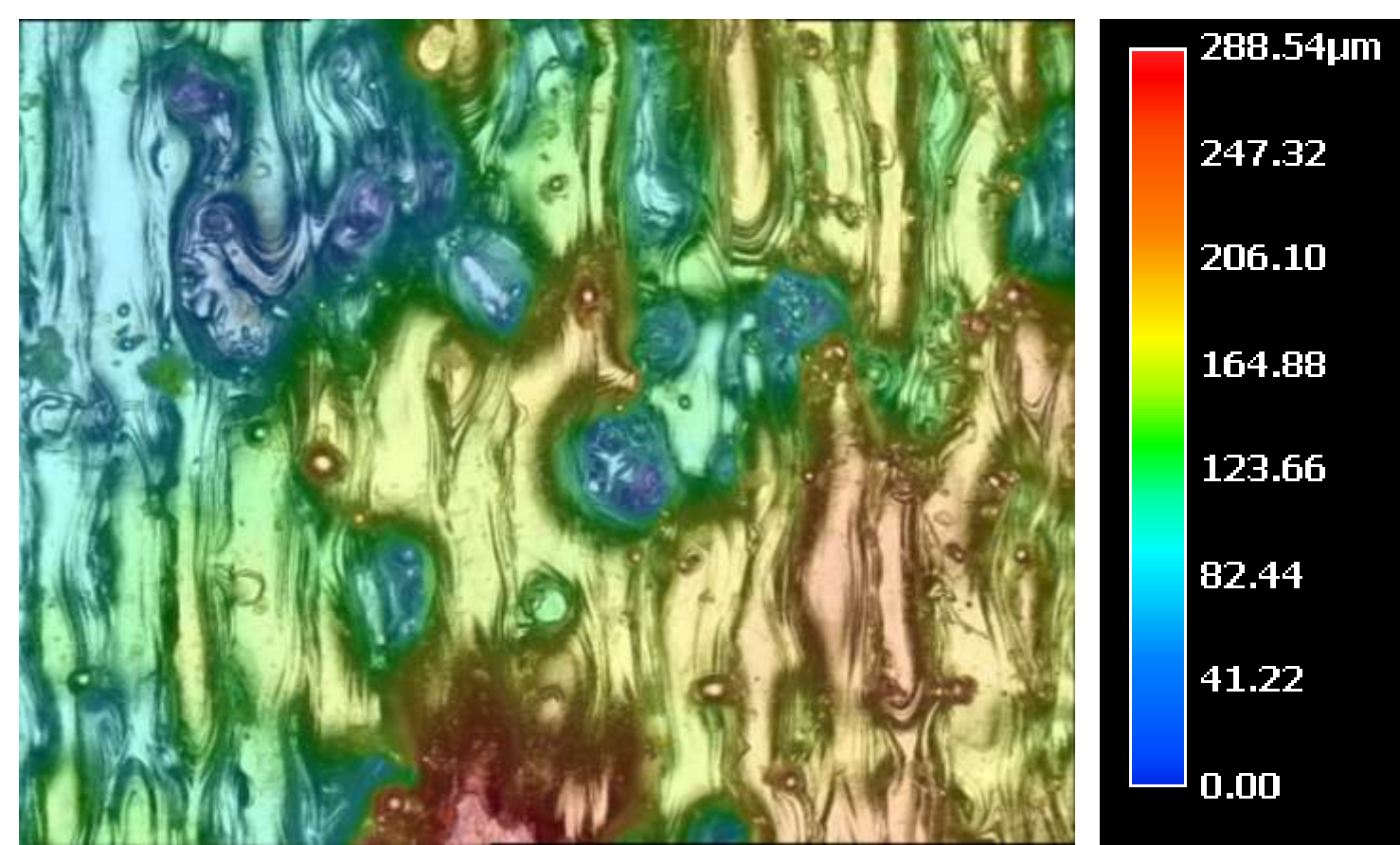


Fig 1. Surface roughness of a printed part. Thermal imaging is a method to monitor printing.

