Design of a Camera Housing with Integrated Lighting for In Situ Monitoring in Laser Powder Bed Fusion Additive Manufacturing

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Abstract

In manufacturing monitoring the process is an important practice to avoid potential failures and defects in the model. This project purpose was to design and build a housing to monitor a type of additive manufacturing called Laser Powder Bed Fusion in which metal is melted layer by layer with a laser and builds the object. I used Inventor, a computer aided design (CAD) software to design the housing and 3D printed out of polylactic acid or PLA. Then I attached an optical camera to the housing to view the printing bed using Spinnaker. This new design of the housing provides a better view of the print bed and allows future work to better optimize the printing process.

Introduction

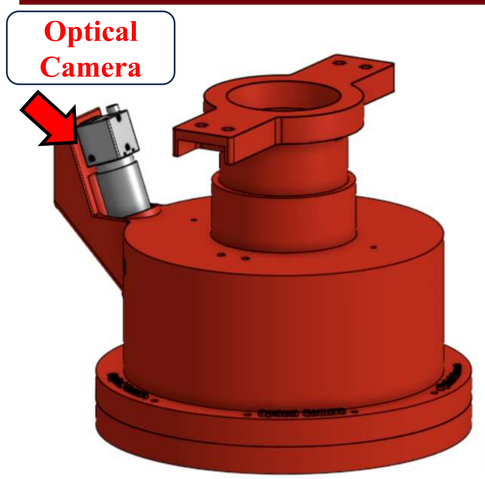
What is Laser Bed Powder Fusion?
Laser Bed Powder Fusion or LBPF is a type of additive manufacturing like 3D printing but instead of plastic being melted from a nozzle, a laser melts metal powder on a build plate and builds the model layer by layer. This type of manufacturing has many benefits compared to traditional CNC manufacturing such as the ability to make complex parts that traditional machines cannot do.

Why do we need to monitor it?

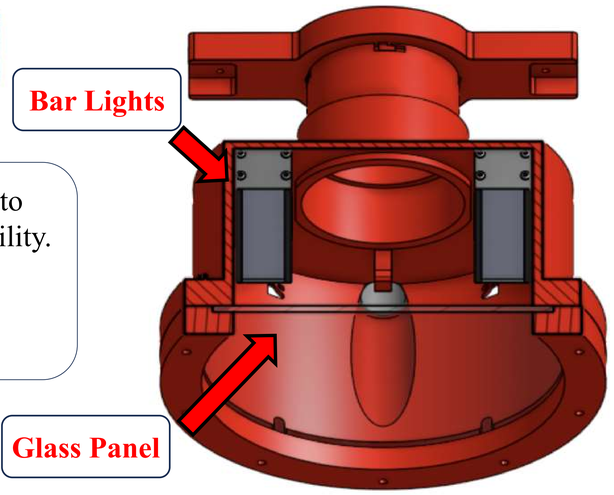
- The print might fail, and the model would be unusable
- Optimization

Monitoring it with optical, thermal, and event cameras can tell us why it failed and stop the print. My part was to design a housing for the optical camera to efficiently monitor the printing bed. Overall improving on the old design of the housing by integrating lights, requiring less parts to assemble, and making a simpler design.

Design and Development



- Used Inventor to design the housing
- Designed a custom housing for an optical camera to monitor the 3D printing bed.
- Reduced the number of parts needed, simplifying assembly
- Telescoping cylinders to turn off safety lock

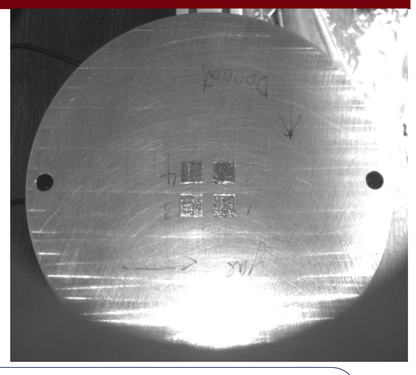


- Integrated bar lights directly into the housing for improved visibility.
- Circular glass panel to ensure visibility and to make design airtight

Before and After

← Before

After →

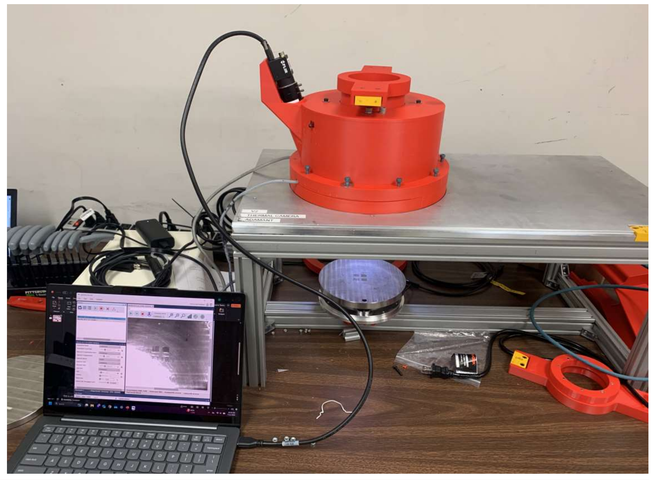


- Old view was positioned farther back, offering limited clarity of the build plate.
- Redesigned housing allows a closer, more direct view on the printing bed
- Although image is in gray scale, integrated lighting shines on the build plate
- Allows for faster process control because of the close-up view

Applications

Purpose of the optical Camera

- Real-time print failure detection: Enables early identification of layer shifts, re-coater issues, and powder spreading defects
- Improved print quality: Enhances visual monitoring, allowing for more consistent layer formation and process control
- Research and development: Useful in lab settings to study the relationship between visual changes and print outcomes



Conclusion and Future Work

The redesigning of the optical camera housing was a success. The new model effectively displayed the print bed clearly. Overall, this design allows higher quality footage of the printing process.

This design will be uploaded to GitHub for continued development with other monitoring equipment such as an event camera, thermal camera, and a laser vibrometer. Future work consists of paring the optical camera with these different instruments to better optimize the printing process.