

Week 5 Formal Meeting Presentation

Group: Lasagna

Introduction

- Status Update
- 3D Scanner
- Laser setup
- Conversion software/algorithms
- Electronic Speckle Pattern Interferometry
- Goals for next week

Status Update

Action Items:

- Martin Battilana and Devang Lamba will be receive 3D printer training
- Obtained a list of the viable options we had discovered and the data for each
- Research into image processing software(ImageJ) and Matlab for the use in this project

Status Update

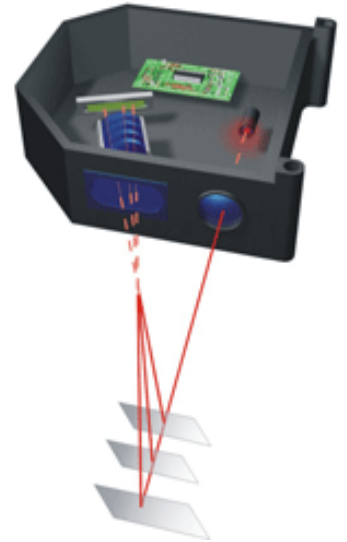
Questions from last week:

- Do we need to stop the printer in order to take the measurements from our sensor?
- How do we differentiate free space from the printed object?
- How do we determine where the edge of the part is?
- How do we detect defects in the z-direction?

Photogrammetry - 3D scanning

Laser triangulation - Distance measurement by angle calculation.

A laser “Source” sensor projects a laser spot onto the “Object”. The reflected light falls incident onto a receiving element at a certain angle depending on the distance. The distance to the “Object” is calculated from the position of the light spot on the to the “Source” of projection.



3D Scanner - Ciclop 3D scanner

2 laser camera, process image by laser triangulation.

Motorized flat table controlled by arduino.

Scanning and post processing in MeshLab (Opensoure, for geometrical and topological information regarding 3D print.

Scanning precision 0.5mm, saves file as STL format.

Note:

- 1) Complicated Routine to compare specifications for detected sample and design sample.
- 2) Ciclop 3D scanner has a rotating flat table

<200 CAD (incl. shipping)

<https://www.instructables.com/id/Ciclop-3D-Scanner-BQ-Horus/>

<https://www.amazon.com/Ciclop-Scanner-Kit-Advanced-Laser/dp/B014G8GME0>



Conversion Software and Algorithms

1. Real time image conversion was thought to be possible with other addons but finding the right software for our situation has been unsuccessful (μ manager returned errors and never seemed to function despite being recommended on various sources)
2. In order to isolate image using ImageJ:
 - a. Analyze the colour spectrum given in the 3D part
 - b. Input this colour spectrum to isolate other parts of the image which do not fall into this spectrum threshold using a custom macro
 - c. Export said image rectified image
3. Further research indicates MATLAB to be better option for image rectification and real time image conversion

Alternative - Process Monitoring Approach with Camera

Matlab Routine (every X seconds):

- 1) Upload Design Dimensions Matrix $2 \times X$ (For every Z-data, there is an XY dimension)
- 2) Routine below:
- 3) Upload new Image to Matlab
- 4) Convert Image to Binary
- 5) After Edge detection
- 6) For every Z-height, Measure distance from edges within xy dimensions
- 7) Compare to Design Dimension Matrix within (allow error tolerance) (Stop if Scanned Image does not meet design dimensions)
- 8) Repeat routine, with new image and next Z-height)

Note:

- 1) Mathematical calculation needed for z-height after every x seconds)
- 2) Routine for Image uploading needed

Code Reference:

- 1) <https://www.mathworks.com/help/images/detecting-a-cell-using-image-segmentation.html>
- 2) <https://www.mathworks.com/help/images/measure-distances-in-images.htm>
- 3) <https://www.mathworks.com/help/images/image-coordinate-systems.html>

