Objective

Designing new resources for visualizing archaeological sites is not a break with current or traditional archaeological techniques and practices, but an opportunity to engage and expand them. Our field methods then have then grown out of Archaeological thought and practice while also influencing them. The goal of our 2003 field season at Monte Polizzo was to digitally record the entire process of an archeological excavation as a test case for developing an archive of multimedia content—video, three-dimensional models, conventional and spherical photography, text and geographic information—to be used in a visually-based excavation report.

Field Methodology

Equipment

Our equipment consisted of a Cyrax 2500 laser scanner, Nikon CP 5000 and D100 digital cameras (the later mounted on the scanner), a Kaidan QuickPan III tripod head, a Leica TPS 700 total station, and Dell and Apple notebooks. The scanner is equipped with a power supply that provides enough power for an eight hours day. Every night the batteries required from four to six hours to come back to full charge. The Nikon camera's battery usually lasted two days of work when used with the scanner, but intensive site photography drained two batteries a day. We kept an extra battery as a backup and for keeping battery performance by avoiding recharging before a battery was fully drained. For the Leica total station we carried two batteries each lasting for
more than two days of work. The average number of points taken per working day was between forty and fifty, probably the reason for the Leica’s low battery consumption. We knew the computer's batteries would be problematic since a single battery would not last more than two and a half hours. The Dell notebook can run with two batteries giving enough power for a four or five hours working day. We took an extra pair of batteries for extend power supply. On average we would use three batteries at most.

*Defining a set of fixed points*

We adopted the coordinate system the Stanford excavations, and on the first day we established the necessary control points allowing us to setup the total station within this system. We also had decided prior to the field season that we would use targets to register all the scans together within the Cyra’s unique coordinate system. To work within both coordinate systems, we used a set of unique targets that we measured with both the total station and the scanner.

*Procedure*

Each day our group started just an hour before the excavations finished in order to limit interference between the excavation and the scanning process while maintaining a window of communication. The first day was the only exception—we tried to work while the excavation team was at the site, but this proved inconvenient for both groups. Each individual scanning session consisted of: 1) selecting the scanning area with the help of the archaeologists; 2) taking
the coordinates of our targets with the total station; 3) measuring the target's location with a low resolution 3D scan and identifying and acquiring the targets using the low-resolution scan (after acquisition, the targets were removed from the scene); 4) and taking a full resolution scan—an image was recorded with a digital camera while the final scan took place. The whole procedure took between 20 and 35 minutes. During each scan iteration, a minimum of two people were required to operate the scanner and the total station. Once the scanner was setup and the targets acquired, no more user intervention was necessary. On a typical day we would perform from six to seven iterations.

*Challenges*

The major bottleneck was the identification of the targets in the low-resolution scan, sometimes taking up to fifteen minutes. At times a target that had already been placed and measured with the total station would not be visible from the scanner position. Similarly, the lack of identifiable features in the low-resolution scan was also a problem that made the matching of the targets on the screen with the real targets difficult. Occasionally, measuring the targets with the total station would also turn out to be challenging. Certain locations were not visible from the total station and we had to use the prism pole to measure their location adding another potential source of error.

Moving the scanner, power supply and computer up to the Acropolis and then around the archaeological site was physically demanding. The scanner and power supply weight twenty pounds each, the computer and batteries five
pounds, and the total station another six. We were also carrying our food and water and other equipment. We used an steel backpack frame that allowed a single person to carry the scanner up the mountain on his/her back. Once on site, we tried to keep the scanner running even when moving from one position to the next as the device has an substantial startup time. If this was close to the current position and the path was an easy one, then we were able to move it while still on. However, this required at least 4 people: 2 to move the trip, one to move the computer and another one to look after the cables and alert of any possible tangling. This person would also watch our feet and made sure we were not damaging archaeological remains. When either the path or the distance to the next location was difficult or long, then we would shut everything down, remove the scanner from the tripod and set it up again.

Environmental conditions were also an issue of concern. Heat and dust were the main factors to take into account. It turned out that the scanner handled both very well. We did not experience any operational failure due to overheat, nor did we experience any sensing problem due to the dirt. Dust did accumulate on the scanner surface but we kept the scanner window clean. The Nikon camera did heat up easily after being in the sun for only a few minutes, and although we did not experience any failure, we took the precautions of either covering it or keeping it inside its bag when not in use. The computer heated up easily as well. If left uncovered, the touchpad would become too hot for use. Dust accumulated on the keyboard and on the screen, the latter being the biggest problem. It was difficult to see with a dusty screen and the intense sun and we improvised a hood
to limited success.