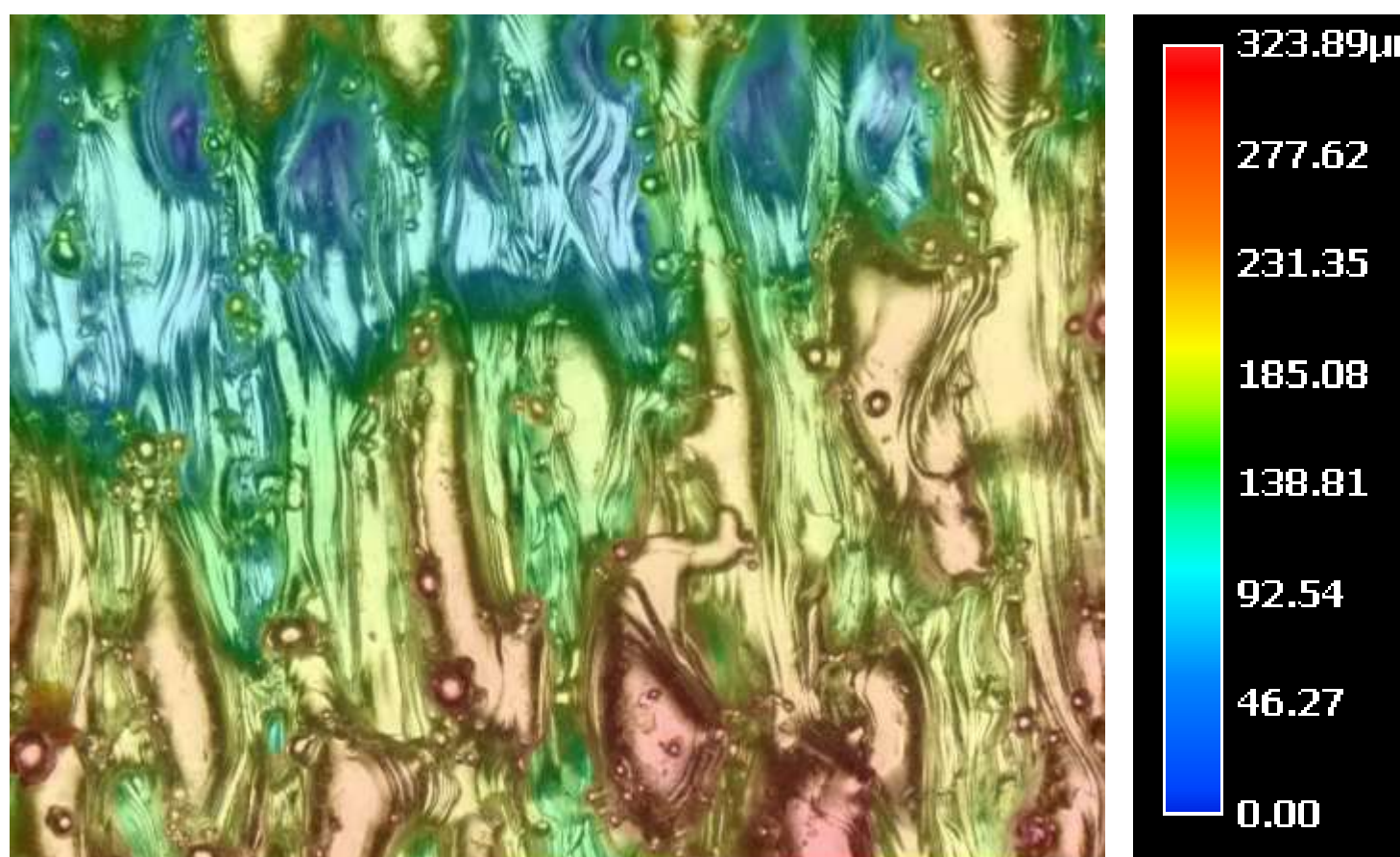


Fig 2. Another location of print

- Reducing the surface roughness is a goal of this project.
- Design and produce a custom cover to mount to a Aconity MIDI printer featuring a Optris Xi 400 thermal camera. Cover cannot allow any light from welding laser to exit.
- LabVIEW: Collect temperature data and thermal image data from thermal camera to generate topological space from pixel intensity.