Line Laser Defects Detection Setup

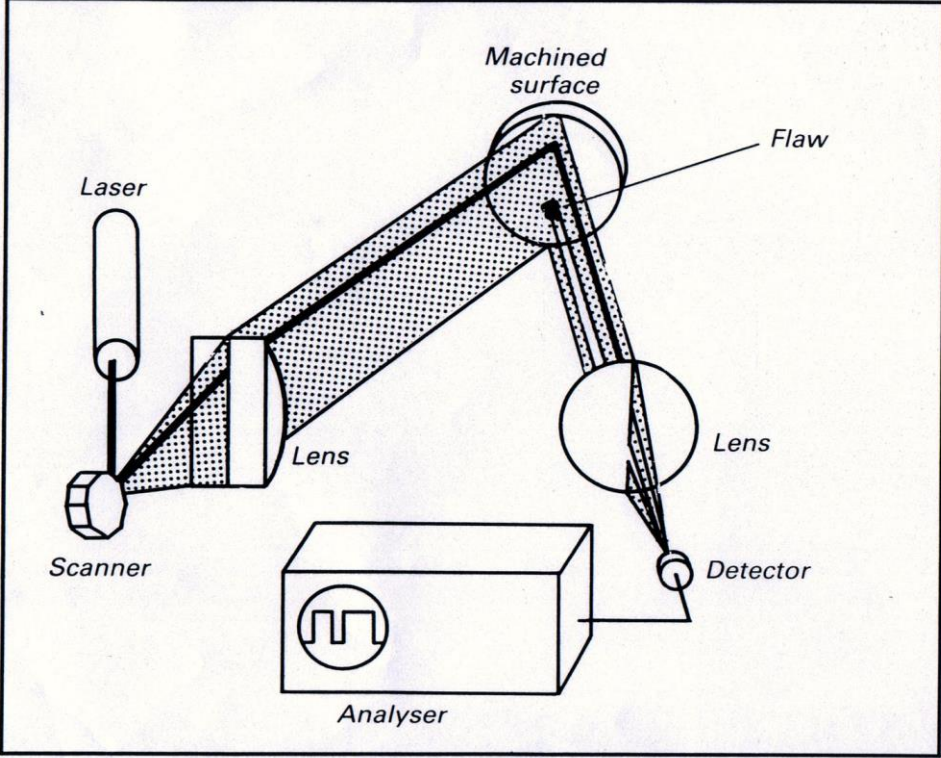
