Serial Grinder & 3D Imaging System

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Overview

Determining the shape and layout of fossilized sedimentary remains is largely only possible through the suggestion of 2D sections of the specimen. However, in the same way that CAT scans and MRI's work, where a sequence of 2D images can be stacked together to produce an approximated 3D model. The scope of this project is to create an automatic grinding and 2D imaging machine capable of grinding layers off of a rock core specimen and taking and storing sequential images of the new face.

Objectives

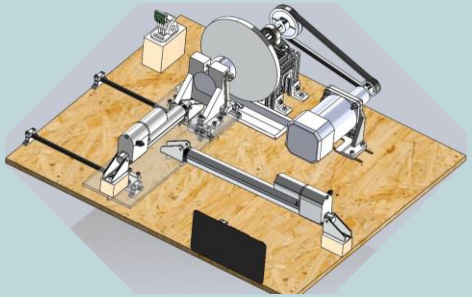
The object of this project is to create a fully autonomous system. This system will grind the face of the rock core and then take a picture of the new rock surface afterwards. Ideally, this will repeat ad nauseum until there is no more rock core left to be ground off. The system should be able to run with minimal overwatch by the operator.

Prototyping

Our design has changed in a couple ways since its initial inception. The mdf we were initially going to use has been converted to a steel plate. We have also decided to tap holes into the plate to avoid having to nut the bolts. We have also changed how many sleave bearings we have on our linear rails. This is due to when we would attempt to move the plate forward or backwards, it would bind up with only two. Once we added a sleave bearing to both plates, the binding problem went away. As of 03/30/21, the system is still in the prototyping phase and we be transferred to the final steel plate near the very end of the semester. Below is the current state of the prototype: Image taken on 04/03/2021.

Conceptual Design

The idea behind this design is that the rock core move left and right and forward and backwards via linear actuators that will be controlled using an Arduino Uno. The rock core and actuators ride on linear rails with sleeve bearings. The grinder is driven by an AC motor with a pulley powering the grinding wheel. Once a layer of core is ground, the actuators moves the core to the left then an autofocusing raspberry pi camera takes a picture of the core. The core then returns and the process repeats.



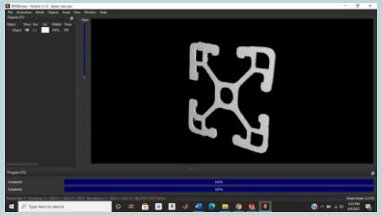
Budget

Motors and Linear Motion - $610
Precision Motion Components - $270
Mounting Hardware and Fasteners - $280
Framing Materials - $285
Controls and Electronics - $260

Estimated Total - $1,705

*Some parts are being reused or have already been purchased and are not included in the budget

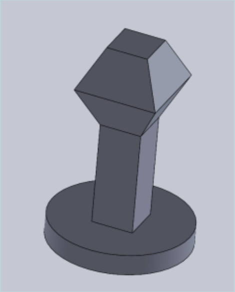
3D Imaging



To achieve the desired 3D image from a stack of 2d images, the software SPIERS is used. SPIERS is the Serial Palaeontological Image Editing and Rendering System. This program is responsible for setting captured images to a monochrome grayscale and determining boundaries for the desired internal grains and fossilized remains. Once the software does this for each image, the boundaries and can be stacked, and a 3D image produced of the selected boundaries. Prior to this these images need to be manually lined up for precision and refined in terms of their boundaries. After this is done, a more accurate model can be produced.

Conclusion

Once the prototyped assembly is together and the machined steel plates arrive, the final assembly will go together, and testing will ensue for the remaining time we have. We hope to grind a 3d printed test piece shown to the right and reconstruct a 3d image from it. The process at that point will not likely be automated though it will more certainly suffice as a proof of concept for this machine. After this test the automation code for the Arduino and the HMI are to be programmed and tested together. We have thought of some upgrades after pursuing this design: using stepper motors for driving precision and implementing a load cell behind the grinding disc to act as a limit switch when the proper grinding force is applied.



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