MATLAB to Python: Initial Code Translation

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Introduction

We are looking at a body scan code from Pennington Biomedical Research Center. This code takes in a scan of an individual and uses the code to find specific measurements at specific places on the body. The body scan code is currently written in MATLAB, and this is an issue because MATLAB requires a license to use. The big motivation for this project is to translate the ideas behind the code into Python, so that it is more accessible to researchers and can more easily facilitate measurements and future projects.

At the end of the semester, we had accomplished writing a code that aligns the mesh, gets an orientation, finds the feet of an individual, finds the crotch, and finds the armpit.

History and Motivation

This project began circa 2012 with the Math Consultation Clinic receiving the idea from Pennington Biomedical Research Center. The original team used MATLAB because it had the most resources and libraries available at that time. They worked through many different cases based on the scans they got from Pennington. When they finished the code, Pennington began using the code to get measurements from scans of individuals. But to continue using the code, Pennington must purchase a MATLAB license each year. This gets to be quite expensive as time goes on. In 2024, they reached out to the Math Consultation Clinic and Dr. Wolenski to ask us to revisit the code and translate it into Python.

Python has many benefits over MATLAB now that were not available then. Some of these benefits include: access to newer libraries, can be used in a cloud based system, can be easier to troubleshoot, and easier to share with other researchers.

Biomarkers

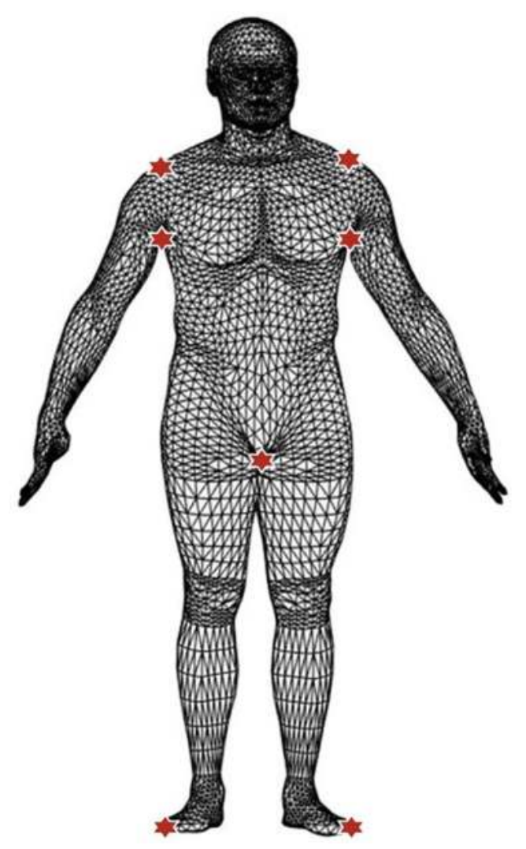

Figure 1. An example mesh with some of the biomarkers highlighted.

In the code, we are trying in getting specific biomarkers from the 3D scan of an individual. These biomarkers are significant to help orient our scan and take specific measurements. The biomarkers that we are interested in include: feet, knees, thighs, crotch, hips, forearms, bicep, shoulder, chest, neck, and the top of the head. Each of these will tell us a specific measurement that we care about. (For example, at the bicep we want to calculate the arm circumference.)

What We Tried

We initially tried translating the code line-by-line. This proved to be much less efficient than we thought. We discovered that many of the functions that had been hand written in the original code have Python libraries that could be used instead. Using these libraries would cut down on the lines of code needed.

In order to test this code, we found an ideal .obj file of a man. This scan was very idealized and would not necessarily be what a real-world scan looks like. We tried getting some real scans, but time was against us to find these.

What We Did

Translating line-by-line was not the most effective use of our time because the errors and lack of scans kept us from checking ourselves. So we decided to start coding the ideas behind the functions from scratch. Thankfully we had amazing coders on our team so we were able to get something started. Our code currently can orient the scan and align the model, find the feet, find the crotch, and find the armpit.

The first thing we do in the code is align our mesh so that the largest direction of variance is the z-axis. Then we need to orient the mesh so that we know which directions we are talking about. We can find the orientation by taking a slice of the mesh at half the height and seeing the variance of the points at half the height. The picture below illustrates our idea. From this slice, we can get the two directions: front/back (our y-axis) and left/right (our x-axis). We get these directions by looking at the medial cross-section of the individual.

