HAAG Weekly Report Week 1 s 2

Shuyu Tian

Lizard Jaw Segmentation

Jan 17, 2025

Time-Log

- Very brief sections of bullet points for the following:
    - **What did you do this week?**
        - My teammate Ming and I hosted a meeting with my internal project team (Ming, Philip, and Shuyu) on Wednesday at 5 PM EST.
        - We discussed prior progress made on the project and areas for improvement and further investigation, specifically on how the work done can be improved to become novel enough for publication
        - We gained access to past work done by Philip, specifically his GitHub repository and project documentation. We then reviewed the information
        - I signed up to be the Lizard Jaw Segmentation group's web manager
        - I developed an initial research plan with Ming, submitted last week
        - I gained access to MorphoSource to get access to data needed for research
    - **What are you going to do next week**
        - We will meet with our computational advisor on Monday, January 20th
        - We will resubmit our research plan based on feedback from Bree, specifically on how to execute our plan and reasoning behind our choices.
        - We will get access to data used by Philip to continue research
        - We will continue to read through the list of relevant research Philip provided
    - Blockers, things you want to flag, problems, etc.
        - N/A

Abstracts:

Abstract

Teeth reveal how organisms interact with their environment. Biologists have long looked at the diverse form and function of teeth to study the evolution of feeding, fighting, and development. The exponential rise in the quantity and accessibility of computed tomography (CT) data has enabled morphologists to study teeth at finer resolutions and larger macroevolutionary scales. Measuring tooth function is no easy task, in fact, much of our mechanical understanding is derived from dental shape. Categorical descriptors of tooth shape such as morphological homodonty and heterodonty, overlook nuances in function by reducing tooth diversity for comparative analysis. The functional homodonty method quantitatively assesses the functional diversity of whole dentitions from tooth shape. This method uses tooth surface area and position to calculate the transmission of stress and estimates a threshold for functionally homodont teeth through bootstrapping and clustering techniques. However, some vertebrates have hundreds or thousands of teeth and measuring the shape and function of every individual tooth can be a painstaking task. Here, we present *Dental Dynamics*, a module for 3D Slicer that allows for the fast and precise quantification of dentitions and jaws. The tool automates the calculation of several tooth traits classically used to describe form and function (i.e., aspect ratio, mechanical advantage, force, etc.). To demonstrate the usefulness of our module we used *Dental Dynamics* to quantify 780 teeth across 20 salamanders that exhibit diverse ecologies. We coupled these data with the functional homodonty method to investigate the hypothesis that arboreal *Aneides* salamanders have novel tooth functions. *Dental Dynamics* provides a new and fast way to measure teeth and increases the accessibility of the functional homodonty method. We hope *Dental Dynamics* will encourage further theoretical and methodological development for quantifying and studying teeth.

Link: https://academic.oup.com/iob/article/6/1/obae015/7668472

Summary

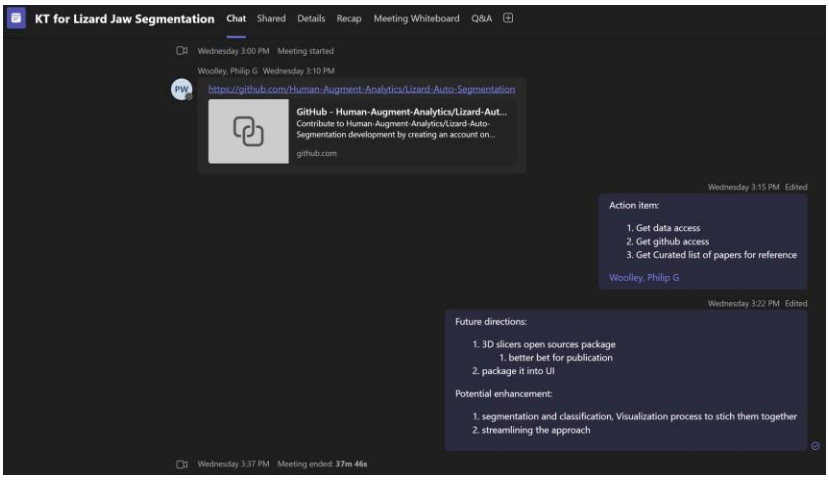
The paper shows a novel module named Dental Dynamics for 3D Slicer software to more quickly and accurately quantify tooth and jaw biomechanics. The tool automates calculation of key dental traits such as aspect ratio, mechanical advantage, and force transmission. The module was tested on teeth data from salamander species to show if they exhibit novel dental functions. The study demonstrated that different teeth shapes and sizes can result based on different methods, such as regionalization of stress in the jaw.