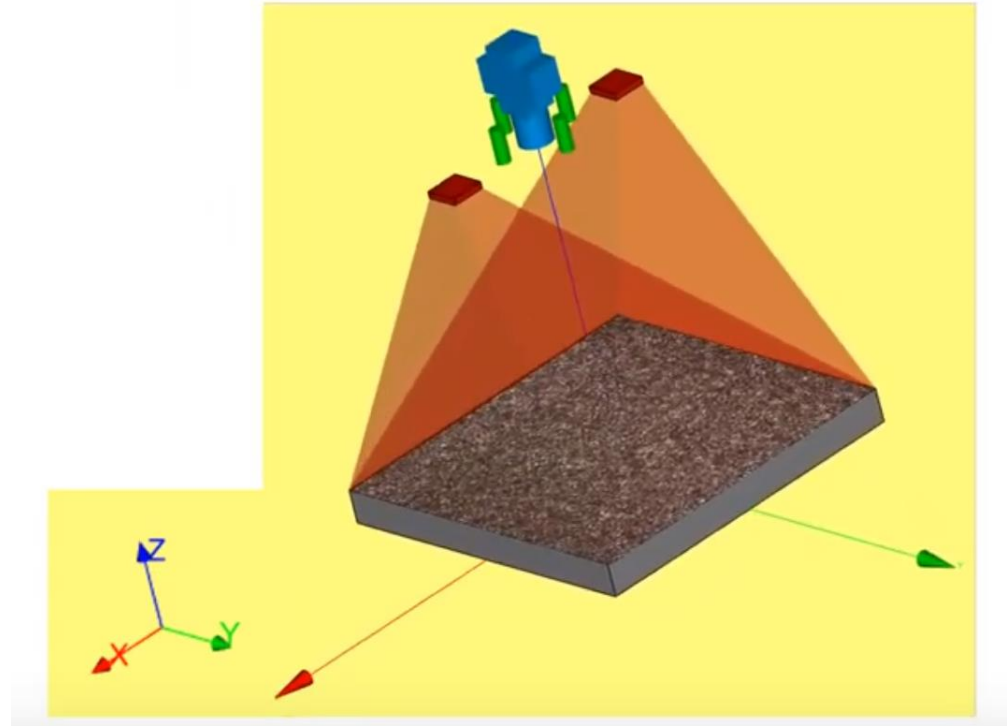
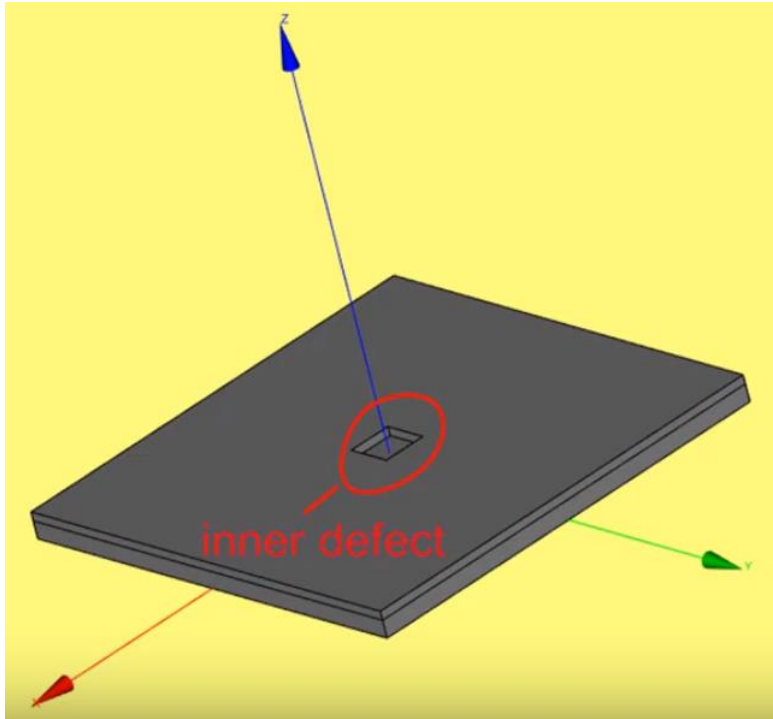


