Columbia University Scholars Win $2 Million National Science Foundation Information Technology Grant to Develop New Tools for Digital Archaeology

The National Science Foundation has awarded a $2 million grant to a group of Columbia University scholars from computer science, earth and environmental sciences, anthropology, historic preservation, classics, and art history and archaeology to create new computational tools for modeling, visualizing, and analyzing historic structures and archaeological sites. The five-year project will focus on Columbia's new excavation at Amheida in Egypt's Western Desert as a field center for cross-disciplinary scientific, environmental, cultural, and archaeological research and education in collaboration with Columbia's Media Center for Art History, Archaeology, and Historic Preservation.

The endeavor will explore and document the historically and culturally complex site using a variety of advanced techniques—including a laser scanning device mounted on a mobile robot and ground-penetrating radar for recording sub-surface structures. This information will be used to construct a three-dimensional, photo-realistic model linked to a database of the entire site. This dynamic model and database will help record and annotate archaeological information and the physical environment; target opportunities for excavation; conserve structures and artifacts and reconstruct their context for an interpretive center for visitors to the site in Egypt; and serve as the basis for distance learning Internet-based college and pre-college level education in science, engineering, social sciences, and the humanities.

There are five major scientific components to this research:

1. Developing new methods of creating complex, three-dimensional, photo-realistic, interactive models of large historical and archaeological sites.

2. Developing new methods to image below-ground data accurately and efficiently. These methods are especially suited to modeling the wealth of sub-surface information at archaeological sites.

3. Developing new database technology to catalogue and access a site's structures, artifacts, objects, and their context. This will significantly improve a user's ability to query and analyze a site's information.

4. Developing a system to create a new class of information visualization systems that integrate three-dimensional above- and below-ground models, two-dimensional images, text, and other web-based resources to annotate the physical environment. This system will support scientists in the field, as well as facilitate on-site interpretation and distance learning.

5. Developing an educational interface that will permit teachers and students to access the model and associated information over the Internet and to use it both in the classroom and at home. The goal is to allow flexible access on a variety of educational levels to a mass of emerging scientific and historic data to show how discovery and change are a part of both scientific and interpretive dynamic processes.
Computer Science Professor Peter K. Allen leads a group that encompasses a wide scope of knowledge and expertise, including Computer Science Professors Steven Feiner and Kenneth Ross, Earth and Environmental Engineering Professor Roelof Versteeg, Art History and Archaeology Professor Stephen Murray, Anthropology Professor Lynn Meskell, and Classics Professor Roger Bagnall. The project is co-administered with Columbia's Media Center for Art History, Archaeology, and Historic Preservation by Associate Director Maurice Luker and Staff Associate for Archaeology and Historic Preservation James Conlon who also serves as Assistant Field Director of the Amheida Excavation.

According to Professor Allen, "we could not have put this spectacular group together anywhere else except at Columbia-the mix of experts right here on our own campus is tremendous." Peter Allen is an expert in robotics and computer vision. Roelof Versteeg specializes in below-ground and non-invasive sensing. Kenneth Ross is an expert on databases and new methods of accessing data. Steven Feiner is at the forefront of user interface design and augmented reality research. Lynn Meskell is an authority on Egyptian archaeology and serves as Field Director of the Columbia Excavation at Amheida, Egypt. Stephen Murray is a leader in bringing historic monuments and sites alive through his use of new technology.

Developing new computational tools is a complex project that requires integration efforts between groups of researchers and technologies. The tools will be developed with archaeologists and tested at a unique site in Egypt's Western Desert, and also at the Cathedral of St. John the Divine in New York, adjacent to the Columbia campus. As the tools are developed, the team will bring them to Columbia's excavation at Amheida in the Dakhleh Oasis in Egypt. The site is unique in that it is previously unexcavated, and of significant size, and thus promises to be one of the most important excavations in Egypt. Amheida provides a unique opportunity to confront the central issues of Egyptian settlement archaeology in a site that is already producing an impressive array of artifacts, architecture, and wall painting.

This is a five year, multi-dimensional and multi-layered study. The project will begin with the creation of detailed and accurate site models, both above- and below-ground. As researchers continue to unearth new material they can be combined into an interactive, query-capable database that will allow students and researchers access to a wide scope of learning materials related to the site. This database will also serve to direct new modeling efforts and integrate the efforts of all researchers on the team. This project will attract students and the public to the study of world heritage; provide an exceptional opportunity for active learning; and develop the capability to explore, analyze, critically evaluate and interpret material culture within historical contexts. Also, it will redefine the relationships among technology, faculty research, and curriculum content.