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Parameter Estimation of Fossil Oysters from High Resolution 3D Point Cloud and Image Data

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A unique fossil oyster reef was excavated at Stetten in Lower Austria, which is also the highlight of the geo-edutainment park “Fossilienwelt Weinviertel”. It provides the rare opportunity to study the Early Miocene flora and fauna of the Central Paratethys Sea. The site presents the world’s largest fossil oyster biostrome formed about 16.5 million years ago in a tropical estuary of the Korneuburg Basin. About 15,000 up to 80-cm-long shells of *Crassostrea gryphoides* cover a 400 m^2 large area. Our project “Smart-Geology for the World’s largest fossil oyster reef” combines methods of photogrammetry, geology and paleontology to document, evaluate and quantify the shell bed. This interdisciplinary approach will be applied to test hypotheses on the genesis of the taphocenosis (e.g.: tsunami versus major storm) and to reconstruct pre- and post-event processes. Hence, we are focusing on using visualization technologies from photogrammetry in geology and paleontology in order to develop new methods for automatic and objective evaluation of 3D point clouds. These will be studied on the basis of a very dense surface reconstruction of the oyster reef. “Smart Geology”, as extension of the classic discipline, exploits massive data, automatic interpretation, and visualization. Photogrammetry provides the tools for surface acquisition and objective, automated interpretation.

We also want to stress the economic aspect of using automatic shape detection in paleontology, which saves manpower and increases efficiency during the monitoring and evaluation process. Currently, there are many well known algorithms for 3D shape detection of certain objects. We are using dense 3D laser scanning data from an instrument utilizing the phase shift measuring principle, which provides accurate geometrical basis < 3 mm. However, the situation is difficult in this multiple object scenario where more than 15,000 complete or fragmentary parts of an object with random orientation are found. The goal is to investigate if the application of state-of-the-art 3D digitizing, data processing, and visualization technologies support the interpretation of this paleontological site. The obtained 3D data (approx. 1 billion points at the respective area) is analyzed with respect to their 3D structure in order to derive geometrical information. The aim of this contribution is to segment the 3D point cloud of laser scanning data into meaningful regions representing particular objects.

Geometric parameters (curvature, tangent plane orientation, local minimum and maximum, etc.) are derived for every 3D point of the point cloud. A set of features is computed in each point using different kernel sizes to define neighborhoods of different size. This provides information on convexity (outer surface), concavity (inner surface) and locally flat areas, which shall be further utilized in fitting model of *Crassostrea*-shells. In addition, digitizing is performed manually in order to obtain a representative set of reference data for the evaluation of the obtained results. For evaluating these results the reference data (length and orientation of specimen) is then compared to the automatically derived segments of the point cloud.

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