FMRI RET 2016-Industrial 3D Printing Alternative

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Abstract

Selective laser sintering (SLS) is an industrial 3D printing technology which uses a high power laser to fuse powder to make a solid 3D object. However, in our alternative approach, a modified projector is used instead of a laser. This alternative method allows an entire layer to be created simultaneously rather than by scanning the surface with a small spot produced by a laser. In order to make high quality parts, the powder must be evenly preheated before being fused together. In addition, the high intensity image must have a uniform intensity.

Background

Additive manufacturing (AM), most commonly known as 3D printing, has become a technology used across various disciplines for different applications.[1,2] One AM technology, called Selective Laser Sintering (SLS), uses expensive lasers to produce solid 3D structures by tracing the laser beam over a preheated layer of powder to fuse it together (Fig. 1). Our approach utilizes a high power projection system, this can be a cheaper alternative to a laser and provide additional benefits. It is critical for the projected image to be uniform (evenly white over entire image). To measure the level of nonuniformity, multiple points of a projected white image are measured to apply a correction. To minimize warping, the powder must be evenly preheated. The temperature of the heat source was measured with a thermal camera.

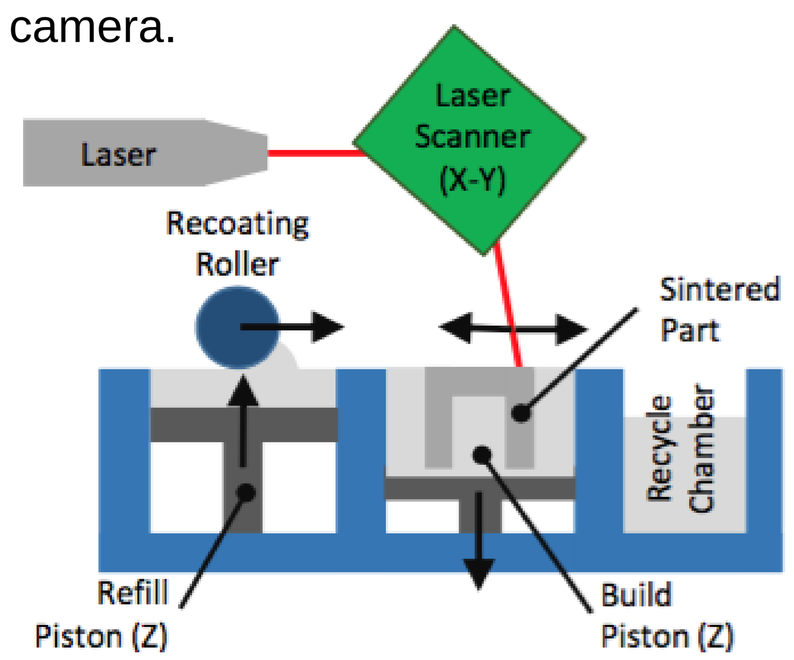

Fig. 1: Process of sintering with SLS system.[3]

Objectives

- Understand how the projector's optic power is distributed across a projected screen.
- Determine how heat is distributed across the surface of heating sources.

Approach

Projector Light Intensity:

•Fixed photodiode to CNC machine
•Connected photodiode to oscilloscope
•Focus projector image from Optoma X316 onto photodiode
•Program CNC machine to move photodiode to 100 points across exposure screen and measure intensity
•Saved measured voltages of each position from oscilloscope

