Data-Driven Image Correction for SLA Printing
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Background
- Laser galvo mirror system is widely used in scanning and manufacturing such as stereolithography (SLA).
- Projected patterns from galvo mirror systems usually have distortion that reduces its accuracy.
- At large distances the distortion can be amplified leading to large error.
- Global or complex in situ imaging are the only solutions that exist currently.
- This distortion limits the usage of laser galvo in high precision or large scale industry applications

Circuit Board Fabrication    Metal Printing
Laser Scanning    LiDAR systems
Automobile/Aerospace parts

Purpose
Create a universal software correction for SLA printing using a data-driven approach.

Workflow
Calibration files are requested
Pictures are taken of the projection
Information uploaded
Image processing extracts features from the tests
Features used to measure distortion over the range
Correct gcode coordinates interpolated
Corrected gcode(s) zipped for user

Adjust of Tests
Photos are auto adjusted to generalize the shape photos being analyzed

Image Processing
Skeletonize and Dilate
Separate then Bitwise And
Nodes Located
Threshold Printed
Hough Circle Masks
Extract and Interpolate

Why use a bitwise approach to image processing?
Accuracy. Some of the newer image processing techniques (edge detections, Hough Transforms, etc.) are not accurate enough for our measurements.

Correction Processing
All Tests are Measured
Distortion Matrix is Calculated
Inverse is used to Correct Error

Results
Even the most significant errors were corrected accurately

- Decreases error by ~60% on average over a 130mm by 130mm domain.
- Maximum Error Reduction: 76%

Conclusion
Yes, a data-driven, software solution is effective at reducing distortion driven error in SLA machines.
Unique Aspects that Increase the Effectiveness and Applicability of this solutions.
- Django and Cloud Integration
- Data-Driven Parameter Fitting of the Coordinates
- Software solution for a Hardware Problem

Ongoing Use
- Our solutions will be posted online to allow anyone to correct their machine with our outlined process.
- This is a first of its kind solution which can be done with just a cellphone, computer, printer and the machine.
- Gcode files are corrected in minutes and the users can always run the correction on new files in the future.
- Working to test corrections on top of our initial output in order to increase accuracy.

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Citations