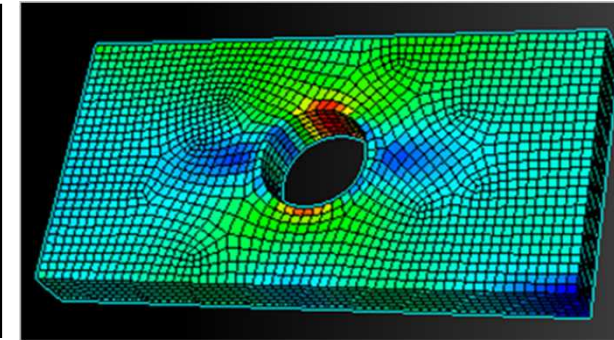
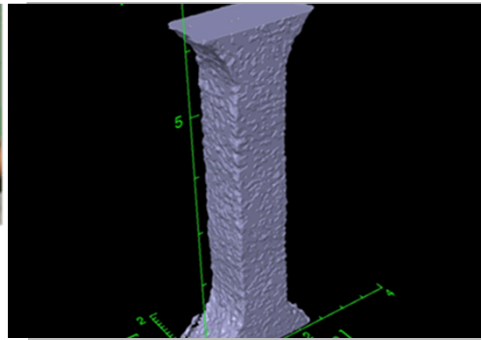


Exceptional service in the national interest



Summer Internship Presentation

Ashley Saltzman, 1554

November 15th, 2016

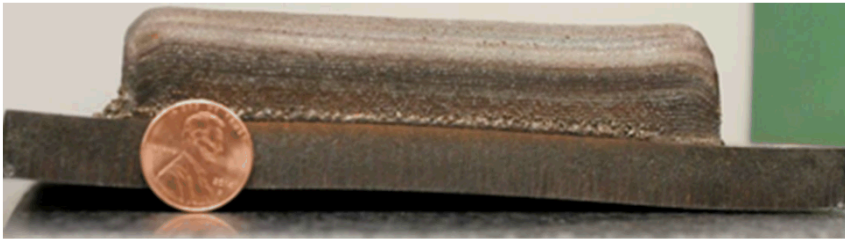
Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.



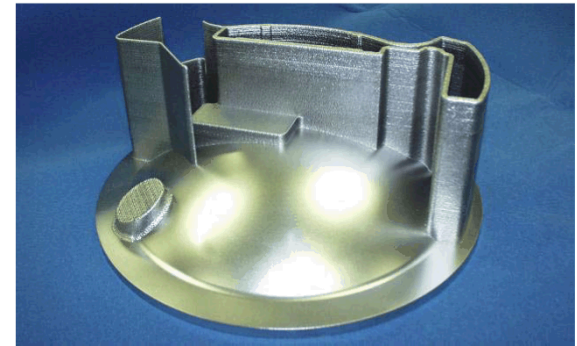
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Geometric Uncertainty

- Overall goal: Investigate the effects of geometric uncertainty in parts built through additive manufacturing



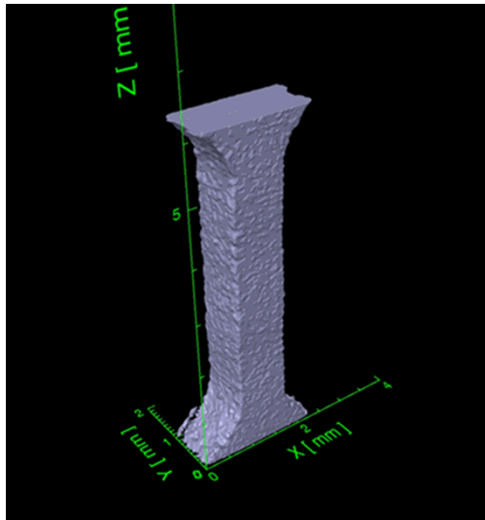
Metal plate warped due to residual stresses from 3D printing process



3D Print on top of conventionally machined dome

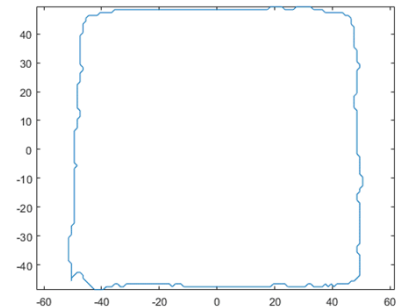
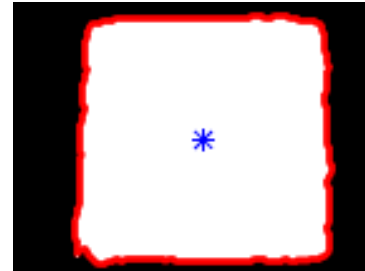
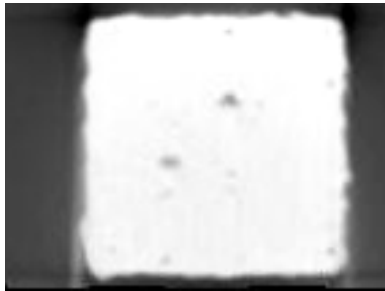
Example Used for Project

- 100 parts were made using selective laser melting
 - A laser beam melts metal powder into a desired shape, layer by layer
- Each part has slight variations in its outside geometry