Fig. 5.1 One-dimensional laser scanner flaw detector

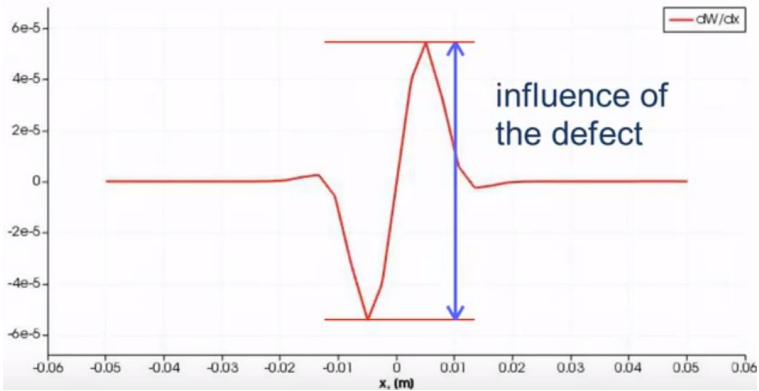
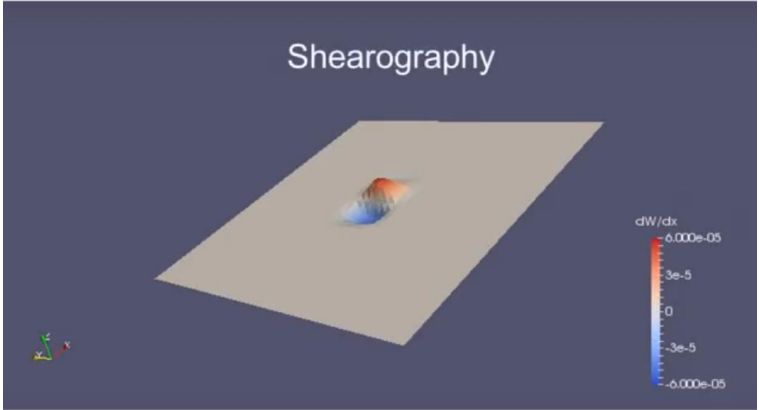
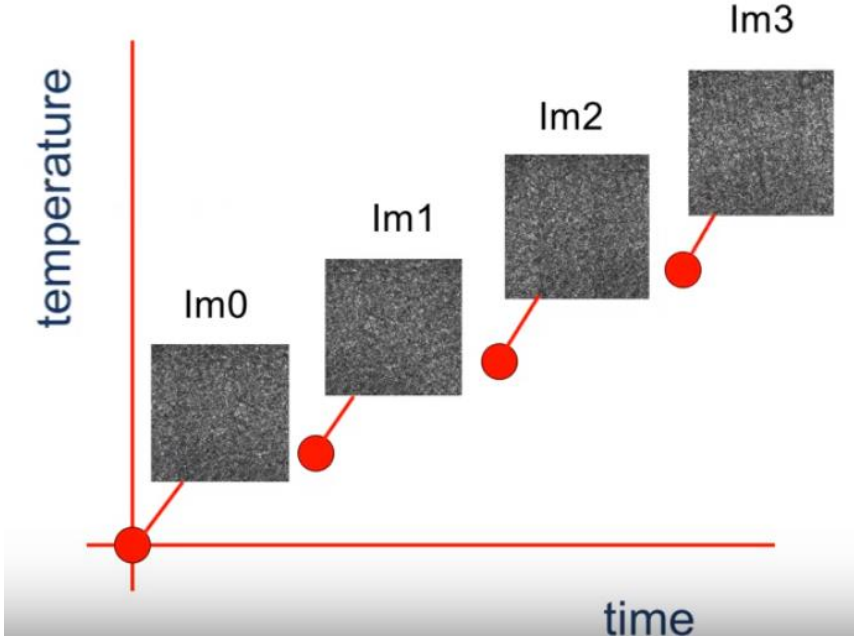
Line Laser Defects Detection

- The line laser defects detection unit consists of a laser which projects a line onto the flat surface, and an CCD camera which detects the reflection of laser beam.
- When the laser line passes over defected points, the image moments on the pixel information would change.
- By comparing the preset pixel data and the detected pixel data, considering a acceptable difference coefficient, the printing process could be stopped if a beyond range defect is detected
- The scanning speed and sensitivity to defects may vary among different detector cameras
- With a high-resolution 45 M pixel CCD camera, and the laser line at 60 mm length. the defect as small as $0.7 \mu\text{m}$ can be discovered at the line scan speed of 17 mm/s.

Shearography



Shearography



Shearography

- Software: Istra 4D (<https://www.dantecdynamics.com/istra-4d-shearography>)
- 'FlawExplorer' in Non-destructive Testing Inspecting system (<https://www.dantecdynamics.com/products-and-services/flawexplorer-ndt-inspection-system>)
- 2 square meters inspecting area and data acquisition time is less than 30 seconds
- Issue: cost

Goals for Next Week

- Image transmission from camera as video or snapshots
- Obtaining measurement data from design file X,Y & Z
- Upload and isolate the print from the background and obtain a reference point
- Conversion of image file to matrix and obtaining distance for each height
- Error routine pseudo-code