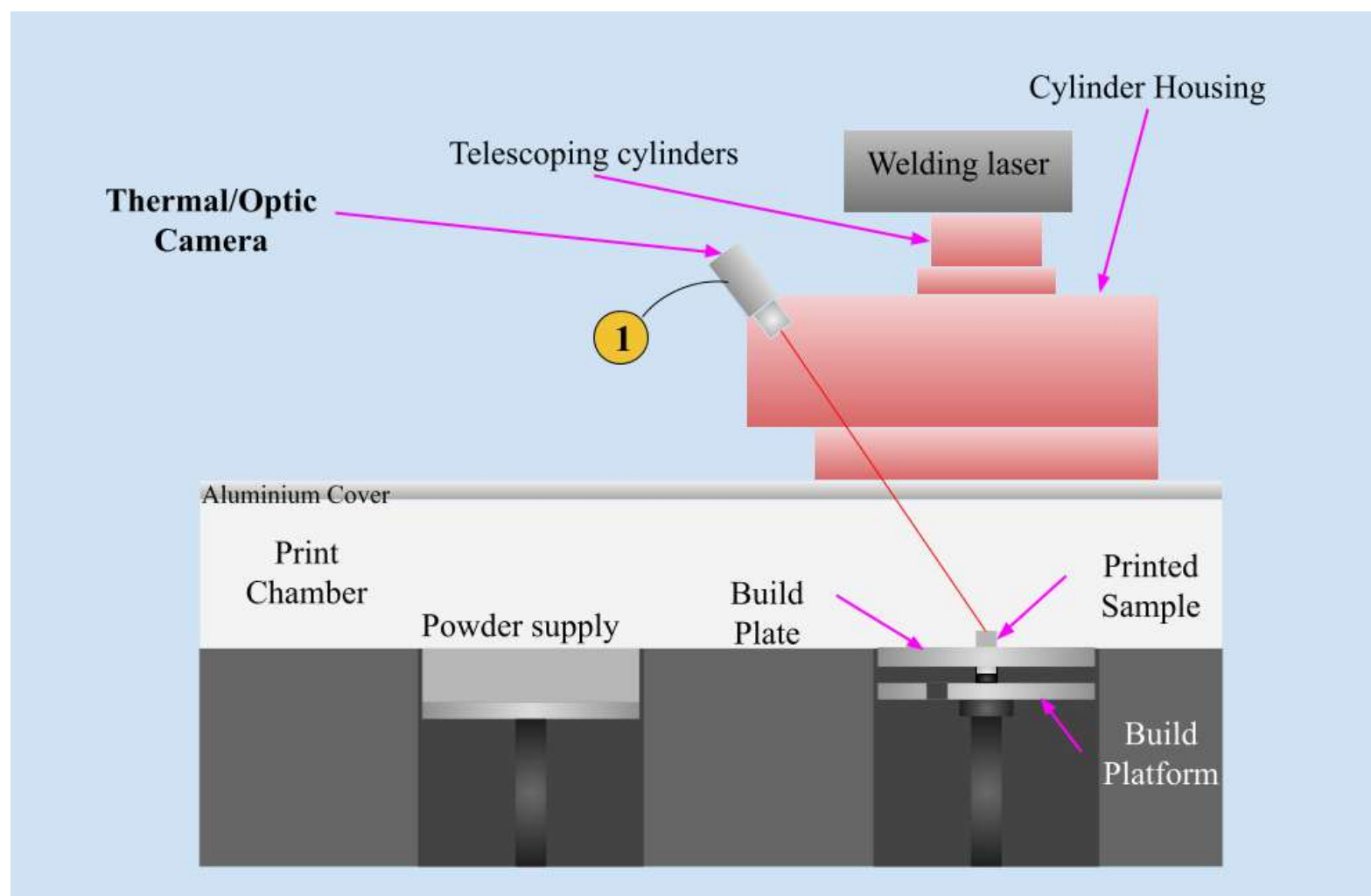


Fig 3. Hardware implementation for Aconity MIDI printer. Cable 1 is connected to a nearby computer.

