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Core-CT: A MATLAB application for the quantitative analysis of sediment and coral cores from X-ray computed tomography (CT)

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X-ray computed tomography (CT) is a non-destructive imaging technique that provides three-dimensional (3D) visualisation and high-resolution quantitative data in the form of CT numbers. CT numbers are derived as a function of the X-ray energy, effective atomic number and density of the sample. The sensitivity of the CT number to changes in material density allows it to successfully identify facies changes within sediment cores by detecting downcore shifts in sediment properties, and quantify skeletal linear extension rates and the volume of internal voids from biological erosion of coral cores. Here we present two algorithms to analyse CT scan images specific to geoscience research packaged within an open source MATLAB application (Core-CT). The first algorithm facilitates the computation of representative CT numbers from a user-defined region of interest to identify boundaries of density change (e.g. sedimentary facies, laminations, coral growth bands). The second algorithm enables the segmentation of regions with major density contrast (e.g. internal void space or biogenic material) and the geometric measurements of these irregularities. The versatility of Core-CT for geoscience applications is then demonstrated by utilising CT scans from a range of environmental settings comprising both sediment (Lake Huelde, Chile and Kallang River Basin, Singapore) and coral cores (Thuwal region of Red Sea, Saudi Arabia). Analysis of sediment cores show the capabilities of Core-CT to: 1) locate tsunami deposits from lacustrine sediments, 2) provide rapid and detailed measurement of varved sediments, and 3) identify sedimentary facies from an unsplit shallow marine sediment core. Analysis of coral cores allow us to successfully measure skeletal linear extension from annual growth bands, and provide volumetric quantification and 3D visualisation of internal bioerosion. Core-CT is an accessible, multi-use MATLAB based program that is freely available at GitHub (<https://github.com/yutingyan/Core-CT>).