



Comparing 3D CT Scans and Photogrammetry

Models of Fish Jaws

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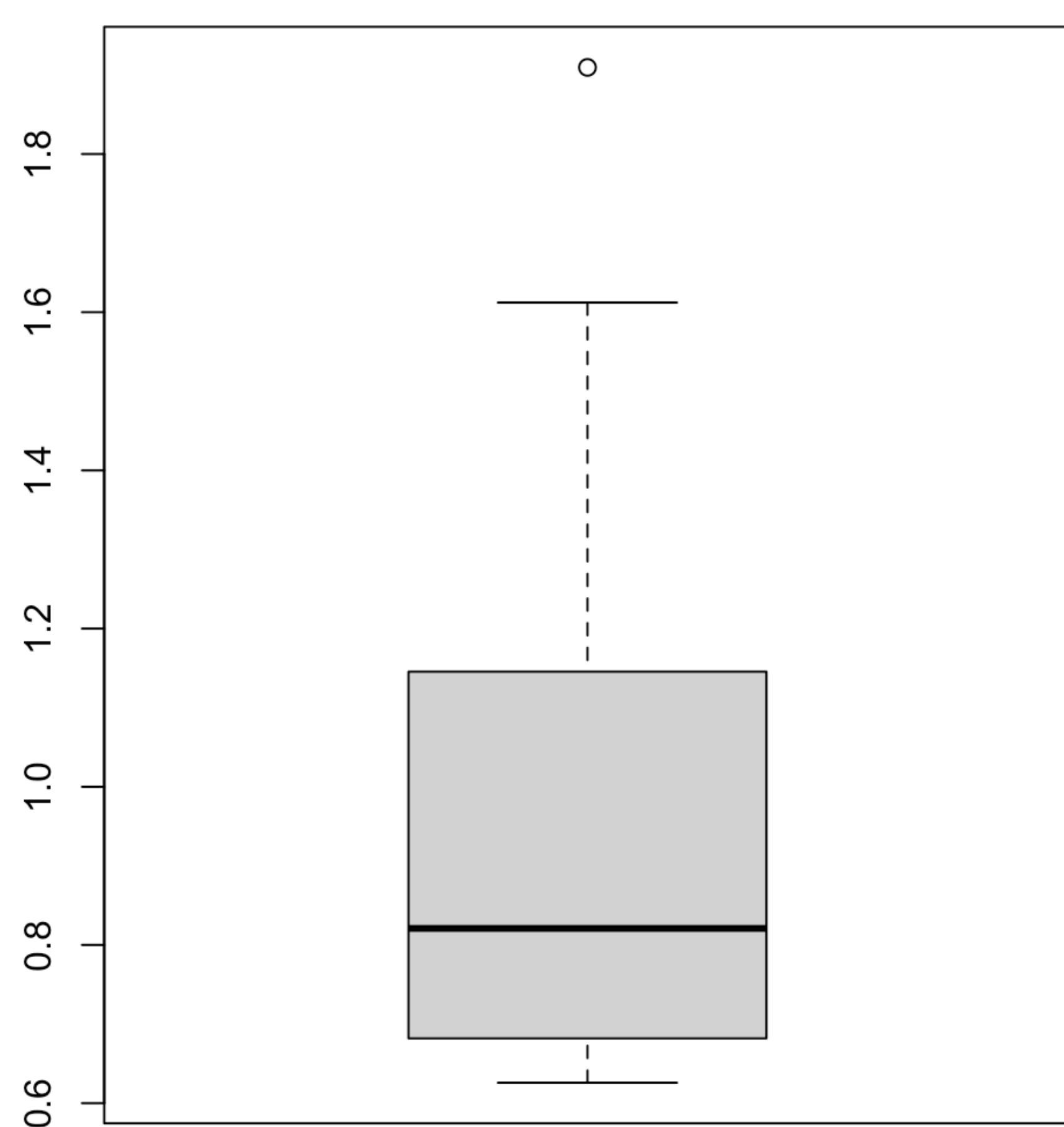
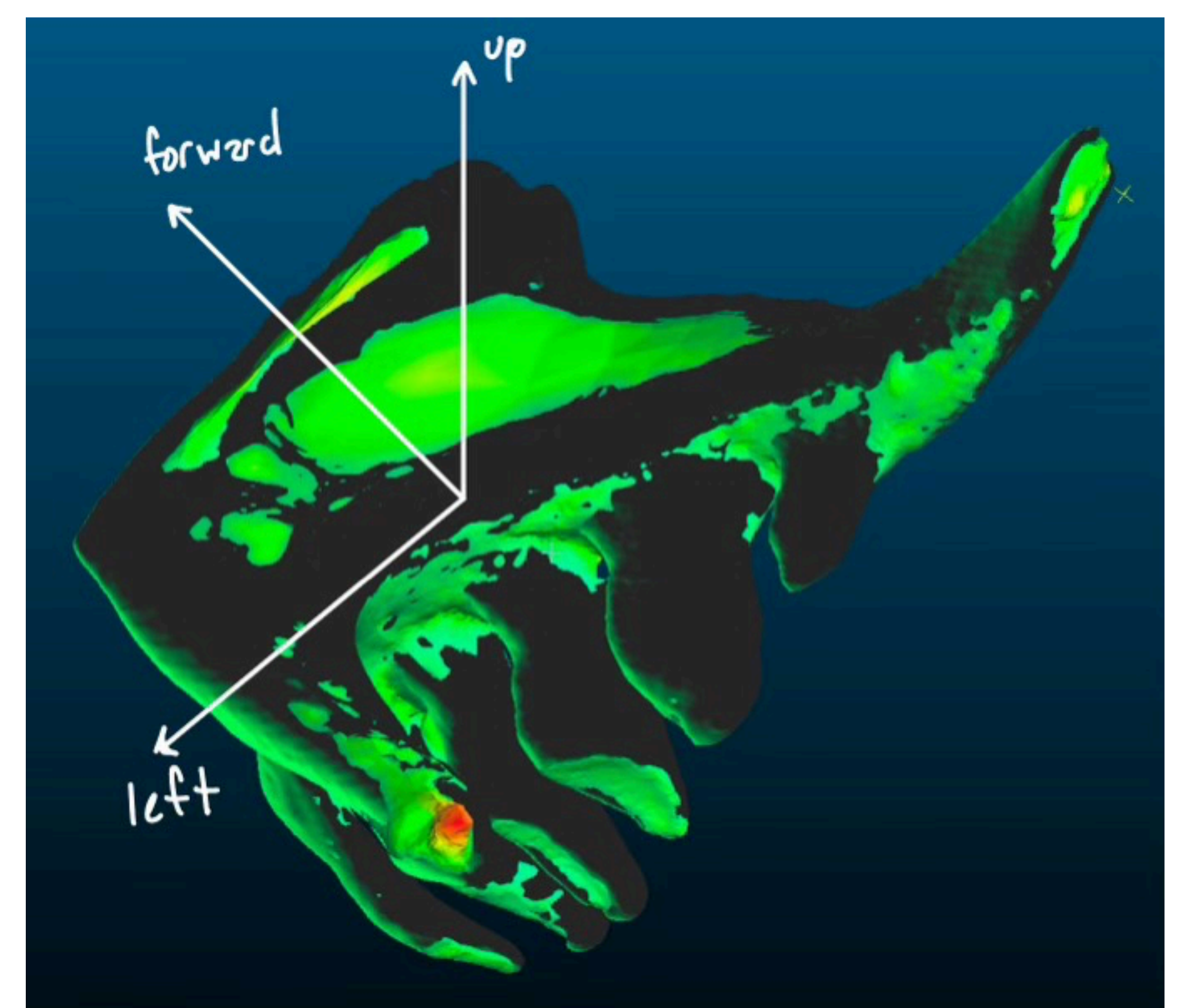
Introduction