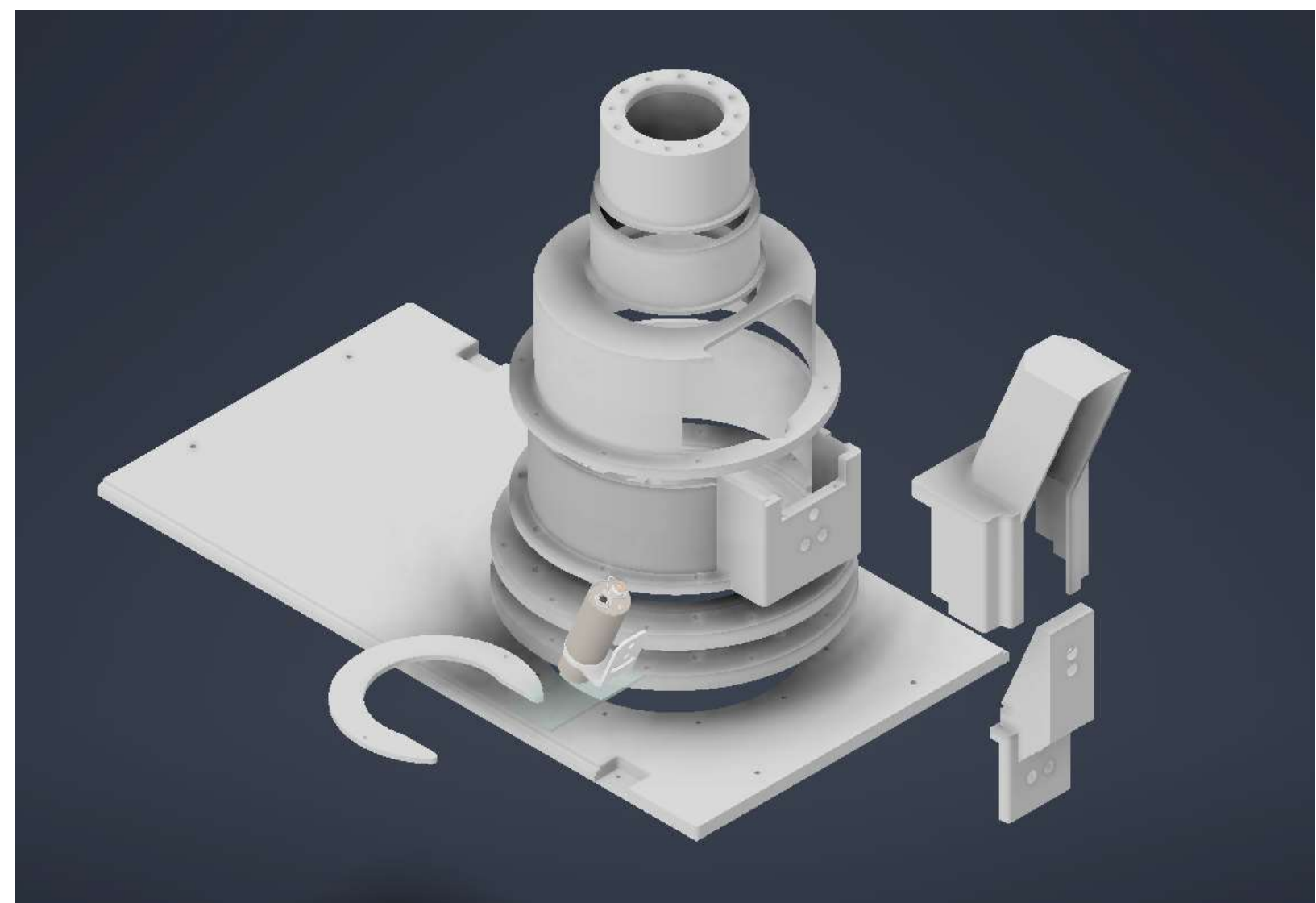


Fig 4. Exploded view of 3D model of hardware implementation

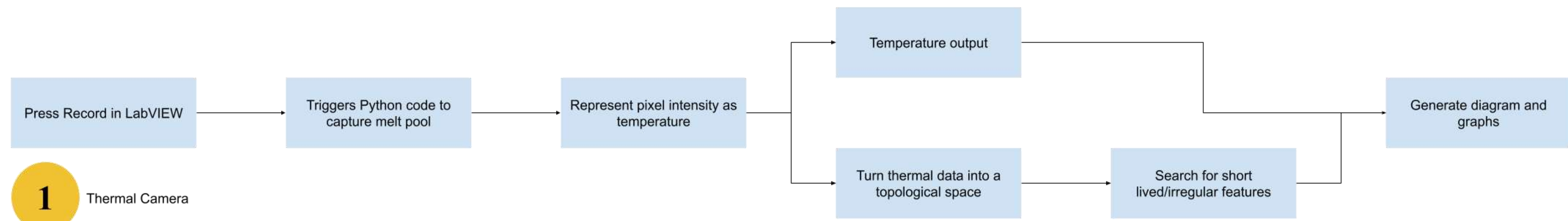


Fig 5. producing a thermal graph and diagram. Software implementation for data collection and