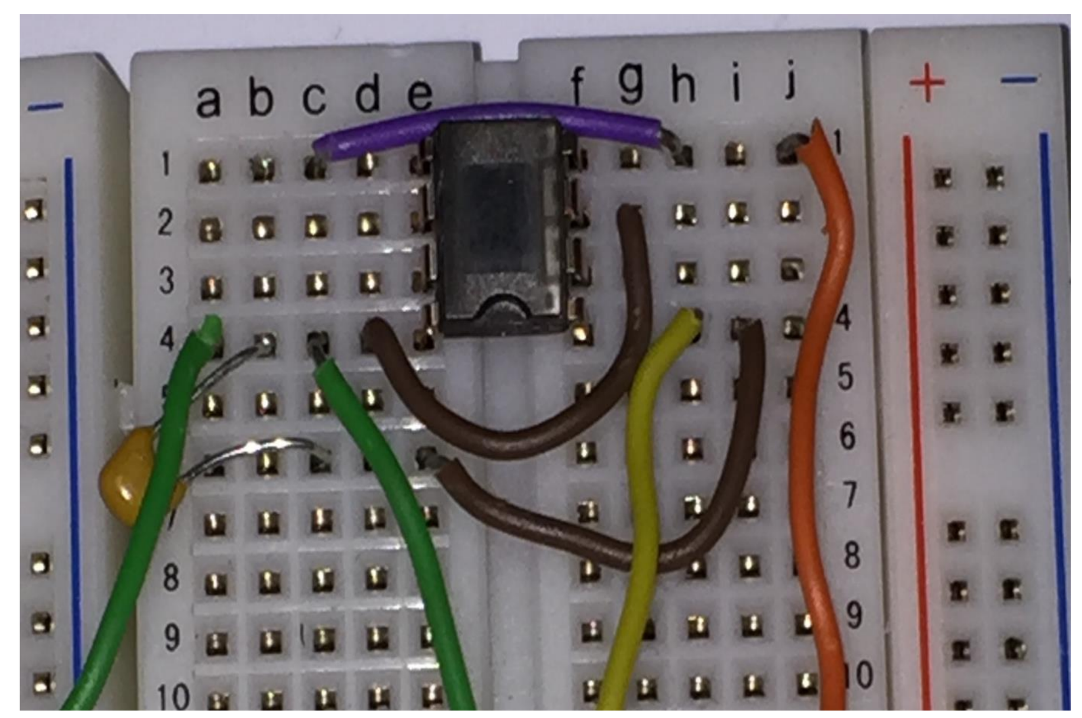

Fig. 2: Photodiode mounted on breadboard

Heat Source Distribution:

•Focus FLIR Thermal Camera on heating surface
•Used variac to control the power of the heating source
•Captured and analyzed images from ThermaCAM Researcher Pro 2.1

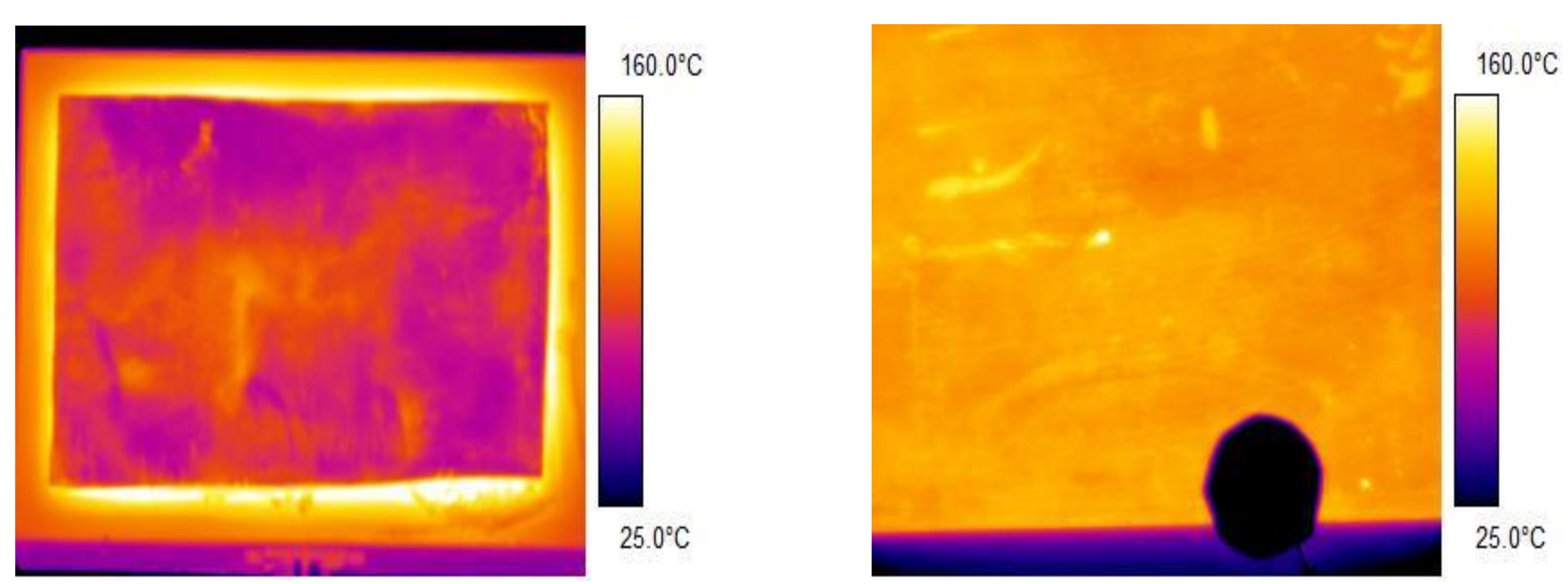

Fig. 3: (left) Thermal image of heat distribution on aluminum sheet affixed with thermal grease to a hot plate. (right) Thermal camera picture of heated platform.

