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GeoLiTE, an ArcGIS Extension to Assist in LiDAR Data Processing

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LiDAR (light detection and ranging) is an airborne remote sensing technology based on laser scanning techniques. It was developed as a fast and effective method to collect detailed topography data, even in rugged areas that were previously difficult or impossible to access. Through measuring the two-way travel time of the emitted laser pulses, the distance between the sensor and the target can be calculated. Thus, the elevation of the target and its geographic coordinates can be determined with the help of an onboard GPS (global positioning system) unit. The accuracy can be as good as 15 centimeters (about six inches) vertically and 30 cm to five meters (about one foot to 16.5 feet) horizontally.

LiDAR can assist foresters and other natural resources managers in many ways. First, accurate high-resolution DEM (digital elevation model) or contour data (such as two-foot contours) can be derived from processed bare-earth LiDAR data. This is extremely useful for designing roads, settling ponds, drainage channels, dams, and other features. Second, unlike other remote-sensing technologies, such as satellite imaging, airborne LiDAR instruments collect data for every point from which they receive a return echo, from bare earth, branches or leaves, rooftops, and other surfaces. In other words, a raw LiDAR dataset is a three-dimensional point cloud containing all this information, and thus it provides opportunities to study tree heights, densities, and crown widths, as well as gaps in a forest cover. Additional applications, such as volume and biomass estimation and stand-type classification, are also practical with LiDAR data or LiDAR data combined with multispectral images.

GeoLiTE was developed with C# and C++ programming languages and ArcObjects for ArcGIS 9.2 and later versions. From a data-processing workflow aspect, GeoLiTE can convert and sample raw LiDAR data, merge and clip multiple tiles, create DEMs, evaluate DEM accuracy, and run surface analyses. Several GeoLiTE functions may be of interest to foresters and other natural resources managers.

In general, LiDAR data are delivered in LAS or XYZ formats. If needed, GeoLiTE can covert an LAS file to XYZ format. Because of large file sizes, LiDAR data usually come in tiles, each covering a two-kilometer by two-kilometer (1.24-mile by 1.24-mile) area. Very often, a user's study area may need tens or hundreds of tiles of LiDAR data. GeoLiTE can merge these tiles together and clip the result with a user-defined boundary.

To provide high resolution, LiDAR datasets contain millions of points for a small area. However, not every application requires this high resolution. For such situations, GeoLiTE pr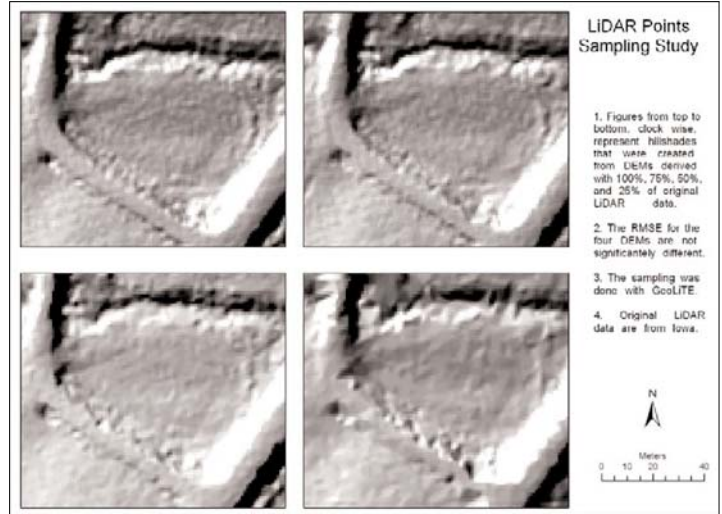ovides a convenient tool to randomly sample the points to retain only the user-specified percentage of points. We conducted one study in which we found that a one-meter resolution DEM derived from 25 percent of the original points has no accuracy difference compared with the DEM derived with all LiDAR points (Figure 1). However, the file size was reduced by 75 percent for storage purpose.

With ArcGIS, it takes many steps to create a DEM from LiDAR data. GeoLiTE combines all these steps together to one user interface in which you can derive DEM directly from XYZ file (Figure 2). Accuracy is often a paramount concern when DEMs are created. GeoLiTE's DEM accuracy evaluation function allows you to easily assess the accuracy of your LIDAR-derived elevation models. The general standard for DEM accuracy assessment is RMSE (Root Mean Square Error). Real Time Kinematic (RTK) GPS units can be used to collect independent reference data for the accuracy evaluation of LiDAR derived DEM. After reference data are collected, RMSE can be easily calculated with this GeoLiTE function.

