Computational Measurement of *L. variegatus* Volume

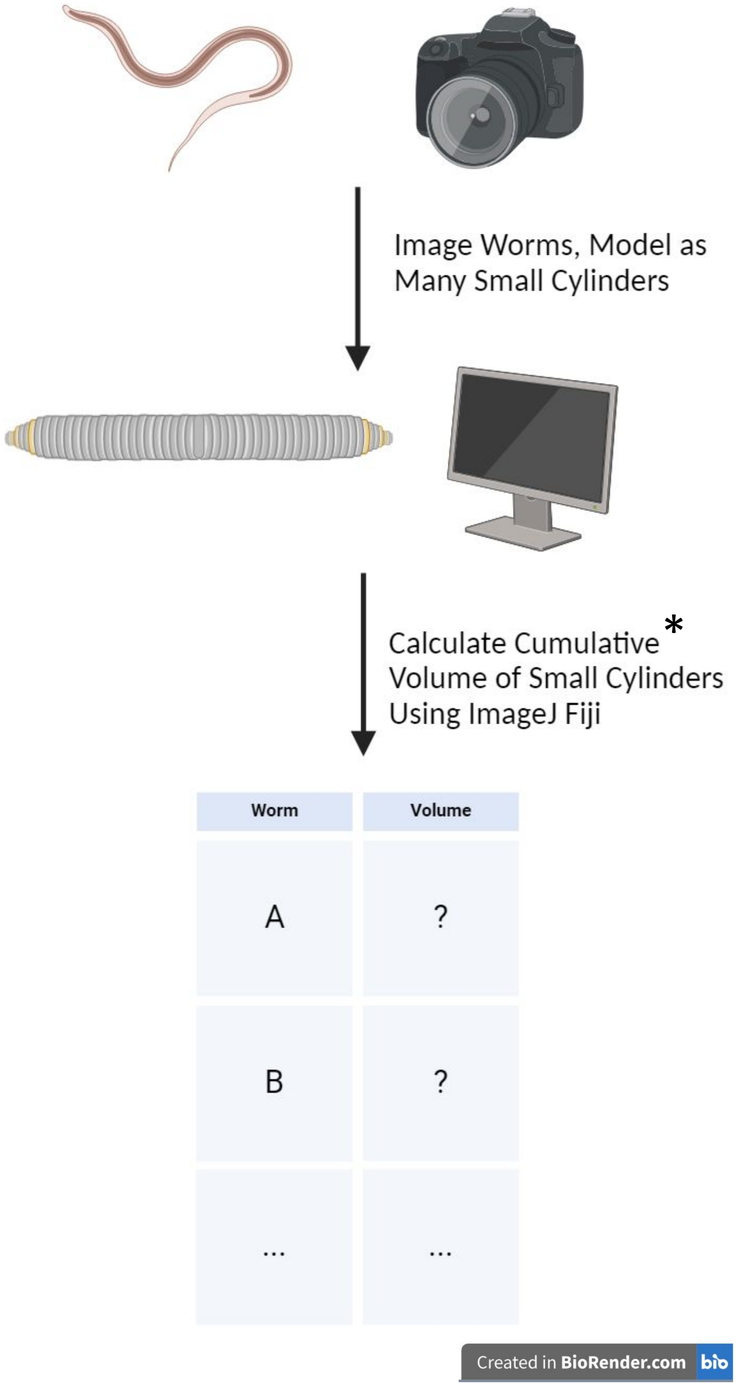
Zachary L. Baker, Dr. Erin Leatherman, Dr. Kathy Gillen
COMP401 Seminar, Kenyon College

Introduction

- *Lumbriculus variegatus* can fully regenerate from small segments
- Many experiments depend on measuring worm regeneration
- Current way to measure regeneration require extensive human input (time-consuming, subject to bias)

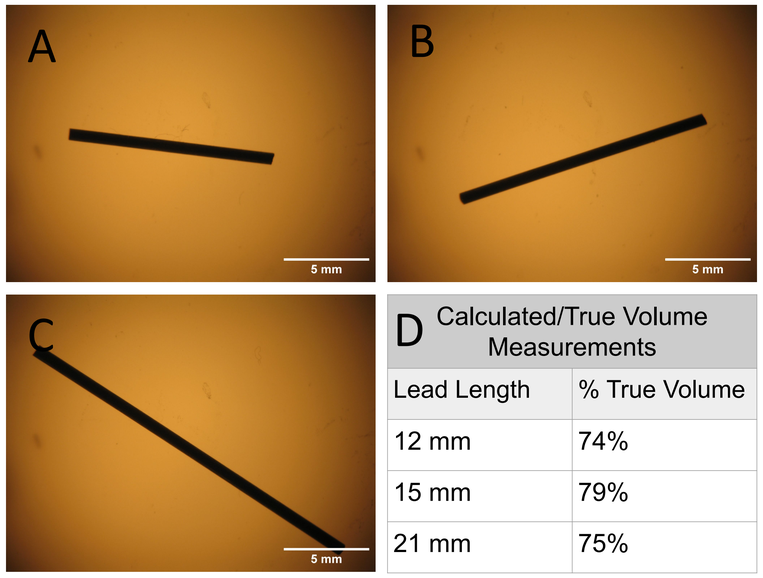
Goal: Create an ImageJ[1] Fiji[2] Macro to Measure Volume

