Is it worth spending so much time? A comparative study on micro-CT segmentation techniques for quantitative investigations of bone.

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Bone inner structure is of great interest in vertebrate evolution studies, because it is known to bear a strong functional signal and is often well conserved in fossils. Micro-computed tomography (µCT) is a widespread and non-destructive technique that provides three-dimensional density images of both fossil and modern bones. Scanning parameters can substantially vary between the data acquisitions pending on the X-ray beam (e.g. clinical or laboratory CT scanner, synchrotron radiation -SR- µCT), the object size and chemical composition. This results in huge differences in the contrast quality between the osseous tissue and other materials constituting the bone (soft tissues or infilling sediment in fossil specimens for instance).

The trabecular architecture of the bone requires a segmentation technique in order to be described. Various approaches exist, from manual to fully automatic, and choosing one is a trade-off between time, accuracy, reproducibility and robustness to poor-contrasted images. We here evaluate different segmentation methods: manual segmentation, half mean height thresholding (1), local thresholding (2) and MIA Clustering (3) for both laboratory and SR µCT, modern and fossil taxa, complete bones or regions of interest. We measure the impact on the quantitative analysis of the trabecular bone using the BoneJ plugin (4) of ImageJ (5) and then discuss the optimal segmentation strategies.

References

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