## LiDAR Reveals the Weedon Island Landscape

Large and complicated sites like Weedon Island present challenges for archaeological mapping with conventional technologies like transits and total stations, and even more so when they are covered by dense vegetation and have restricted access. It is perhaps not surprising, therefore, that published maps of Weedon Island are so lacking in detail.

Recent advances in Light Detection and Ranging (LiDAR) technology offer unprecedented opportunities for the detailed mapping and visualization of archaeological sites. In airborne LiDAR, instruments are mounted on a plane or helicopter (the process is sometimes referred to as airborne laser scanning [ALS]). The laser emitter-receiver scanning unit is used in conjunction with global positioning system (GPS) units on the aircraft and on the ground, as well as an inertial measurement unit (IMU) attached to the scanner. The IMU measures the roll, pitch, and yaw of the aircraft. The laser scanner on the aircraft sends hundreds of thousands of pulses of light per second to the ground and measures how long it takes each pulse to reflect back to the unit. These times are used to compute the distance each pulse traveled from the scanner to the ground. The GPS and IMU units determine the precise location and attitude of the laser scanner as the pulses are emitted, allowing an exact coordinate to be calculated for each point.

The large number of laser pulses, the variety of scan angles, and the redundancy of scans together ensure that at least some of the pulses generated by the LiDAR system will penetrate the forest canopy and reach the ground surface. Filtering algorithms rely on an analysis of the relative spatial variance of the echoes to differentiate terrain from off-terrain points (structures, trees, etc).Thus, the technology yields direct, three-dimensional measurements of the ground surface, vegetation, roads, and buildings. Archaeologists are generally concerned mainly with ground surface elevations.

In the U.S., airborne LiDAR data has been generated by state and federal agencies for environmental management. In Florida, for example, the Florida Division of Emergency Management (FDEM) has been collecting LiDAR data for coastal areas in the interest of emergency preparedness. But the data may also be used to map archaeological sites like Weedon Island.

The FDEM data is obtained in square "tiles" measuring 5000 feet a side. The Weedon Island site complex covers a minimum of six tiles, each of which contains tens of millions of data points. However, many of these data points pertain to roads and other structures rather than the terrain itself. Removing the unwanted points results in a total of about 12 million surface elevation points. These can be used to interpolate a digital elevation model (DEM), or representation of the ground surface. This, in turn, can be used to generate contours that show changes in elevation. Here are three maps of the site at increasing finer scale, each with 25 cm contour lines.