The paper is important to our research since the module presents a reference to how our module can and should work for jaw segmentation.

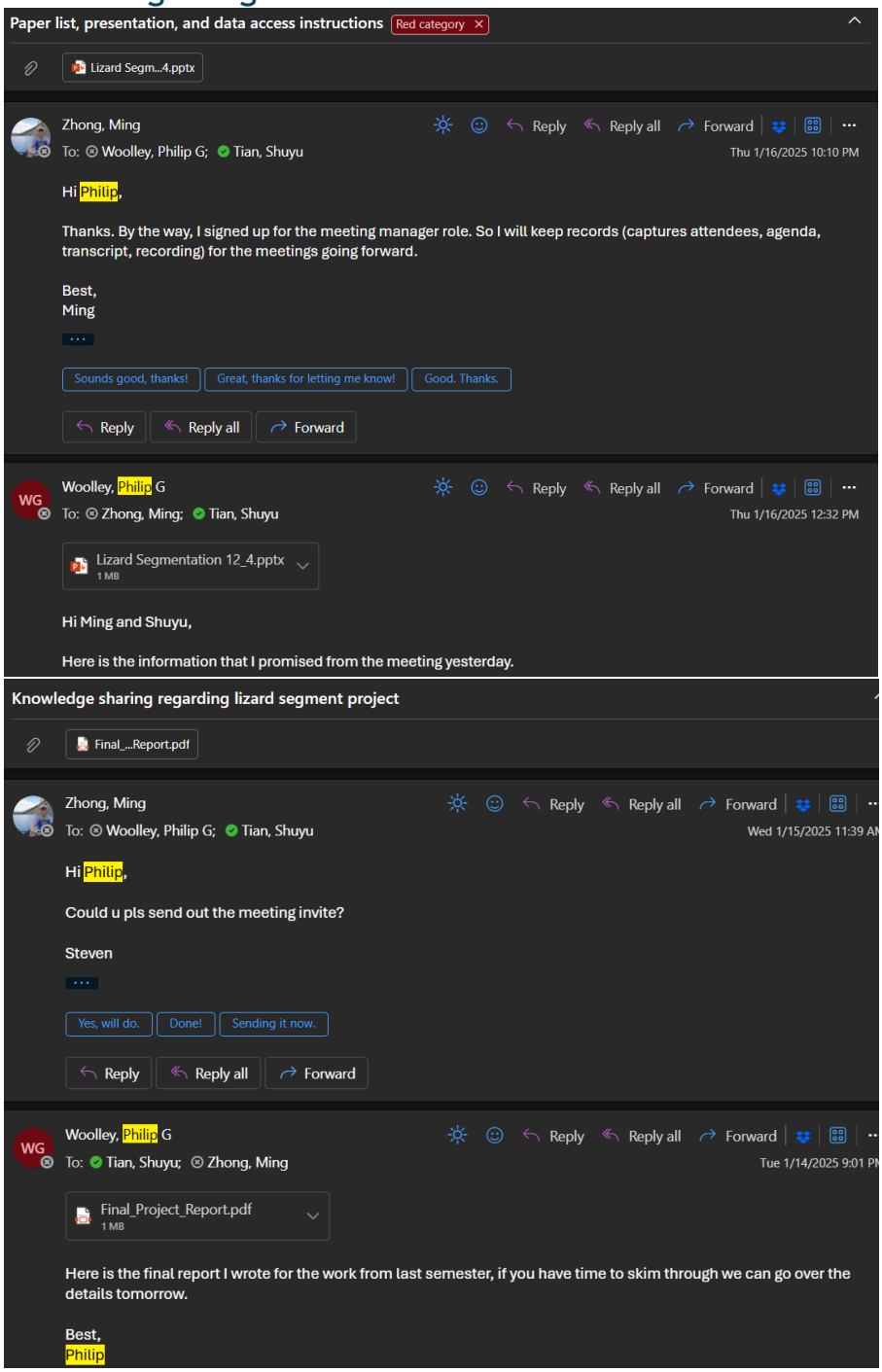
What did you do and prove it

I focused on understanding the overall progress of the project up to now and getting properly onboardeded. I began reviewing literature, documentation, and resources needed for advancing the project, such as Morphosource and previous researcher's Github repository.

