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Projects LiDAR

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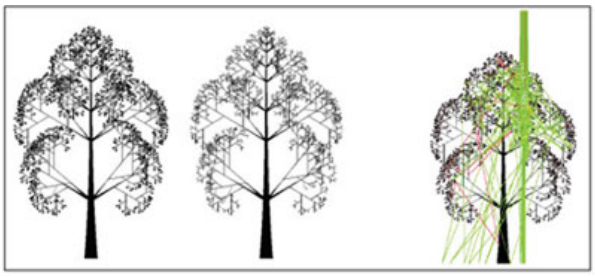
LiDAR

LiDAR (Light Detection and Ranging)

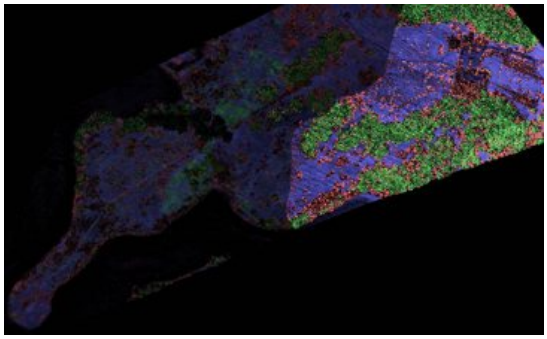
LiDAR (Light Detection and Ranging) technology is rapidly advancing and has proven to be valuable in the fields of terrain mapping, bathymetry, and more.



Simulated LiDAR waveforms for understanding factors affecting waveform shape

(Poster presented at SPIE 2011, authors: Angela M. Kim and Richard C. Olsen)

LiDAR works as an optical analog to RADAR with advantages related to the smaller wavelengths of the laser pulse.



Lidar image Elkhorn Slough

LiDAR ranges in wavelength from ultra-violet (0.3-0.45 um) to visible (0.45-0.70 um) to the infrared (1-15 um), which is at least 1000 times smaller than RADAR. The RADARSAT satellite, for example, has a wavelength of 5.6 cm.

Data

The raw form of data is a set of x, y, z coordinate points. With recent advances, these points can be seen as distinguishable returns. An instrument that would once give only a bare earth model can now differentiate between the ground and bottoms and tops of tree canopies.

The raw data can be processed to remove unwanted areas or features. Outputs such as topographic maps with contour lines can also be derived from LiDAR.

Manipulation

Programs to manipulate LiDAR data include ENVI, ERDAS Imagine, ArcInfo,Quick Terrain Modeler, and ESRI ArcView (with 3D analyst ext.).

Applications

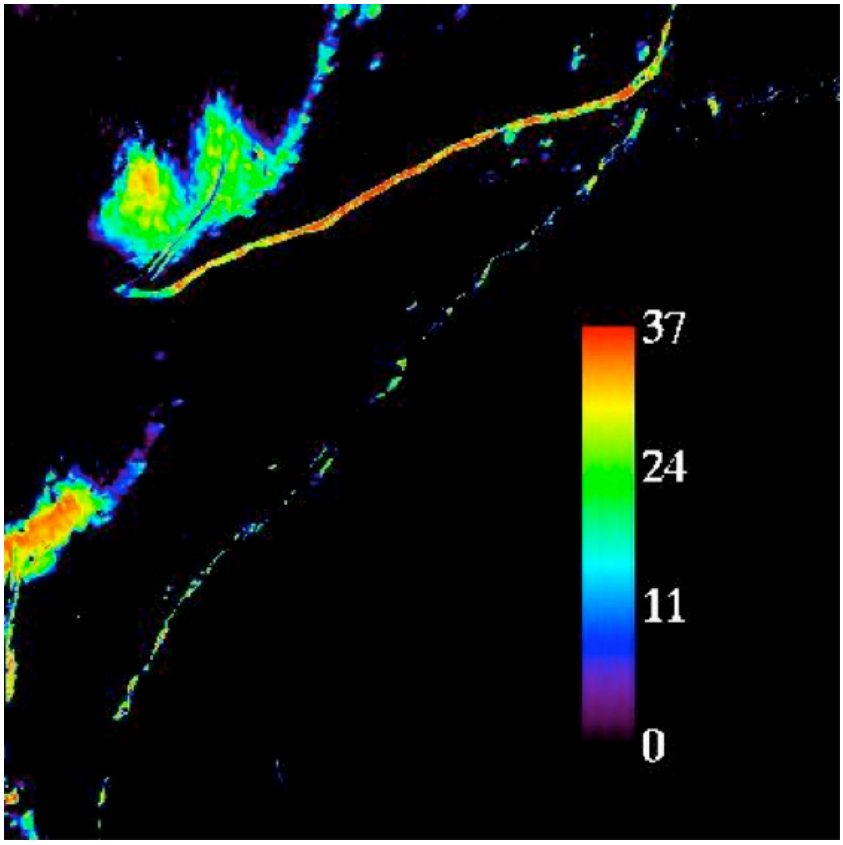
One useful derivation of LiDAR data is the DEM (digital elevation model).

