MTRL 466- Sensing Failure Weekly Meeting Minutes

Date: 23 October 2019, 4 - 5 PM

Room: TBD

Week 8: Understanding Laser Line Projection and Edge Detection

Leader: Clement Asiedu-Antwi

Secretary: Sofia McGurk

Attendance:

Individual	In Attendance
Catherine Greenwood	Y
Jenna Moledina	Y
Clement Asiedu-Antwi	Y
Isabela Taketa	N
Aleisha Cerny	Y
Sofia McGurk	Y

Agenda:

1. Status Update
    a. Printer Location

Chad: Printer is going second floor 218 undergraduate lab in FF.

2. Hardware Team Presentation

Cat: going over slides… y is defect size want to max x.
Chad: Max x will magnify the image.
Chad: Shine laser as a pictorial explanation for laser to object distance.
Cat: Assume angles are constant, and the number of pixels is constant. Distance camera is from object is what changes. FOV is proportional to the distance squared.
C: Line laser is a tool of use. Test run was off by half a mm.
Chad: How did we determine we were off by that much?
C: measured height of laser, took a measurement of x distance and then do calcs to find the angle.
Chad: Is it really 0.05 cm? How do we know this?
C: Difference between what we calc'd and what we measured.
Chad: Accuracy or precision?

MTRL 466- Sensing Failure Weekly Meeting Minutes

J: Think of darts on a dart board. Accuracy and precision= all in target bulls-eye, precision is all-together but not centered and then accuracy is all close to middle but some variation in placement of the darts.
Chad: Must think about the errors that we induce, minimize what we can.
Chad: What do we need to do this better?
Cat: Need a stand
Chad: Retort stand from Be's lab for the laser.
Chad: Selfie stick or tripod for the camera.
Chad: Find something that has a high precision size and see if can determine it.
J: Coin
Chad: What is the feature height on a coin? Could we find the height profile on the coin?
Chad: Feeler gages.
Cat: Get something from work.
Chad: Find something that has a well known thickness (plus or minus) and test it?
Chad: He can give us a retort stand.
Chad: Can take picture of setup from side and measure angle that way. If had to calibrate angle, take a surface you can move up (table) measure how much it goes up by and see how the laser moves. Might have something in labs or 303.
Chad: Want to nail down the set up for the final report- give him a list of requests and things we might need.
C: Mount laser on camera?
Chad: Don't worry till next term. First thing is to show him that we can detect a defect. Take a part that has a defect and prove that we can "detect it". Once we can do that find out can we do it during a print? Next step is can we make something that will stop the print if a defect detected. Don't worry too much about the expected challenges for now.
Cat: Can we use the camera right over top of the laser?
Chad: yes, we need to prove that this method works even on something super simple. Show some kind of increment so that he will "invest" in our method the next semester.
Chad: For expected challenges he is not saying don't think of them, we just don't necessarily need to have answers just yet.
Cat: Integrated units are very expensive.
Chad: What is the defect we are looking at? And where on the part are we going to look?
Chad: Need a plan from us on what we are going to print so that it is not a waste of money? Design a part that you think will fail in a known way so we can test reproducibly.
C: Can we design something with a bump?
Chad: People print things that will fail to re-calibrate, there are standard test parts.
Cat: then we can just download cad files.
Chad: Some examples: Print steps with overhangs, can print up to about 45 degrees but beyond that the overhang will sag or fail. Build two towers side by side, if not right conditions you get stringing between the towers. More out there- we should look them up.
Chad: What is the size of the feature we wanna test and how are we going to set up the laser? Where are you trying to make measurements and why.
Cat: have laser on side. Start with squares. If more complicated and all went successful the line should be at the highest point.
Chad: Laser at edge or middle or ?
Cat: Put it at the edge?

MTRL 466- Sensing Failure Weekly Meeting Minutes

Chad: Think about where we want the laser as well. After we prove we can detect a defect. Are we doing this every layer or every few layers?
Cat/ C: Every layer but depends on print and processing.
Chad: What about defect size? When will we know to stop?
Cat: 400 um?
Chad: Look up standard error parts. Don't choose too small of a defect size. Layer size- catch all defects but throw away some good stuff. Too big tolerance will print too many bad things. There must be an optimum level.
Cat: Can you have a defect that is larger than a layer but isn't really bad?
Chad: I don't know, think of stringing between towers- might not detect.
Chad: Get pictures of simple builds and the defects that they generate. Pick what we want to detect, and how can the computer recognize as a defect.
Chad: Deliverables: List of requests before next week. Want version 2.0 of PP with a better estimate of the size of the part. Can we tell if something is wrong in a defective part. Software go over the simple image processing technique and find out if it works?
Cat: Laser size changes will this affect results?
Chad: Use a part of the laser that is similar sized.
Chad: Bitmap image is a matrix of numbers. JPEG and PNG make it binary and use compression. Python converts binary JPEG to text format. Text files not very efficient as too many bytes per position. Binary is simple and gets rid of not needed information. Bitmap to open in text file and you will see the numbers. PNG and JPEG can open like that in python. Can look at stuff in matrix format. Can zoom into vector image an infinite amount without losing resolution.

3. Update on LCA for PLA 3D Printing

A: to set up separate meeting with Chad to focus on this.

4. Edge Detection Software

J: Isabella looked at processing images, module in python called pillow. Can split image into individual bands. When processed could use calibration and have a range for the red values, everything else would be in black in white. Might be able to get rid of filter.
Chad: How to code things (sent a link to a YouTube video). Image processing kit. Go to 10 minute mark.
J: Edge detection easy way to determine if laser has moved. Look at where brightness changes dramatically, or where there is a maximum point. Found Canny edge detection method but it involves lots of differentials.
Chad: Image what is uncertainty- width of a pixel. Plot intensity versus distance x darker is noisy but low then goes up to max over two pixels and is noisy. How do you amplify the edge? Derivation but what's a simpler method?
J: Calc a slope?
Chad: Will be hard to do so.
Chad: Big difference between end of dark and start of white. Binarize, make as much as you can black and white. Shift data over by one pixel and take the difference between the 2. The white and dark regions are 0 but the difference in intensity in the middle will give a

maximum. Resolution size is a pixel. Know line in x direction (vertical) then you can do this. Need fancy filters to find complex objects.
J: Would isabella's thing work still?
Chad: She needs to explain it more next week.
Chad: Grey scale- keep R value, get rid of green and blue. Then can plot intensity. Try the method above and see.

C: 4 more weeks left but with presentation prep only 3 more weeks of work left this semester.

Action Items:

	Item	Assigned To
1.	Come up with a list of things needed for setup	Hardware Team
2.	Test setup on something with a well known thickness and see how accurate we can get measurement (i.e: coin and the features on it). Find height profile?	Hardware Team
3.	Take a defective part and "prove" that we can detect this defect using our method.	Hardware Team
4.	Research on standard test parts (parts that will fail)	Hardware Team
5.	Plan out what objects we are going to print on the printer so we don't waste filament.	All
6.	After proof of concept, where do we want the laser? Also are we testing every layer or every other layer?	All
7.	Find optimal defect size	All
8.	Go over image processing technique and find out if it works.	Software Team
9.	Find pictures of failed object defects and figure out what we want to detect.	All
10.	Version 2.0 of the PP showing better measurement of an object, software and LCA updates	All
11.	If using Pillow module more explanation required next week for Chad.	Software Team

Next Meeting Time: Wednesday the 30th from 3-4 pm