



Ensuring Performance from 3D Printed Parts through Embedded Sensors

Opportunity

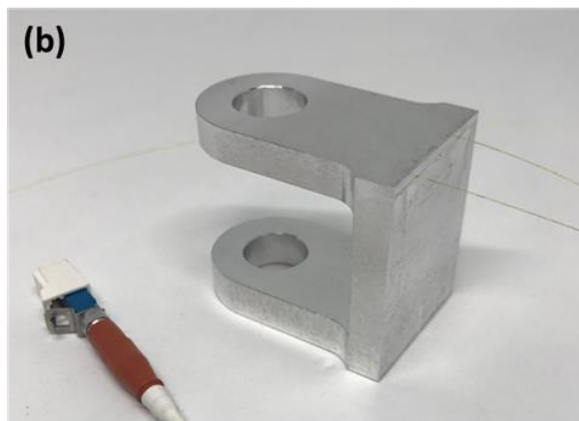
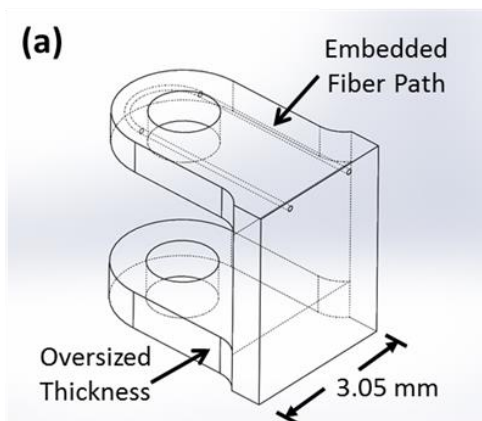
- 3D printing is revolutionizing development and manufacturing
- Critical components are being printed using composites, plastics, and metals
- A good method for characterizing builds and monitoring parts does not exist
- Embedded instrumentation enables smart parts once fabrication is complete

Solution

- Embed sensors into the component during printing
- Fiber optic sensors are only 155 μm OD and do not impact the component's inherent characteristics
- This provides new insight into part design that will enhance the robustness and durability of additively manufactured components
- In-service parts can be continuously or periodically monitored
- High-resolution view will identify defects before a catastrophic failure

Benefits

- Real time print evaluation reduces waste
- Ensures high quality parts
- Reduces development time and cost



Bracket with embedded HD-FOS: (a) model of bracket showing the embedded fiber (oversized for viewing); (b) final part.



Additive
Manufacturing



ODiSI



Temperature



Protection



Software

Hehr, A.; Norfolk, M.; Kominsky, D.; Boulanger, A.; Davis, M.; Boulware, P. Smart Build-Plate for Metal Additive Manufacturing Processes. Sensors 2020, 20, 360.