In short, the free GeoLiTE program provides a shortcut for LiDAR data users with data processing, DEM generation, statistical analysis, and data visualization. GeoLiTE is available at www.geotree.uni.edu/geolite.aspx and www.faculty.sfasu.edu/zhangy2/download.htm. For questions or input regarding further development of this tool, please contact authors of this article.

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Figure 1. GeoLiTE can randomly sample all LiDAR data points to retain only the user-specified percentage of points.

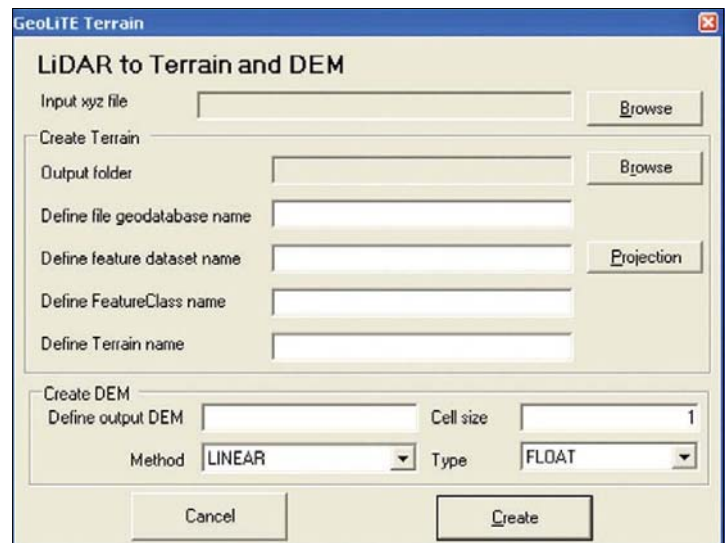Figure 2. The GeoLiTE user interface for deriving a digital elevation model (DEM) from LiDAR data.

A Forester's Professionalism

Do not judge a forester's professionalism by her attire during prescribed burning.

Ted Stubblefield's insinuation that Amy McFadden is less professional than he thinks appropriate is astonishing (Letters, September, in response to "Talking with Amy McFadden of White Oak Management," July). While I do not know Ms. McFadden directly, I am acquainted with her from e-mail correspondence and seeing her at meetings. I do know her by reputation, though, and I am familiar with her prescribed burning. She is a respected member of the forestry profession in South Carolina. Despite being hard-hatless and short-sleeved while stringing fire, her prescribed burns are as safe and effective as any other certified burner's in the state. She has been developing a growing business as a consulting forester for more than eight years. Her business appears to be as steady as any other small consulting forestry business in these difficult times.

My informal survey shows that nonindustrial private foresters who burn in South Carolina do not share Mr. Stubblefield's assessment of professionalism in prescribed burning. Few of us wear hard hats, some wear Nomex. Not once has a potential burning client asked me about my use of a hard hat or other personal protective equipment (PPE). Most, though, do quiz me about my ability to burn their woods safely and successfully without damaging their woodlands.

I do not know Mr. Stubblefield, but I am familiar with the large corporate and government-agency atmosphere, which the content of his letter reveals he has been immersed in for 25 years. It is an atmosphere of formal, usually inflexible rules; an atmosphere in which lawyers and risk managers influence and sometimes dictate operational procedure and second guess on-the-ground managers. Many, possibly most, of us in small-shop consulting forestry and forest management businesses are content with our career and business choice, because we have the entrepreneurial wherewithal to assess risks and make rules that suit our particular business situations as well as meet the needs and satisfy the requirements of our clients.

In this matter that has moved Mr. Stubblefield to provide his welcome but curious perspective on the relationship between PPE and professionalism, some nonindustrial private foresters may don hard hats. The rest of us will continue to burn hard-hatless.

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I too read and enjoyed "Talking with Amy McFadden of White Oak Management." Her lack of hard hat and protective clothing in the picture did not faze me a bit. I do not know Mrs. McFadden, although we work in the same general part of the Deep South. I have been a consulting forester in southeastern Georgia and southwestern South Carolina for 28 years. Aside from logging operations, I never wear a hard hat to the woods, nor do I wear expensive and cumbersome clothing to conduct understory or site-prep burning. Of course, I wear good boots and have my cell phone and/or a two-way radio with me. In 28 years I have never had an accident that warranted anything else. In the South, we dress for comfort and for protection against ticks and snakes. Anything else is overkill and has nothing to do with professionalism as Mr. Stubblefield suggests in his letter.

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