Field-based GIS mapping of topography using LRF and DGPS

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Topographic datasets such as topographic maps and DEMs (Digital Elevation Models) are fundamental material for various kinds of field-based sciences, although detailed topographic data suitable for field surveys are not always available. It is often expensive and time-consuming to obtain detailed topographic data by traditional or high-tech methods. For instance, measurements by plane-table survey or a total station require many operating persons and much time, whereas topographic data from high-resolution satellite imagery or airborne laser swath mapping are usually too expensive to be frequently utilized by individual researchers. The free topographic dataset of SRTM (Shuttle Radar Topography Mission) is widely available but often unsuitable for field surveys due to its coarse resolution.

A practical method of on-site quick acquisition of topographic data using a handheld LRF (Laser Range Finder) has been previously proposed, but its uncertainties sometimes exceed several to tens of meters due mainly to its method of setting measuring locations by only LRF. Here we show a more efficient method to obtain finer topographic data using LRF and DGPS (Differential GPS) with sub-meter accuracies, developed in an archaeological mound (the Hacitugrul Tepe) in Turkey. The measurement data are automatically transferred to a digital data-collecting device, and are integrated in GIS. The point cloud data obtained are then interpolated to a DEM using an appropriate interpolation function. The final dataset has sub-meter accuracies, and its resolution can be changed from ca. 10 cm to several meters by adjusting the point spacing of measurement. The application of this method is appropriate for topography in small to wide areas, approximately on the order of 10^2-10^9 m^2, whose data can be obtained within a few hours to days. It should be noted that the method of topographic measurement should be carefully selected considering the time, energy and expense for the measurement to have appropriate accuracy and resolution.