Methods



*2D Measurements Collected with Fiji Ridge Detection Package[3]

"Similarly Wrong" Measurements



D Calculated/True Volume Measurements	
Lead Length	% True Volume
12 mm	74%
15 mm	79%
21 mm	75%

Figure 1. Calculation Consistently Inaccurate. Mechanical pencil lead 0.7 mm in diameter was sectioned, its length measured, and its true volume calculated. These lead pieces (Lengths: 12 mm [A], 15 mm [B], 21 mm [C]) were imaged and their volume was calculated using my macro. These measurements were divided by the respective true volume to calculate "% True Volume" (D). (n = 1).

Testing Calculation Precision

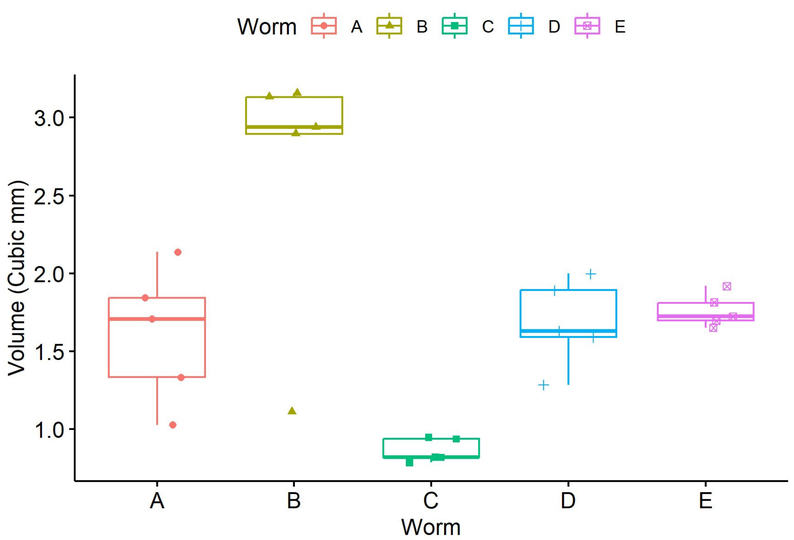


Figure 2. Worm Volume Shows Inconsistent Variance. Five *L. variegatus* were each placed under a microscope, imaged, and their volume measure using my macro. The large differences in variance between worms may suggest issues with image quality. (n = 5).

Conclusions

- Program Can Inaccurately but Consistently Measure Volume of Standard Object
  - Experiments/later code must account for inaccuracy
- Worm Movement Does Not Seem to Greatly Affect Volume Measurements
  - High variance is likely due to the use of low contrast images and shadows, possible bugs

Future Directions

- Test Program Using Higher Contrast Images
- Test Sensitivity of Program to Determine if it Can be Used to Measure Regeneration
- Further Develop Program to Measure Worm Regeneration
  - Divide volume of regenerated tissue by volume of worm right after cut

References

1. Schneider, C. A., Rasband, W. S., & Eliceiri, K. W. (2012). NIH Image to ImageJ: 25 years of image analysis. *Nature Methods*, 9(7), 671–675.
2. Schindelin, J., Arganda-Carreras, I., Frise, E., Kaynig, V., Longair, M., Pietzsch, T., … Cardona, A. (2012). Fiji: an open-source platform for biological-image analysis. *Nature Methods*, 9(7), 676–682. doi:10.1038/nmeth.2019
3. Wagner, T., Hiner, M., & Xraynaud. (2017). thorstenwagner/ij-ridgedetection: Ridge Detection 1.4.0 (Version v1.4.0). *Zenodo*. doi:10.5281/ZENODO.845874

Acknowledgements

I thank Professor James Skon and all members of the Spring 2024 COMP 401 Senior Seminar course for their attention and input throughout this project. I also thank Kenyon College and its Computing Department for providing a platform to complete this work.