Proof of meetings



Proof of getting access to literature



Paper list, presentation, and data access instructions Red category

Lizard Segm...4.pptx

Zhong, Ming — Reply | Reply all | Forward
To: Woolley, Philip G; Tian, Shuyu
Thu 1/16/2025 10:10 PM

Hi Philip,

Thanks. By the way, I signed up for the meeting manager role. So I will keep records (captures attendees, agenda, transcript, recording) for the meetings going forward.

Best,
Ming

Sounds good, thanks! | Great, thanks for letting me know! | Good. Thanks.

Reply | Reply all | Forward

Woolley, Philip G — Reply | Reply all | Forward
To: Zhong, Ming; Tian, Shuyu
Thu 1/16/2025 12:32 PM

Lizard Segmentation 12_4.pptx
1 MB

Hi Ming and Shuyu,

Here is the information that I promised from the meeting yesterday.

Knowledge sharing regarding lizard segment project

Final_...Report.pdf

Zhong, Ming — Reply | Reply all | Forward
To: Woolley, Philip G; Tian, Shuyu
Wed 1/15/2025 11:39 AM

Hi Philip,

Could u pls send out the meeting invite?

Steven

Yes, will do. | Done! | Sending it now.

Reply | Reply all | Forward

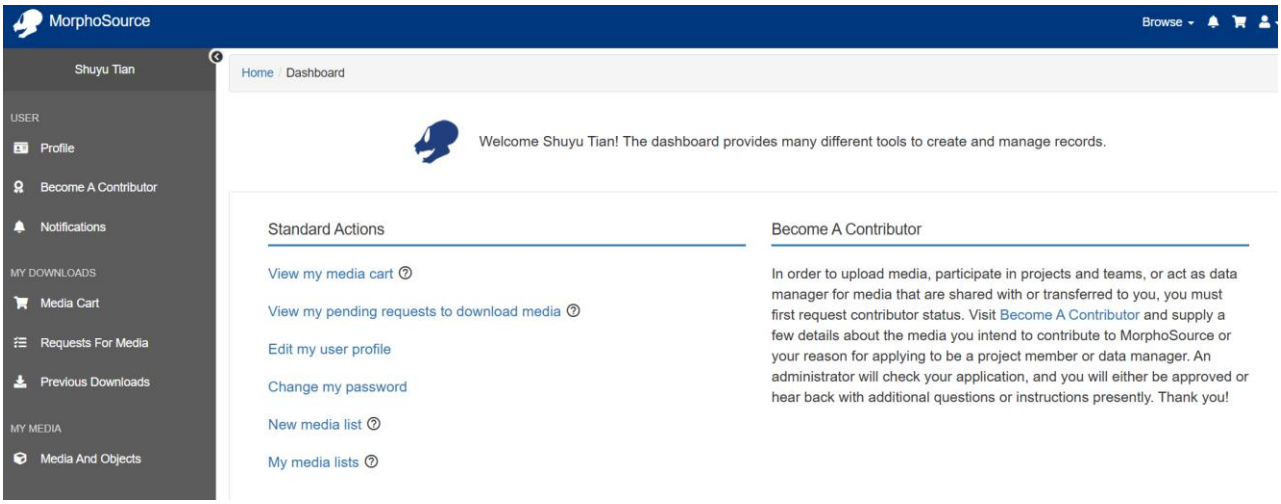
Woolley, Philip G — Reply | Reply all | Forward
To: Tian, Shuyu; Zhong, Ming
Tue 1/14/2025 9:01 PM

Final_Project_Report.pdf
1 MB

Here is the final report I wrote for the work from last semester, if you have time to skim through we can go over the details tomorrow.

Best,
Philip

Proof of getting access to MorphoSource



Proof of getting access to Github repository