HAAG Week 3 Report -Lizard Jaw Segmentation

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Time-Log

What did I do this week?

- I met with the computational advisor Chansa Chishimba about the project and received feedback on needing more background on computer vision concepts.
- I started to familiarize myself with computer vision fundamentals and concepts through CS231A: Computer Vision, From 3D Perception to 3D Reconstruction and beyond and chapters 1 through 5 of Computer Vision: Algorithms and Applications by Richard Szeliski
- I started collecting raw CT scans of Anolis lizards and began slicing practice on collected data. Through the weekly team meeting, I was able to become more familiar with the nuances for jaw image processing on 3D Slicer from teammate Philip Wooley's experience, including using thresholding and masking of TIFF images
- My teammate Ming Zhong and I submitted the research plan for evaluation
- As the webpage manager of my group, I update the webpage of the Stroud group with bios, weekly reports, group meeting recording links, and group introductions.

- What are I will do next week
  - I will continue to conduct data collection work on 3D Slicer to increase data quantity for algorithm development in the future (see updated research plan)
  - I will continue to update the webpage with the latest weekly reports, meeting recordings, and updated bios of my teammates
  - I will create a separate subpage for my project on the main Stroud projects group: https://sites.gatech.edu/haagstroudprojects/
- Blockers, things I want to flag, problems, etc.
  - Feedback on the revised research methods and plan for my group will be helpful to further develop our tasks to further the project and eventually reach a point where there is publishable work
  - A method to streamline and minimize the time it takes to segment CT image data will be needed as we continue to proceed. Philip informed the team that

it can take up to 3 hours for image processing on 3D slicer, so having a more automated method for slicing would be very helpful

- Recorded team meetings of my group are not displayed on the webpage. We may need to move to another platform like Google Meets to have embedded meeting links to show up.

Abstract:

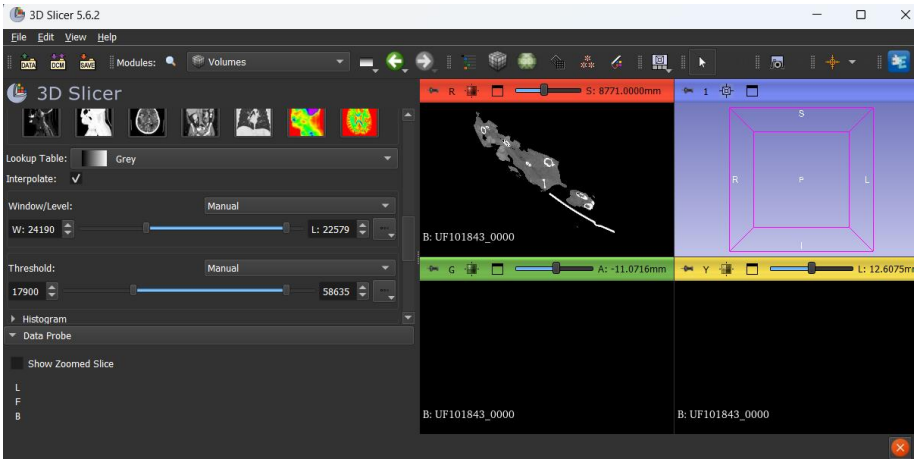
3D tooth segmentation is an important task for digital orthodontics. Several Deep Learning methods have been proposed for automatic tooth segmentation from 3D dental models or intraoral scans. These methods require annotated 3D intraoral scans. Manually annotating 3D intraoral scans is a laborious task. One approach is to devise self-supervision methods to reduce the manual labeling e ort. Compared to other types of point cloud data like scene point cloud or shape point cloud data, 3D tooth point cloud data has a very regular structure and a strong shape prior. We look at how much representative information can be learnt from a single 3D intraoral scan. We evaluate this quantitatively with the help of ten different methods of which six are generic point cloud segmentation methods whereas the other four are tooth segmentation specific methods. Surprisingly, we find that with a single 3D intraoral scan training, the Dice score can be as high as 0.86 whereas the full training set gives Dice score of 0.94. We conclude that the segmentation methods can learn a great deal of information from a single 3D tooth point cloud scan under suitable conditions e.g. data augmentation. We are the first to quantitatively evaluate and demonstrate the representation learning capability of Deep Learning methods from a single 3D intraoral scan. This can enable building self-supervision methods for tooth segmentation under extreme data limitation scenario by leveraging the available data to the fullest possible extent.

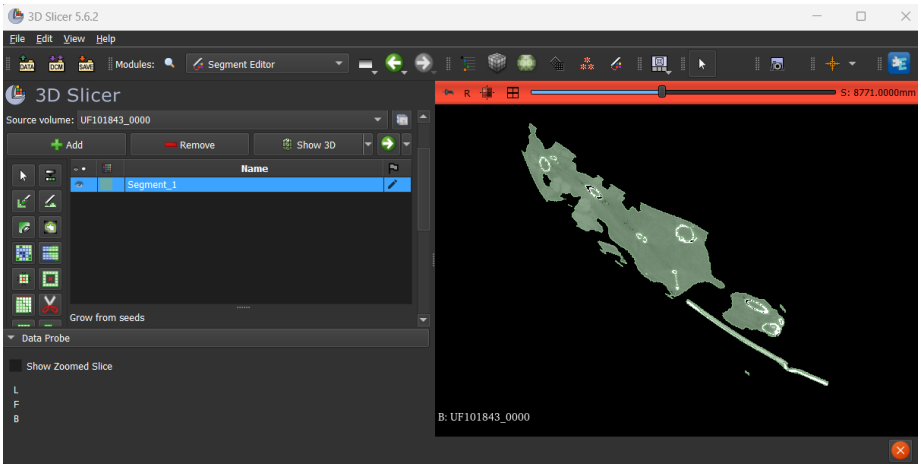
Link: https://arxiv.org/abs/2209.08132

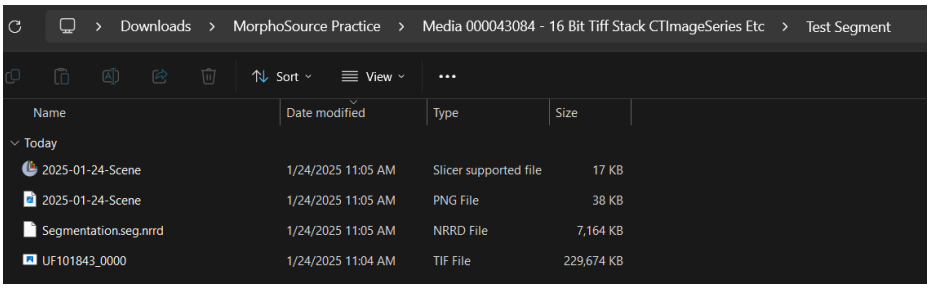
General summary: This paper explores how effective deep learning methods can be for automatically identifying teeth in 3D dental scans, even when trained on just one scan instead of many. It shows that a single scan can provide valuable information for segmentation, potentially reducing the need for extensive manual labeling.

What did you do and prove it

I download Anolis lizard CT scan data from MorphoSource to begin familiarizing myself with 3D Slicing for the project and to collect data for future research plan steps. I specifically investigated tuning thresholding and using mask volume to produce more accurate image data. The most difficult aspect of processing the image data was developing the intuition of how much threshold value to use as well as locating jaw sections of the lizard. These aspects will get better with time as I gain more experience in using 3D Slicer.







Additionally, I updated the Stroud lab webpage with my group's relevant information up to week 2 of this semester (see images below).