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OPTIMIZING RESOURCES

Using Point Cloud Data for Precise Volumetric Calculation and Change Detection

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Summary

More and more geoscientists are utilizing LiDAR and other high resolution point cloud datasets to leverage the third dimension in their analysis and site planning projects. The increased availability of these datasets, combined with the development of powerful software to efficiently and effectively utilize this data, have provided the means to create 3D data layers that were virtually unheard of a few years ago. Beyond simply generating crude surface models, these software tools significantly improve the usability of the data through the elimination of erroneous points and the automatic reclassification of the point cloud to reflect the actual characteristics of the mapped surface. In this presentation, we will explore the procedure for transforming raw X,Y,Z point files into a commodity that can be utilized for highly accurate ground analysis. We will demonstrate the procedure whereby the non-ground points and other anomalies are removed and the remaining ground points processed into an accurate 3D model.

With the decreasing cost of point cloud collection and processing, and with the emergence of unmanned aerial vehicles as an alternative to piloted aircraft as a collection platform, it is now possible to generate 3D data for a project area on a continuous temporal cycle. The analysis of this time series allows volumetric fluctuations to be precisely monitored and measured. In this presentation we will demonstrate the procedure for calculating these temporal differences and for creating a subtracted model that clearly identifies areas of significant change.

Theory and/or Method

A high resolution, LiDAR- or point cloud-derived terrain model forms the basis of the analysis procedure. The raw data is first analyzed to determine a best bit plane represented by likely ground points. Those that adhere to these criteria are automatically reclassified as ground with the non-ground points remaining unclassified. Filtering tools allow just the ground points to be converted into a 3D raster model with every pixel assigned with a Z-value. Analysis procedures can be applied to this data to model variation in slope orientation and aspect; watershed and local drainage patterns; and other terrain parameters. Volumetric differences are calculated by comparing the Z-value in each overlapping pixel, resulting an aggregated 3D model that is used to clearly visualize the offset over the prescribed time period.

Conclusions

Change detection has long been a critical component of many spatial analysis projects. With the increased availability of high-quality 3D datasets, theses detection procedures can now be applied along the Z-axis. Using low-cost, off-the-shelf tools such as Global Mapper, the detection, measurement, and analysis of even the smallest fluctuations in the terrain are within everyone’s reach.