Microtomographic investigation of a large corpus of cichlids

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Abstract

A large corpus of Cichlids from Lake Victoria in Africa spanning a size range of 6 to 20 cm was nondestructively imaged using micro-computed tomography. The presented manuscript describes a method to efficiently obtain three-dimensional tomographic data sets of the oral and pharyngeal jaws and the whole skull of these fishes. We describe in detail how the data has been acquired to aid in reproducible research. The tomographic data we acquired (8.6 TB projection images and 1.4 TB reconstruction images) are used for further projects, an outlook on two of them; a morphological description of the oral and pharyngeal jaws of the fishes as well as a principal component analysis of landmark features on the fish skulls.

Introduction

History

- Cichlids from Lake Victoria
- Sample ‘library’ of EAWAG
- Valuable, hence non-destructive imaging is *paramount*

micro-CT

- Nondestructive imaging of a diverse kind of samples
- Ideal method to provide insight into *these* samples
- Has been used to investigate fishes before, e.g. ‘fishguy’[1] [1].

Materials and Methods

Preparation of fishes

- Collection
- Storage in 75% Ethanol.

micro-CT imaging

- Scanned on the 1272 (some fishes) and the 2214 (most of the fishes)
- 8.6 TB of projections
- 1.4 TB of reconstructions

Data analysis

Preparation for analysis

Image processing

We wrote a set of *Jupyter* [2] notebooks with *Python* code to work with the images and wrangle the acquired data. The notebooks were written at the start of the project, to be able to process new scans as soon as they were reconstructed. Re-runs of the notebook added newly scanned and reconstructed fishes to the analysis, facilitating a nearly constant quality check of the scans and batched processing of the data.

All Jupyter notebooks for this work are available online [3].

Extraction of OJ and PJ

- Details needed from Mikki on how she did it exactly

PCA of skull landmarks

- Very superficial description of work from Kassandra. We do *not* want to cannibalize her upcoming manuscript, but only hint at what will be done.

Results

- A lot of fishes
- A lot of scans
- A lot of data

Discussion

The discussion of the results and the outlook to what we'll do in the future is going into this file here.

Acknowledgments

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1. For which David made a tomographic scan of an adult zebrafish ages ago.↩