

Utilizing a Graphic User Interface for the Personalization Process of 3D Printed Prostheses



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Abstract

Currently, many 3D printed prosthetic limb designs fall into the categories of either personalized for each recipient or a fixed design scaled to the approximate size of the recipient. The objective of this research project is to create an optimized customization system for 3D prosthetic limb design, primarily focused on upper limb assistance devices. To test the efficiency of the design system, the time needed to personalize a prosthetic device using e-NABLE's sizing measurement method will be compared to the time to the prosthetic device using the optimized customization system. The measurement methods from e-NABLE previously mentioned uses a sizing guide for the scaling percentage for the prosthetic device based on the recipient's hand width and length.

Background

The loss of arm functionality due to birth defects or amputation from accidents brings down the independence of the amputee. Hands and arms play a large role in the interaction humans have with the world and limb loss force a reevaluation of how an amputee navigates the world. Unfortunately, many amputees can not afford prostheses due to a generally high cost. Child amputees are especially affected by the affordability of prostheses due to their rapid growth requiring regular replacements. This project seeks to create and optimize a new process to quickly produce 3D printed prosthetic hands. To accomplish this, a graphical user interface (GUI) is implemented into the CAD file to allow an intuitive method to quickly edit the prosthetic to meet clients' parameters. A point of reference that this project will used is the sizing guide spreadsheet recommended by e-NABLE to size 3D printed prosthetics.

Illustrations

Fig. 1 : The GUI utilized in this project **Fig. 2 :** Thirty trials of the time needed to adjust the prosthetic STL files. **Fig. 3 :** The prosthetic hand CAD model