Progress

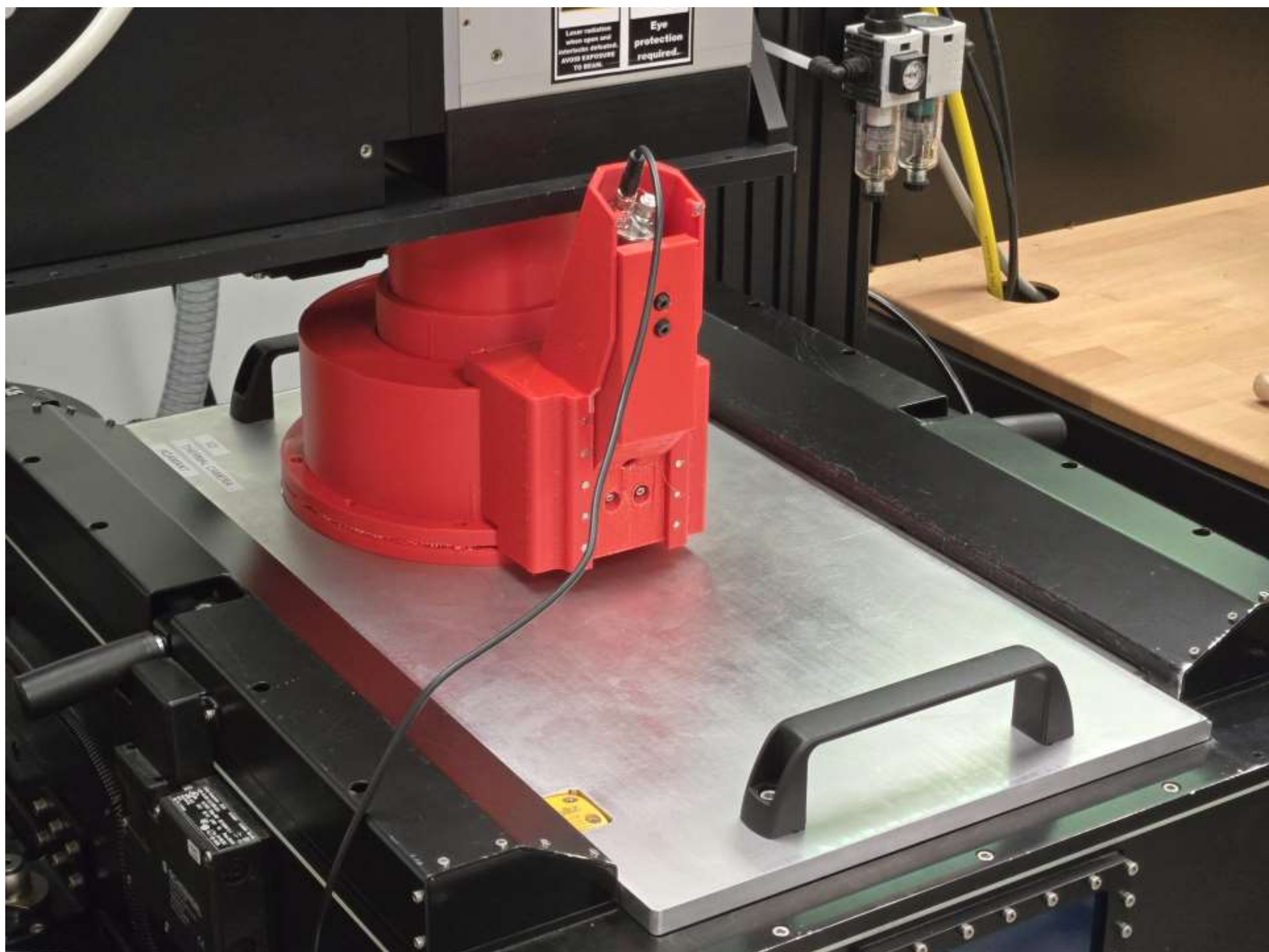


Fig 6. Hardware implementation for Aconity MIDI printer featuring the Optris Xi 400 thermal camera