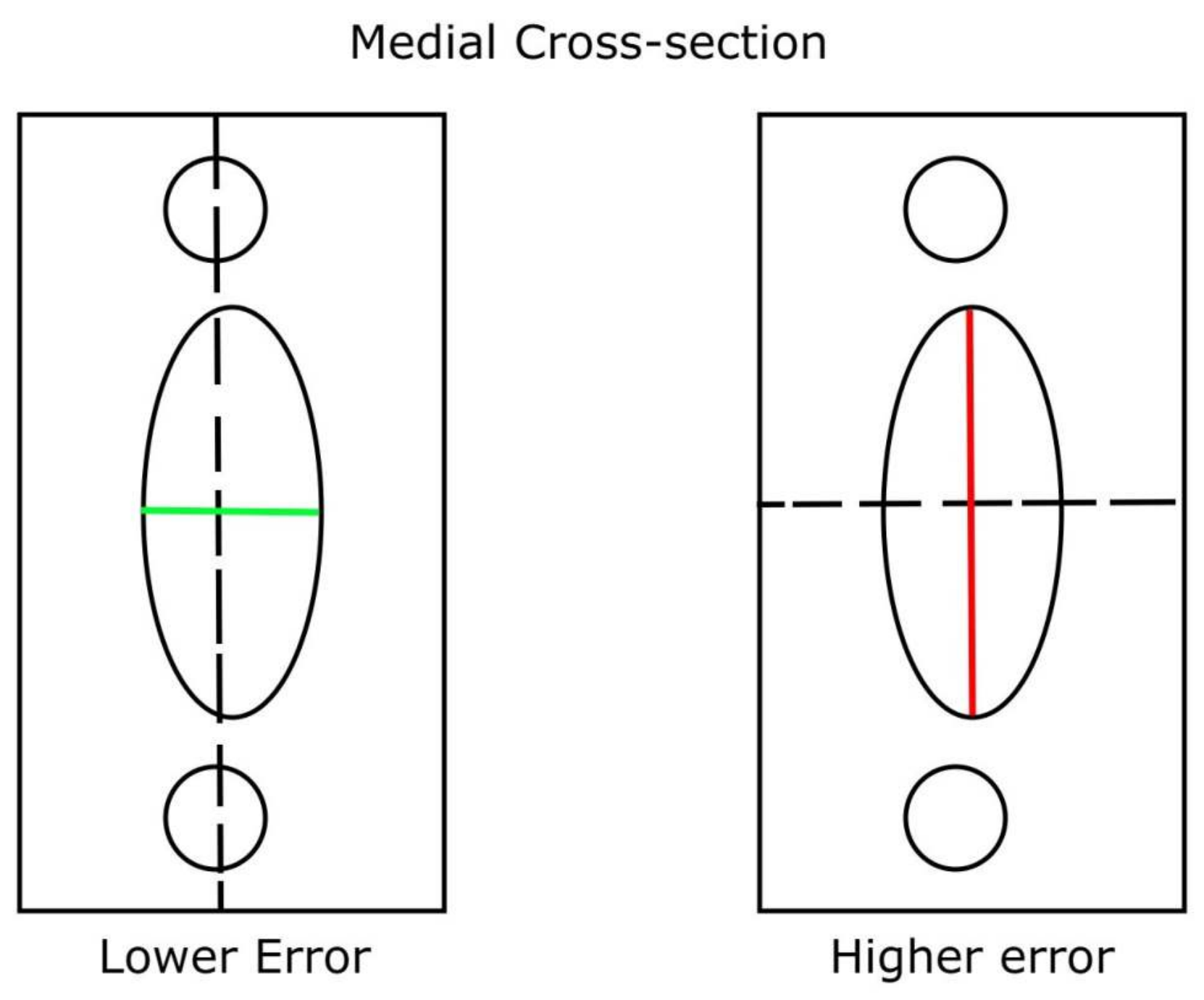

Figure 2. This is a cross section of an individual at about half the height. This tells us how to orient our x and y directions.