Conclusions

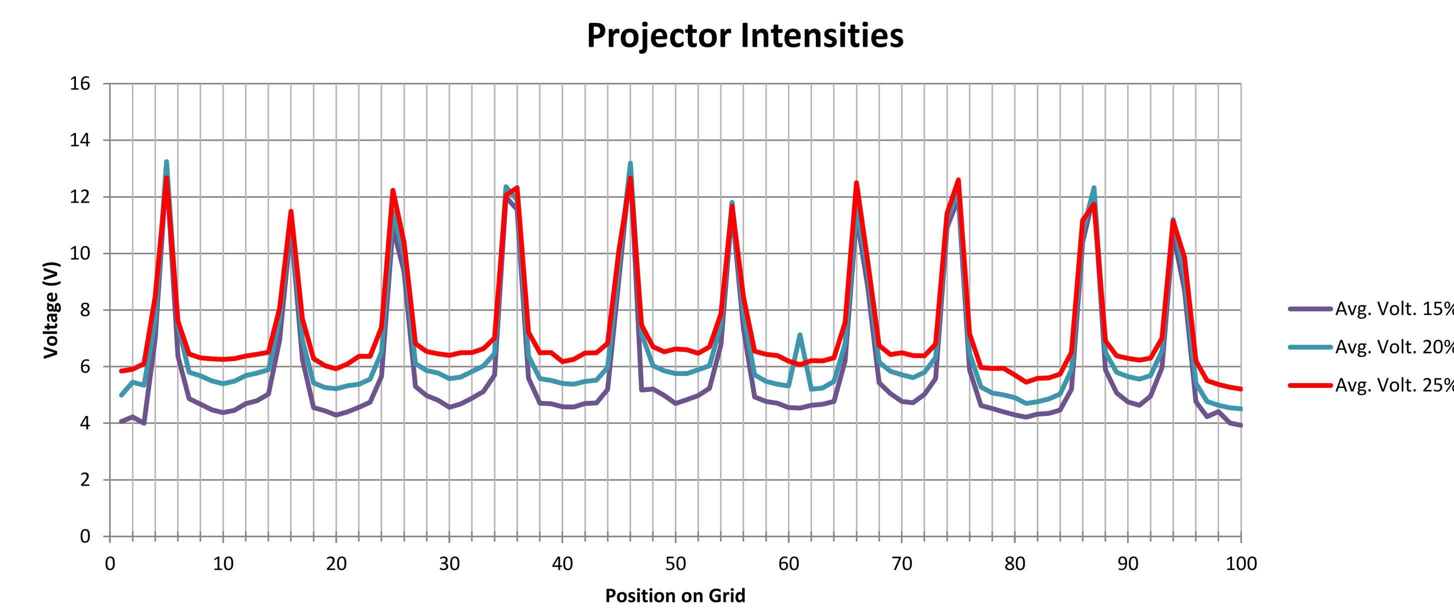

Fig. 4: Power measured by oscilloscope at transparency of 15%, 20%, and 25%. The first position measured started at the top left of the exposure screen.

As the photodiode moved toward the center of the exposure screen, the amount of power produced by the projector increased across all transparencies tested. The data obtained can be used to adjust the power from the projector. Between the two heating sources tested, the heated platform showed the most uniform distribution of heat. Although the data gathered has given incite to the variables of projector sintering, more data on the distribution of light intensity from the projector should be evaluated without other light sources present. Also, other heat sources should be investigated to show complete uniformity across the whole surface.

Referenced Resources

1. Kinstlinger, I. S., Bastian, A., Paulsen, S. J., Hwang, D. H.,Ta, A. H., Yalacki, D. R., & ... Miller, J. S. (2016). Open-source selective laser sintering (OpenSLS) of nylon and biocompatible polycaprolactone. *Plos ONE* 11(2), 1-25.doi:10.1371/journal.pone.0147399
2. Wong, K. V., & Hernandez, A. (2012). A review of additive manufacturing. *ISRN Mechanical Engineering*, 2012, 1-10. doi:10.5402/2012/208760
3. Nussbaum, J., Craft, G., Harmon, J. & Crane, N. (2016). Evaluation of processing variables in large area polymer sintering of single layer components. Unpublished manuscript.

For more information about the program visit: http://fmri-ret.eng.usf.edu/. The Research Experience for Teachers (RET) at the Functional Materials Research Institute at USF is funded by the National Science Foundation under award number 1301054.