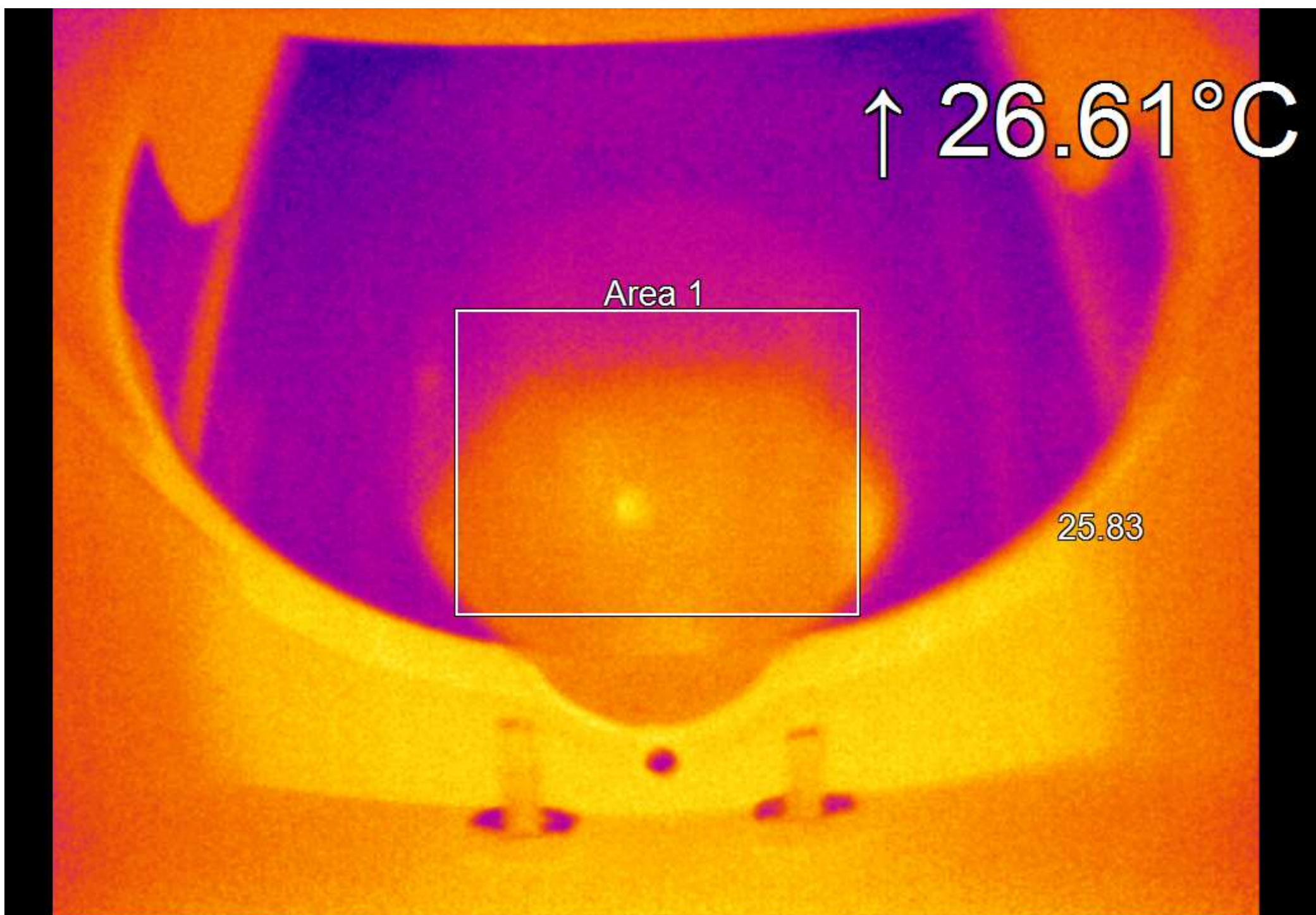


Fig 7. Test run of hardware implementation. White dot in the middle is the weld

- Hardware implementation has been designed and manufactured (Fig. 6) and fits in the Aconity MIDI printer. Additionally, we have done a test print to collect some data. (Fig.7). There is a problem, the camera is either too far away or out of focus leading to poor image quality.
- Software development is ongoing, however there have been some difficulties with inputting the thermal data into LabVIEW.

Conclusion

- Progress has been made on both the hardware and software implementation of this project. The hardware aspect has been manufactured, and some basic data collection has been done (Fig. 5).
- The next steps would be to continue the development of the topological-data analysis. The data we have collected now is through the software provided by the manufacturer of the camera.

