QUANTIFYING AND ANALYZING SURFACE FEATURES IN FOSSILS USING 3D DATA

MILLER, Daniel J. and PAPPAS, Janice L., University of Michigan Museum of Paleontology, The University of Michigan, 1109 Geddes Ave, Ann Arbor, MI 48109-1079, djmill@umich.edu

Characterizing the surface features of organisms can be useful for addressing a wide range of questions in paleontology and neontology. The ability to do so in a quantitative and explicit way permits analysis both within and across data sets. In this study, we use digital close-range photogrammetry to extract 3D coordinates that are then used to characterize surfaces. We use standard statistical parameters used in metrology, such as general surface roughness (average), degree of surface roughness (root mean square), preponderance of either peaks or valleys present on the surface (skewness), and degree of peakedness (kurtosis), as well as direction of change in surface roughness (root mean square slope). All of these parameters incorporate height and spacing information about the peaks on the surfaces of specimens.

In addition, we also explore the potential application of spatial series analyses to characterize surfaces where spatial series take the form of sequential changes in surface features of a specimen. All calculations can be performed at different scales and on single or multiple patches from each specimen's surface. Degree of continuity between patches or matching patches on a specimen surface is another potential way to quantitatively characterize surface features.

We characterize the surfaces of a variety of fossil invertebrates from different phyla and demonstrate the use of these metrics in quantitatively comparing surfaces in different specimens regardless of their taxonomic position. Surface statistics are also used to explore features and patterns at a variety of spatial and size scales. Although these metrics are statistical summaries of surface features, they nevertheless provide a more precise quantitative means of comparing widely disparate morphologies when compared to qualitative approaches. The use of explicit and easily compared surface statistics potentially facilitates the exploration of a wide variety of hypotheses pertaining to biomechanics, development, biogeography, systematics, and taphonomy.

2010 GSA Denver Annual Meeting (31 October –3 November 2010)