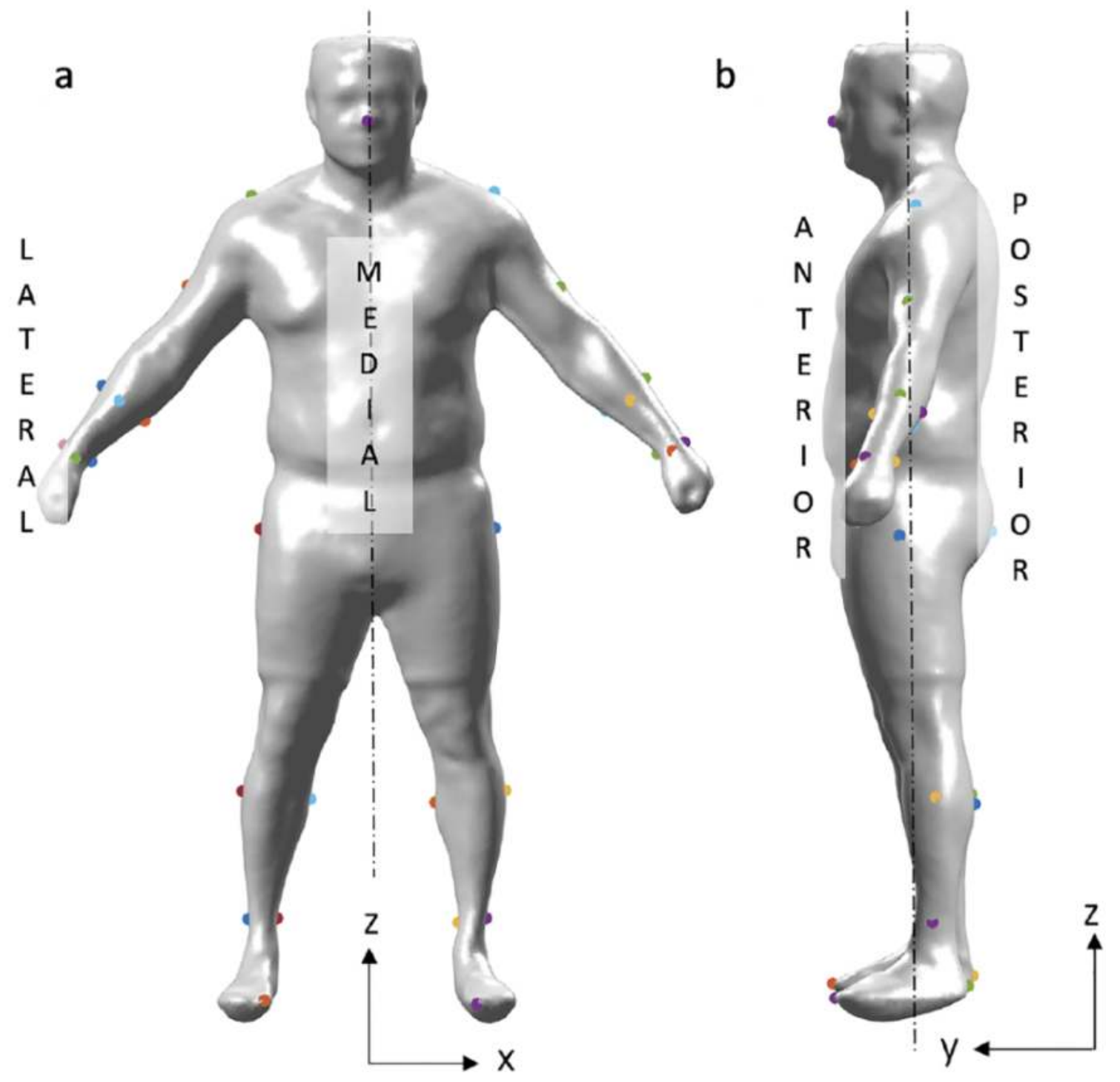

Figure 3. These are our orientations for the body.

Moving Forward

There are many more directions that we would like to consider moving forward. These include:

1. Calculate the circumference at specific biomarkers.
2. Calculate the height of an individual.
3. Calculate surface area.

We would also like to get some sample scans from Pennington to test our code with real-world information. Other directions for this project include testing with scans provided by men and women and adding more measurement opportunities.

Acknowledgments

We would like to thank Dr. Nadejda Drenska, and Dr. Peter Wolenski for their support and help with this project every day during class. And we would like to thank Sima Sobhiyeh for her help in parsing through the files, helping determine appropriate steps moving forward, and explaining what the original group did. We would also like to thank the folks at Pennington for their time and care.

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