Special Issue on Digital Domains

Introduction

Jason T. Herrmann, Guest Editor

More and more archaeologists who once relied on shovels and surveys now regularly collect data with digital sensors and use computer-based management systems to carry out complex analyses. Geographic information systems (GIS) and geographic information science (GISc), satellite remote sensing, aerial and close-range photography, terrestrial and aerial Light Detection and Ranging (LiDAR), near-surface geophysics, and a wide array of visualization schemes designed to integrate and display data from multiple platforms are now integral to every stage of archaeological investigation, interpretation, and reporting. Even though these methods are an increasing part of archaeological research worldwide, there have been few conferences, meetings, or workshops dedicated to sharing methods and applications in digital archaeology in North America or even in the Western Hemisphere, with the exception of a few special sessions in regional or general archaeological conferences. This deficit is particularly striking in comparison with the situation in Europe, where several societies dedicated to archaeological geomatics regularly hold both continental and regional meetings.

Still, North American scholars and practitioners have a growing number of opportunities to engage the community of digital archaeologists. Among them is the National Park Service's Archaeological Prospection Workshop organized by the Midwest Archaeological Center, which meets for a week every year in a U.S. National Park and brings students, state and private archaeologists, tribal archaeologists, and academics interested in learning more about remote sensing together with a group of five to ten experts to get hands-on experience using near-surface geophysical equipment. A growing number of professional societies and conferences offer specialists and non-specialists alike the chance to share methods and applications, including the North American chapter of Computer Applications and Quantitative Methods in Archaeology and the International Society of Archaeological Prospection. The UNESCO-supported International Conference on Remote Sensing in Archaeology will have its fifth meeting, "The Age of Sensing," at Duke University in October, 2014. Finally, more and more universities have established laboratories dedicated to digital methods; foremost among them is the National Science Foundation-funded Spatial Archaeometry Research Collaborations (SPARC) at the University of Arkansas, a program dedicated to promoting geospatial research in archaeology by providing resources and expertise in data collection in the field, guidance through data analysis, and assistance in publishing and archiving geospatial data and models.

In the same spirit of promoting communication among digital archaeologists, this special issue presents contributions from some of the participants of the Digital Domains Conference, held at Dartmouth College in March, 2014, with sponsorship from the Neukom Institute for Computational Science. The intention of this meeting was to foster an exchange of ideas among representatives of a variety of archaeological research communities—scholars working in different world regions, academic and public archaeologists, specialists, and non-specialists—and to bring students into contact with more experienced, senior archaeologists. On the one hand, the high concentration of specialists encouraged participants to share, compare, and contrast applications, technologies, and results from different environments. On the other, the inclusion of non-specialists and students allowed us to bridge the gap between users at different levels and to create new opportunities for research and apprenticeship. While commonalities abounded, as in the other forums listed above, a diverse range of methods, applications, and research interests were represented at the Digital Domains Conference and are assembled in this special issue of *Advances in Archaeological Practice*.

Balloons, kites, and unmanned aircraft of all sizes are now a common sight on archaeological excavations as a means for collecting high resolution images of archaeological phenomena. Steve Wernke and his colleagues tested several options for collecting aerial images in a high altitude environment as they mapped the site of Mawchu Llacta, a large colonial-era settlement in the southern highlands of Peru that was occupied from the Late Horizon period (1450–1532 C.E.) to the Republican Period in 1843. Wernke and colleagues sought inexpensive and

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portable unmanned aerial vehicles to create photogrammetric reconstructions of landscapes and standing architecture. Aerial images were combined with data from mobile GIS to create a high-resolution three-dimensional data registry of natural and cultural features.

Jason Herrmann, Jason King, and Jane Buikstra use pseudo-three-dimensional data from magnetic gradiometry, ground-penetrating radar, and electrical resistance tomography to map the interior structure of Middle Woodland Period mounds in the Lower Illinois Valley. Their research introduces remote sensing to the already rich tradition of research on earthen mounds at the Center for American Archeology to avoid disturbing human remains. They show that they can increase the sample of mounds where the internal structure has been mapped and yet avoid destructive excavation. Their goal is to trace spatiotemporal variation in internal mound structure in the Lower Illinois River Valley during the Middle (200 B.C.E.–450 C.E.) and Late (450–1150 C.E.) Woodland Period.

Elizabeth Stone describes procedures for using high-resolution satellite imagery to map architectural plans at urban sites in southern Mesopotamia that date from the fourth to the first millennia B.C.E. In this case, satellite imagery provides access to archaeological sites and environments where access is limited by the geopolitical climate. The layout of public and domestic architecture is visible in sub-meter imagery from Quickbird, WorldView 1, and WorldView 2 satellites by virtue of the interaction between a water table that is elevated for agricultural irrigation and the evaporation cycle, which enhances the contrast between mud-brick architecture and the surrounding soils. Stone demonstrates that these data not only are a valuable management tool in the face of political instability, but also can be used to answer larger anthropological questions about social organization in early urban settings.

Meghan Howey and her colleagues track surface temperature as recorded in NASA Moderate Resolution Imaging Spectroradiometer (MODIS) imagery to identify differences in seasonal cycles in inland lakes in Michigan. They find that large lakes create microclimates with extended growing seasons that would have been more favorable for maize agriculture. This research highlights some of the advantages of moderate resolution data for archaeological research, specifically the potential for serial imaging to measure environmental response and the ability to examine large areas. By reconstructing these environments, this research helps to shed light on mound building and settlement strategies during the Late Precontact period (1200–1600 C.E.) in the Great Lakes Region.

One of the now more well-known examples of how low-altitude remote sensing has contributed to archaeological scholarship comes from Maya Caracol in western Belize. There, efforts to capture the distribution of archaeological features have been hampered by dense tropical vegetation. LiDAR survey, first undertaken in 2009, proved to be an unprecedented resource for analyzing urban and rural settlement patterns, as well as ancient relationships between human activity and the environment. Here, Chase and colleagues present the results of the 2013 survey, contributing to expansive LiDAR coverage that is changing how we see Caracol in relation to the wider landscape and regional settlement patterns.

Finally, Jesse Casana discusses the benefits of manual analysis of aerial and satellite imagery over automated detection techniques. His contribution is informed by his CORONA research project, in which he used some 2,000 declassified satellite photos to map archaeological sites and landscapes over much of the Middle East, covering an area greater than 300,000 km^2. While he recognizes the practical and heuristic advantages of automatic site identification, Casana found that variability in site morphology and the background environment was too great for automated detection. Instead, he used a number of skilled analysts to map some 10,000 previously undocumented archaeological sites.

The contributors to this special issue of *Advances in Archaeological Practice* represent a broad range of backgrounds, methods, and research interests, but the broad applicability of the lessons and methods presented in each of the individual contributions will hopefully be apparent to the reader. A number of themes crosscut these articles, but at the broadest level all the contributions to this special issue represent a movement toward recognizing that remote sensing data can be used as a primary dataset in archaeological inquiry. Very often, remote sensing data are used to complement data from traditional archaeological fieldwork, or as a way to "see" across physical or political barriers. However, it is now becoming common to see remote sensing data as an independent and central line of evidence in anthropological archaeology (Conyers 2010; Conyers and Leckebusch 2010; (Kvamme 2003; Kvamme 2008; Thompson 2014; Thompson et al. 2011). Each of the contributions here are examples of how digital data can constitute a major part of archaeological anthropology.

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