Currently, Professor Roche is researching how the shell strength of invasive molluscs affects their availability as a food source to fish. The jaws of roaches and roach/breem hybrids are being analyzed using two different methods: 3D CT scans and photogrammetry models. The goal of this particular study was to compare the results of these methods from various sets of fish jaws to determine how similar they are and if photogrammetry could be used instead of CT scans, since it is cheaper and simpler to use. The alignment was completed using the iterative closest point algorithm, which finds the best transformation by minimizing the distance between corresponding points. The comparison was done with visual observation and Hausdorff distance, a measure of the maximum distance from a point on one model to the closest point on the other model.

Methodology

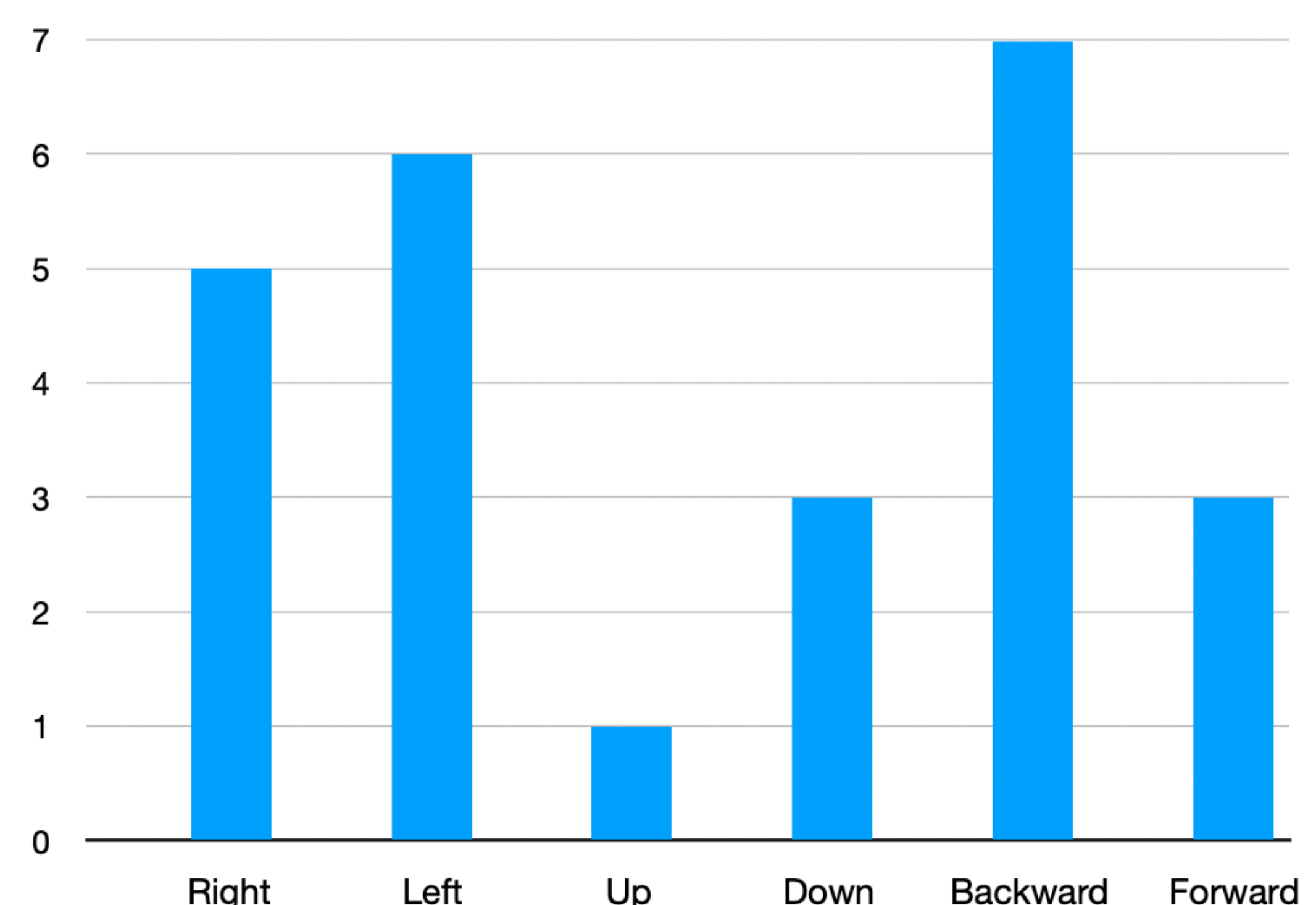
CloudCompare was used for these steps

- Select 4 equivalent point pairs and allow the software to roughly align them
- Use the built-in ICP software to more precisely align models
- Record the Hausdorff distance
- Assign directions to the model
- Make visual observations on which directions the CT scan is skewed from the photogrammetry model in and where the greatest error occurs



Boxplot of Hausdorff Distances

Results



This chart shows how many of the 15 models were pushed in each direction. There could be overlap as not all scans were pushed in just one direction

Discussion

The Hausdorff distances range between 0.63-1.91 mm, but the box plot shows that the average is around 0.96 mm. This is a pretty small error, however, the jaws are pretty small in size. It should also be noted that the jaws have varying initial sizes, so the distances are not perfectly comparable. From visual observations, it seems the CT scans are most often skewed “backward” and in either the right or left direction. The teeth are always larger, looking as if it’s an outer coating to the photogrammetry model. The greatest error is concentrated around the top, often at the two “end points”. Since these were only visual observations, the next steps should be to quantify how much translational error there is in each direction.

Conclusion

Overall, it seems that ICP was a good method for alignment. The CT scans always show the teeth to be larger than the photogrammetry models. There is translational error, but typically only in the left, right, or backward directions and not by much. While there is some error, photogrammetry models are pretty similar to the CT scans, but less detailed. More quantitative information about the translational error could be helpful to make definitive conclusions.