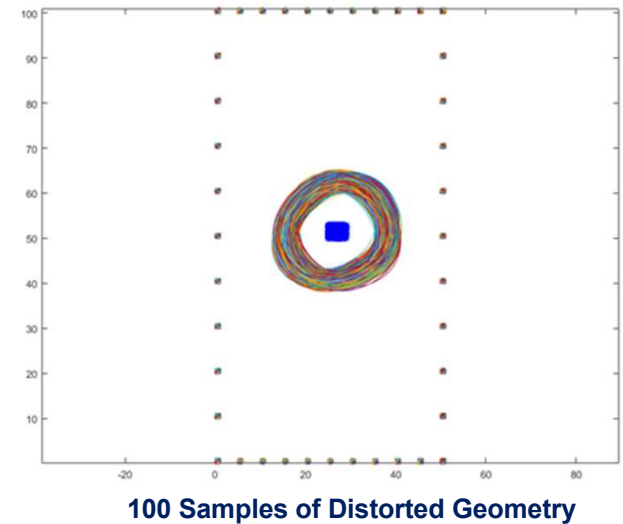
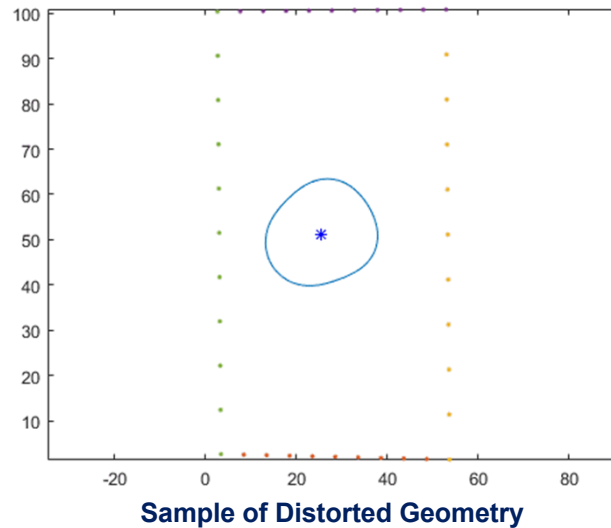
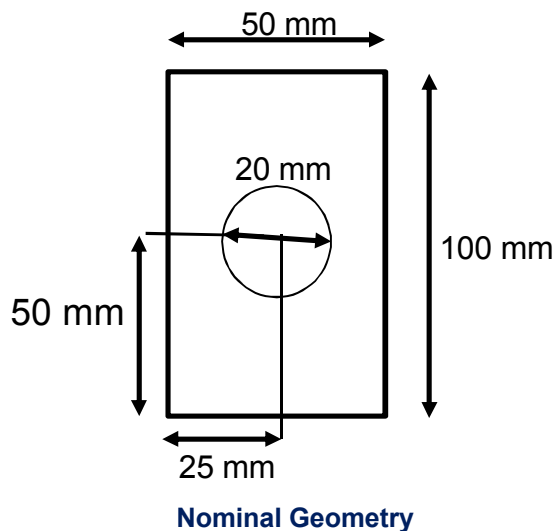
Characterizing the Uncertainty

- Take each frame from the CT scan of the part
- Segment the image using Matlab digital image processing
 - Convert grayscale to binary image
 - Remove small regions and fill in holes
 - Trace geometry of region boundaries



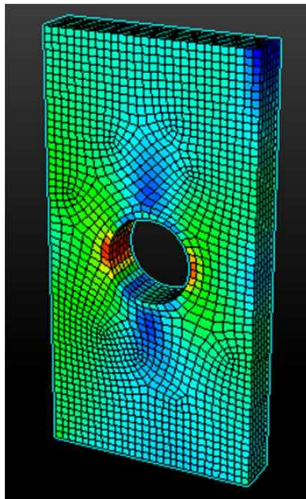
Modeling the Uncertainty

- Use 2D shape of hole in plate which can be modified with idealized variability
- Can use this model to quantify uncertainty, and then relate it back to the additive manufacturing example

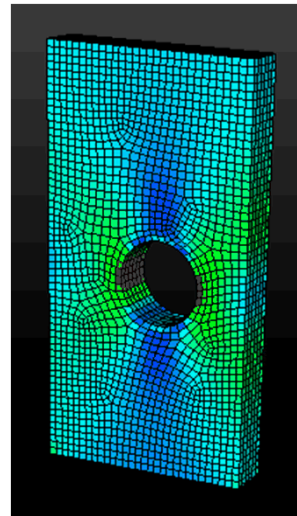


Impact of Uncertainty on Maximum Stress

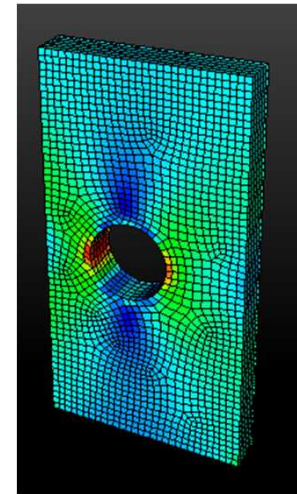
- Plate loaded in compression and run in Abaqus



Nominal Geometry



Distorted Geometry 1



Distorted Geometry 2

Geometry	Maximum Von Mises Stress (MPa)
Nominal	2.90
1	3.37
2	3.20