www.lunainc.com

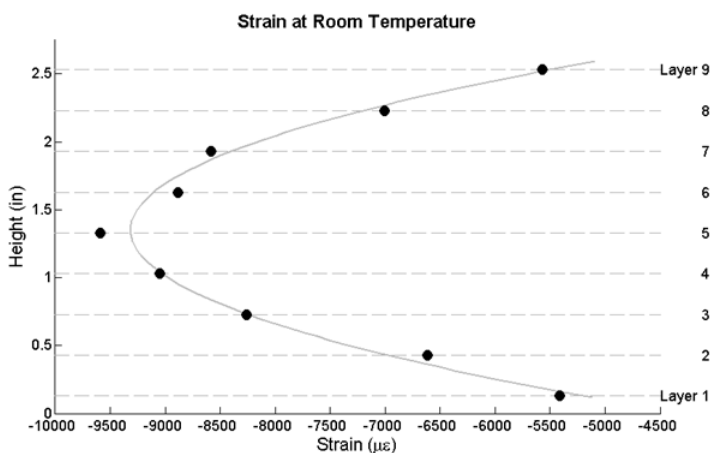
solutions@lunainc.com | 540.769.8400

Process

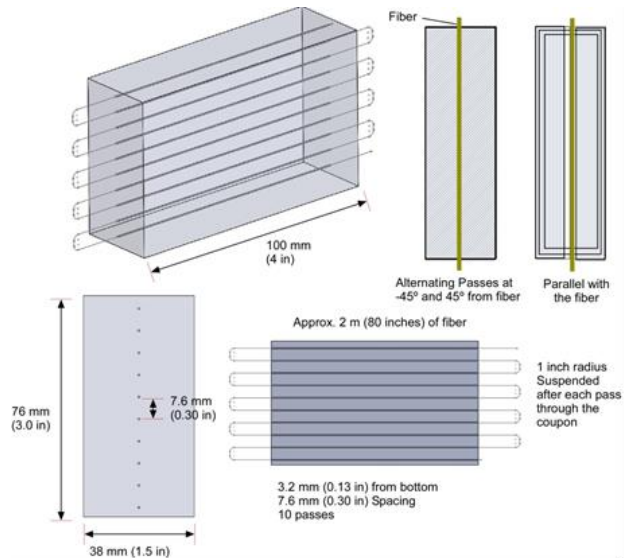
- Design the part and identify the places where instrumentation is desired
- Determine and design strain relief method
- Plastics and composites using fused deposition modeling (FDM): plan to pause the build between layers and place the sensor in locations
- Metals using Selective Laser Melting (SLM): design features to protect the fiber from direct laser exposure in between layers
- To determine build stress or monitor strain during printing, take data continuously during the process
- For residual stress measurements, monitor the part during cooling
- In-service the part can be periodically checked for fatigue

Results

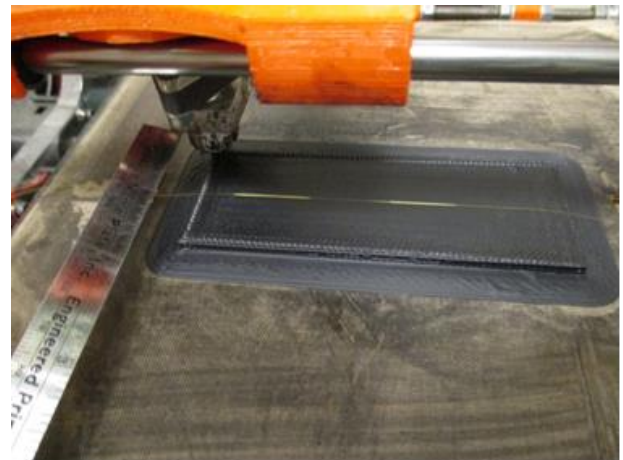
- A smart part capable of providing valuable information regarding its state
- Quantitative evaluation of the printed parts quality



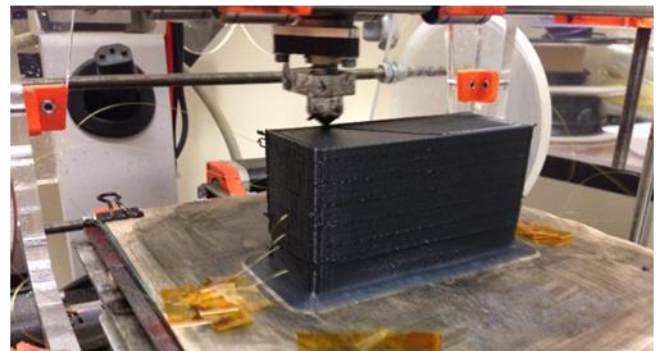
Residual strain profile of a completed part



CAD model of the part used to plan the fiber path and prepare the printer with the appropriate settings



At the pre-defined layers, pause the print process and install the fiber



The fiber is embedded at multiple layers giving a full profile of the part as it cools



Additive
Manufacturing



ODISI



Temperature



Protection



Software