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Conference Abstract

All Our Eggs In One Basket: Challenges of High Resolution X-Ray Micro-Computed Tomography of Great Auk *Pinguinus impennis* Eggshell

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Abstract

High resolution X-ray micro-computed tomography gives the ability to research objects in unprecedented detail in 3D without damaging them but applying these new techniques to specimens can be complex. In 2017 the Natural History Museum (NHM), London embarked on a ground-breaking project with University of Sheffield to compare extinct Great Auk *Pinguinus impennis* eggshell microstructure to that of their extant relatives to gain new insight into their breeding ecology.

NHM has a ZEISS Xradia 520 Versa X-ray microscope capable of submicron X-ray imaging in 3D but using it required supporting and moving complete eggshells within the confined, potentially harsh, mechanised environment of the microscope without risk. Ensuring the correct position and orientation of each egg to image nine distinct areas on the eggshell was also a challenge. Collaboration with colleagues in the NHM Conservation and Imaging & Analysis Centres developed a bespoke solution to hold and protect the eggs during scanning. All six NHM Great Auk eggshells and the inside of the microscope were surface

scanned using a handheld structured light scanner. Scan data produced 3D models from which accurate 3D printed plastic replicas were made of the three Great Auk eggs prioritised for research. Each replica was used to mould a two-part, custom-built, case for each egg constructed from conservation grade epoxy putty and lined with polyethylene foam. This provided close-fitting, durable cases which could be used for the 6-month duration of the project. Each case enclosed its matching Great Auk egg entirely and had the advantage of being rock-hard, electrically insulating and water, heat and chemical resistant. A system of three, interchangeable, tailor-made mounting brackets were designed that married with the cases and held them safely and precisely inside the microscope at the correct angles and positions for imaging. The structured light scan of the inside of the microscope was used to model the necessary rotational movements of the cases and brackets inside the scanner, ensuring that all movements had sufficient clearance to avoid risk of impact. This system successfully protected the fragile c. 200 year old eggs throughout 70 scanning sessions. This provides a methodology for high resolution X-ray micro-computed tomography imaging of any similarly sized, fragile, object.

Keywords

X-ray microscopy, eggs, imaging, research

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