Fig. 1

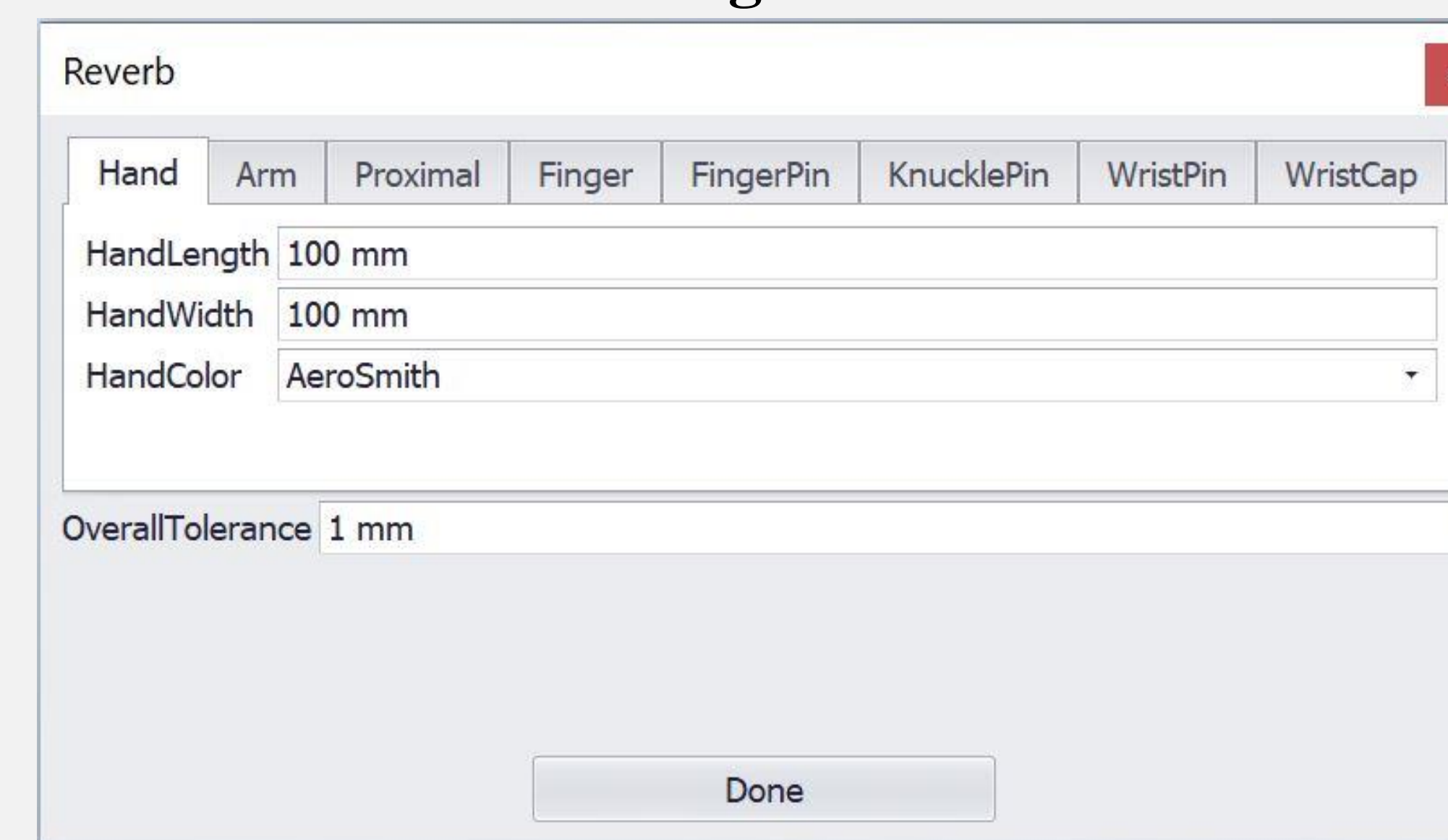


Fig. 2

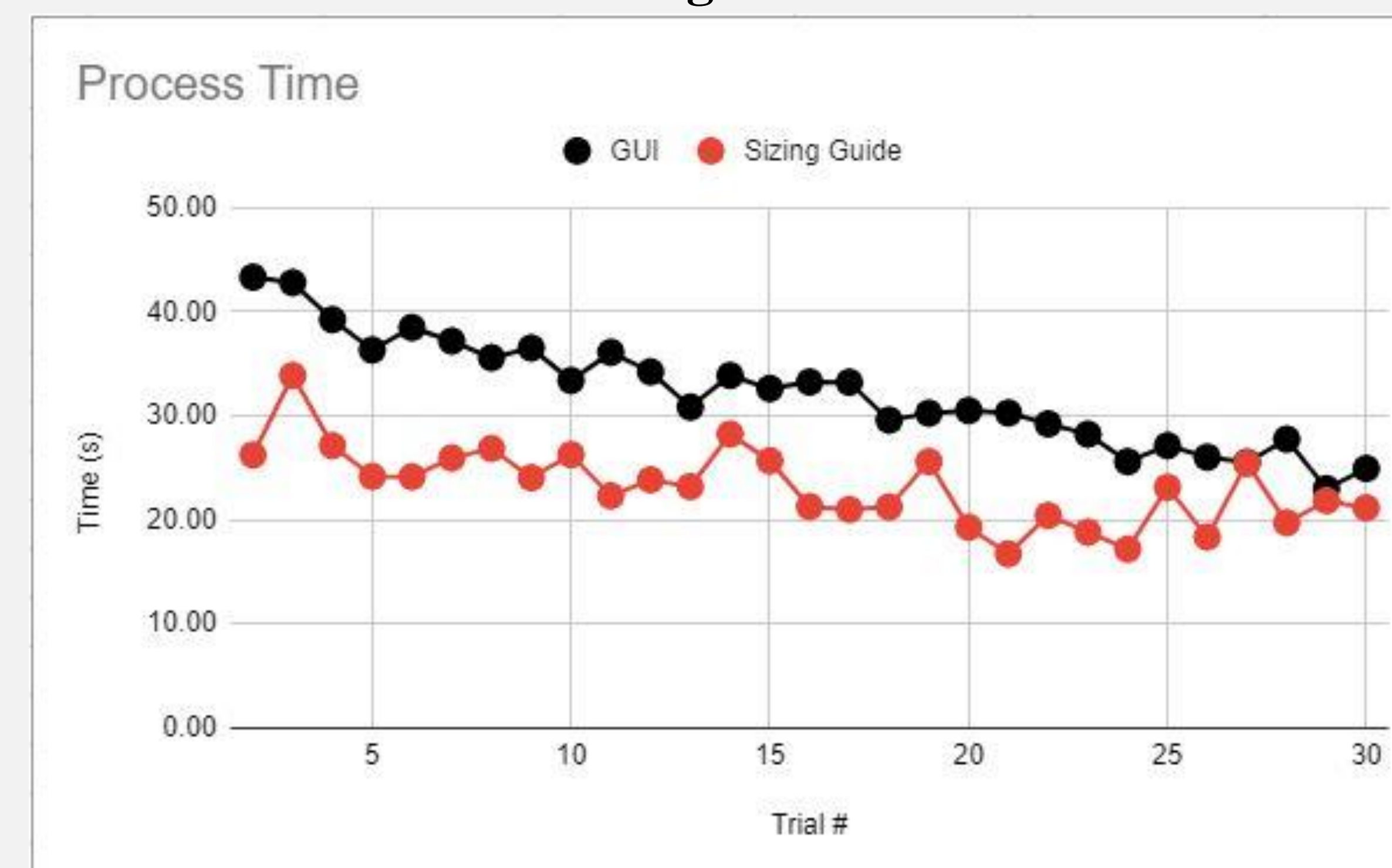
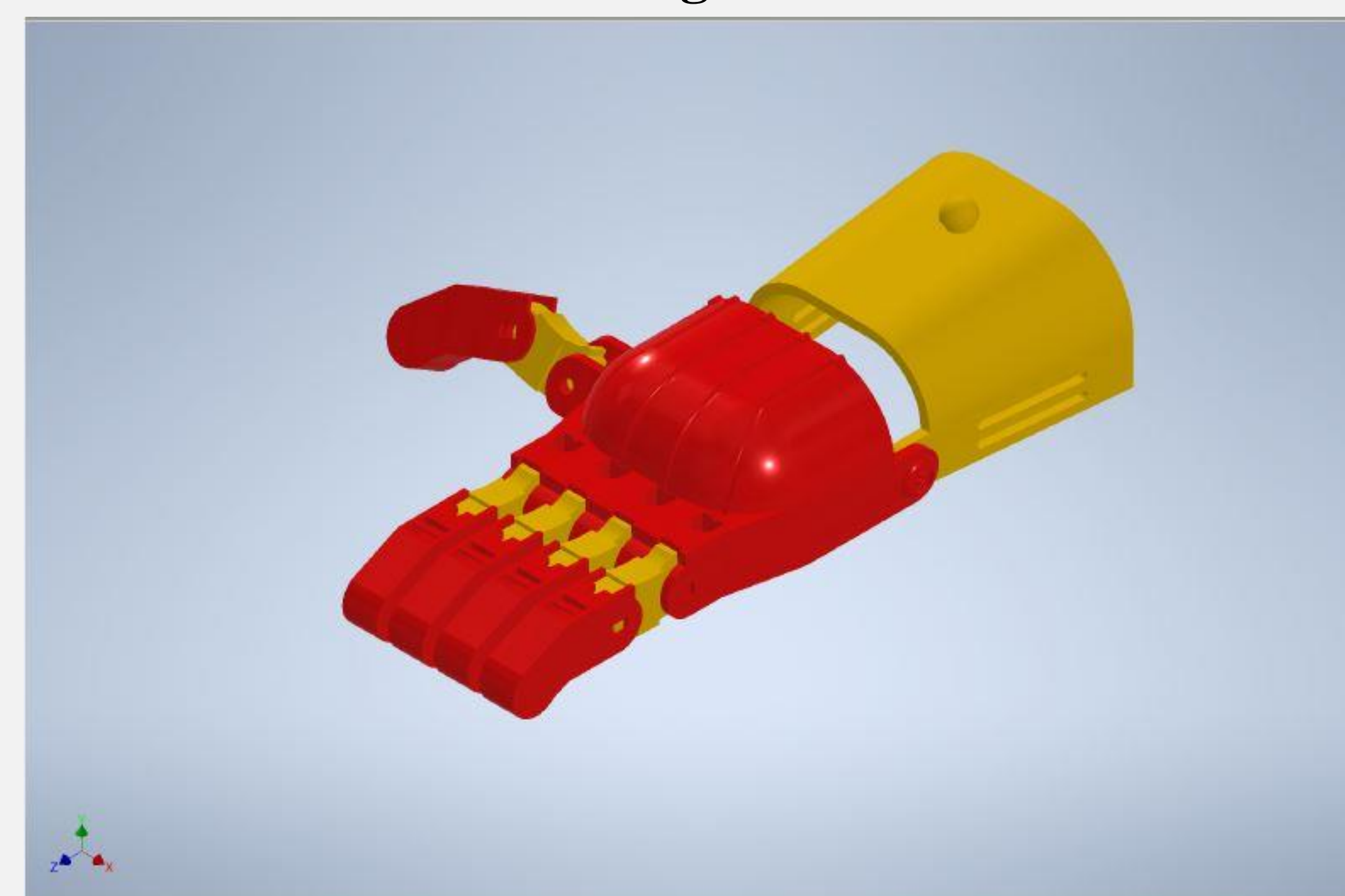


Fig. 3



Methods

The GUI customization process was developed as an alternative to the sizing guide as that guide relies on the scaling of STL models. The GUI process instead relies on the adjustment of the CAD model. To compare the efficiency of the processes, the average time needed to adjust the models to set measurements was determined. The data in Fig. 2 is measured for each process from the first value change to when the STL files placed into a slicing program to be printed. After thirty trials the average time for the sizing guide was 23.06 seconds while the average time for the GUI process was 31.95 seconds.

Graphical User Interface

The GUI is constructed by utilizing the iLogic function found within Autodesk Inventor, with the project using the 2020 version of this program. Several lines of VBA code instruct the parameters of the CAD model to change based on the input. Nearly all aspects of the CAD model can be adjusted to meet a client's needs, ranging from lengths of fingers to the pins that hold the prosthetic together.

Results

While the sizing guide process, on average, took a shorter time to complete the same task, the GUI can accomplish much more. As the sizing guide process only involves the scaling of the STL file, individual components of the prosthetic hand can not be edited.

References

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- Development, W. (2019, November 18). Arm Amputation: A Before and After Guide. *Amputee Coalition*. Retrieved March 28, 2020, from <https://www.amputee-coalition.org/arm-amputation-guide/>