Statistical and 3D Artifact Analysis

Session Overview

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The contributions to this session and the discussions which they evoked, addressed two related topics: (a) The recent developments of 3D scanning, recording and display techniques aimed to support archaeological research, (b) The new questions and research directions which become accessible due to the enormous increase in the detail and accuracy which the modern techniques offer. In this short note I would like to outline the common thread which connects the seemingly separate and rather diverse contributions to the session, and try to extrapolate and indicate promising research directions and applications.

Harnessing computerized methods to record and store archaeological data was originally aimed at solving severe problems which delay and hamper the publication of contemporary excavations, and in particular, pose insurmountable obstacles in their systematic analysis. These difficulties are acutely noticed in the study of pottery – the most abundant finds in many cites. The traditional recording of pottery is based on hand drawn images. The drawing is time consuming, and the resulting accuracy depends on the skill of the draftsman. The semi-automatic 'profilograph' provides uniform machine accuracy (~.3 mm), but the real breakthrough seems to be offered by the new generation of scanning cameras.

The 'profilograph' scans the object along selected features (section profiles, boundaries, rims, bases) and the measured data is transmitted to a computer. The scanning is done manually, and hence a recording of a single profile is only marginally faster than the drawing by an experienced draftsman. Due to its relatively low cost (approximately 1/10 of the price of a scanning camera), the use of the 'profilograph' is spreading, and one of the papers presented in the session is based on data measured with a 'profilograph' (A. Karasik).

The scanning cameras can provide almost complete 3 dimensional representations of the objects at the same level of accuracy as the 'profilograph'. Moreover, such attributes as decorations, colors and texture can be rendered as well. This is a true technological leap which might revolutionize many aspects of archaeological research and documentation.

3D acquisition systems were described in the talks of C. Laugerotte and M. Kampel. The digitized data can be electronically stored and retrieved, and further elaborated using advanced display techniques. The full power and beauty of modern computerized visualization was demonstrated in M. Kampel's examples.

The availability of detailed and accurate digitized information of the artifacts, opens a vast field of applications which was hitherto completely out of reach. Some of the papers presented in our session explore this new domain. Two of them use the 3D data on fragments to reconstruct the original whole. C. Laugerotte's paper describes the computerized reconstruction of a Gothic spire from its excavated fragments, while M. Kampel's work deals with the computerized restoration of pottery from shards. In the former work, the property which was used to position the fragments in the correct proximity and relative orientation was the symmetry of cross sections. In the later work, the original vessel was assumed to have cylindrical symmetry, and the computation of the best symmetry axis for each fragment was an essential step in the reconstruction process. The definition of "proximity", "symmetry" or "similarity" is not unique, and the choice of the most appropriate definition depends on archaeological rather than mathematical considerations. Similar questions have to be addressed when typological classification of ceramics is addressed (A. Karasik's papers). The archaeological data is only approximately symmetric, and a common problem for all the approaches mentioned above is to minimize the uncertainty introduced by these imperfections. The "adverse" effects of imperfect objects – and most archaeological finds are imperfect – is turned into an advantage in the analysis described by A. Karasik. The degree of deviation from perfect symmetry of individual vessels (or assemblages) can be measured, and used to trace production patterns and technological development. The authors even propose that these non uniformities might characterize the style or skill of potters and workshops.

To summarize, the abundant data retrieved by modern scanning devices, may help to overcome some of the difficulties encountered in archaeological research. It also opens new possibilities which are far from being exhausted, and the extraction of the potential advantages require the development of new ideas and concepts which will have to be incorporated into the future archaeological research.

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