

# Companies Use RE to Help Restore Historic Sites

Reverse engineering allows companies to create accurate, 3-D computer models using laser scanners to record the tiniest of details, saving old statues and monuments from the ravages of age and disaster.

## John Connolly

Two companies have combined their engineering talents to help document two famous sites: the Lincoln Memorial in Washington, D.C. and the Parthenon in Athens, Greece. The Lincoln Memorial project was sparked by fears that the country's historic monuments could become terrorist targets. Shortly before the September 11 attacks, **Direct Dimensions, Inc.** (DDI) (Owings Mills, MD) — a reverse engineering company — had approached the government and asked if they could have permission to computer model the Lincoln Memorial as a preliminary to modeling the Parthenon. At the time, the U.S. Park Service would not give its permission, but following the attacks, Park Service officials reversed their decision.

In the case of the Parthenon, the return of the Olympic games has renewed interest in Greece as well as the structure itself. So, with techniques in hand, DDI and **Spatial Integrated Systems, Inc.** (SIS) (Rockville, MD) — a 3-D modeling and visualization company — demonstrated to American and Greek officials that advanced 3-D technology could help them in their efforts to protect and restore their buildings.

The relationship between the two companies sprouted two years ago when both were working on the Parthenon block project. SIS and DDI decided that since they had reciprocal interests — as well as the tools and equipment to complement each other's work — it would be a good idea to work together. Complicating this project are the buildings themselves, dating from periods when architects didn't need to create detailed drawings. Fine detail work was usually conveyed from the designer directly to the craftsman in the field.

“For the Lincoln Memorial, we had access to several surveys and records. The Parthenon is a victim of war and age, with large, jigsaw puzzle-like pieces of the temple lying all around it. The work we have planned includes analyzing our laser-scanned survey data and comparing it to drawings of the Parthenon published in 1851 by Francis Penrose,” says Chris Korkalo, systems engineer for SIS.

### Lincoln's Memorial

The statue of Lincoln himself, as well as the decorative entablature and columns, are difficult to accurately portray with 2-D drawings. Through reverse engineering, the missing parts of these structures can and would be restored by curators working from 3-D models that accurately recreate the damaged areas.

The companies were given one day to obtain scans for research purposes and to demonstrate the equipment and capabilities to government representatives. SIS scanned views that included Lincoln's figure in the chair. Close to 20 shots were obtained, encompassing millions of point clouds ready for downloading in DDI's Pentium workstations. Subsequent post-processing over the next several weeks provided DDI with watertight STL files that it rapid prototyped. The scanned area included the front columns, the outer upper entablature, some

of the steps and a wall directly behind Lincoln's figure, including the inscription. The companies tested various parameters including scan resolution, times and rates, and data file sizes. Advanced software was utilized for the data's post-processing.

“The challenge to the Lincoln Memorial was to minimize our disturbance to the visitor's experience,” says Korkalo. “We roped off a small working area and used batteries for our equipment, which negated running a power cord across the chamber floor. For the scan, we needed a laser scanner with a large field of view to quickly capture a large number of points. We also needed to capture these points from fairly large distances. Some of our scans were 100 feet away. For the interior detail we were about 40 feet away. All of these aspects came into play when choosing which data capture tool to use.”

### Barriers in Greece

The Parthenon project is still on the drawing board and could go forward as early as next year. While the Greek government gave SIS and DDI the go-ahead, DDI says it is still waiting for a cash commitment from other sources. DDI began the project two years ago with a demonstration on a model of an actual “building block” from the Parthenon. The structure itself was almost

The Lincoln Memorial project was sparked by fears that the country's historic monuments could become terrorist targets.



Photo courtesy of Direct Dimensions, Inc.

completely destroyed in the 17th century and ever since has become a labor of love for Greeks interested in seeing it restored.

Today, the building has nearly 700 pieces lying around it belonging to specific areas within its walls. The original designers used construction features that provided unique locations for each block. The task for DDI would be to measure and model each block so that a computer can figure out where each piece fits into this ancient puzzle.

Measuring the Parthenon will present another set of challenges. Because the structure is in a constant state of repair, the site is always congested. Working around the other activities and then filtering out the unwanted data that does not pertain to the actual structure will be SIS's primary challenge.

Other challenges include equipment transfer to Athens and then to the Parthenon itself, which is on top of the Acropolis, overlooking the city. A quarter-mile pathway weaves its way from the parking lot to the site. The weather also will be a worry, along with finding a secure storage site and perhaps the most difficult barrier of all: understanding the language.

"Since we are engineers, we work hard to understand the purpose and requirements of the project and the end use of the models," says Michael Raphael, owner and engineer of

DDI. "We've mastered the 'design intent' technique in that we strive to engineer the models as the original designers intended them to be. Our techniques are relatively new and becoming more capable and affordable each day. The Greek and American governments created 2-D blueprints of these structures using conventional measuring tools. The issue we wrested with was how to capture the detailed art and contours in the architecture and sculpture — such as Lincoln sitting in his chair. You can take photos, but it is unlikely that they will be able to reproduce faithfully today."

TCT

*For more information contact **Michael Raphael** of Direct Dimensions, Inc. (Owings Mills, MD) at (410) 998-0880 or **Chris Korkalo** of Spatial Integrated Systems, Inc. (Rockville, MD) at (301) 610-7965.*

©2002 Communication Technologies, Inc., All Rights Reserved.

Reprinted from *Time-Compression Technologies* magazine. Contents cannot be reprinted without permission from the publisher.

**Time-Compression**  
**TECHNOLOGIES**