DEMS are displayed in a raster format with a matrix. The DEM has a specified cell size that corresponds to the earth's surfaces. The cell contains the average elevation of the points within it.

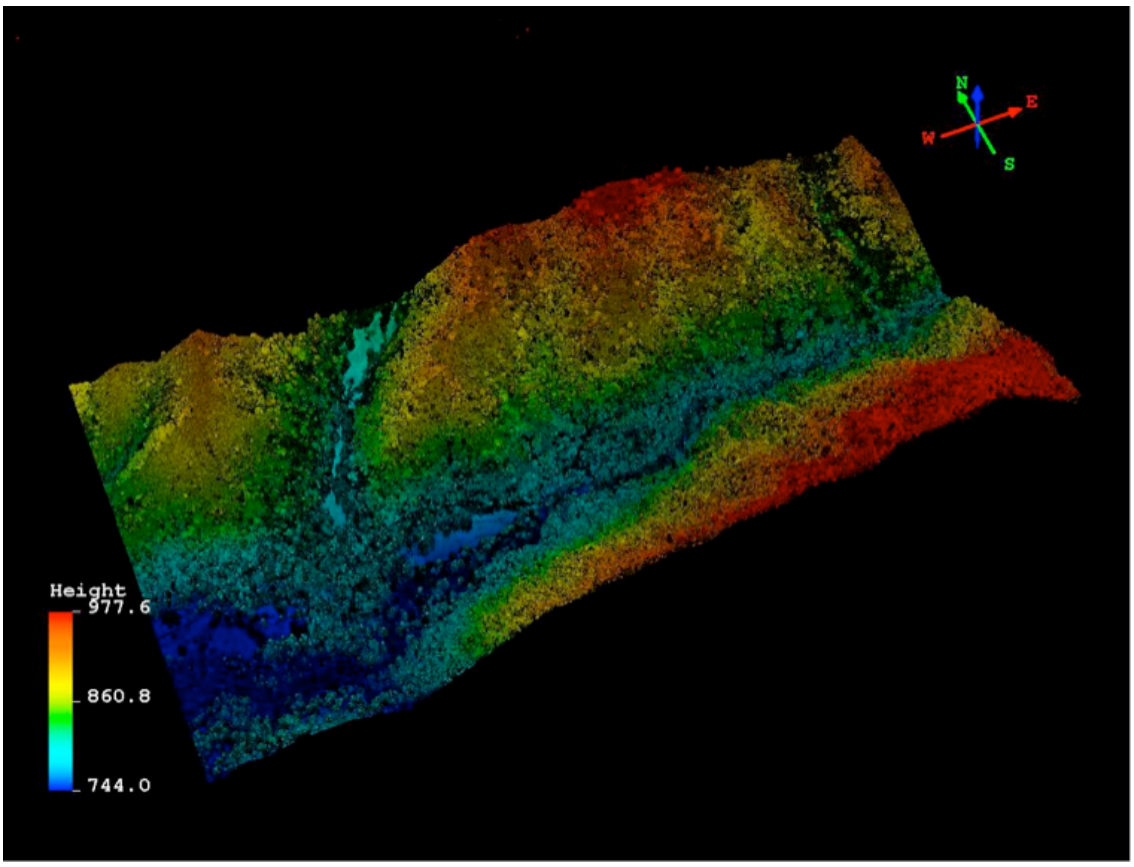
LiDAR can detect much smaller particles than RADAR in the atmosphere (which cannot detect things smaller than cloud particles) and thus can be used for aerosol detection.

Projects

Recent thesis projects have looked at using airborne LiDAR for automated recognition of hidden roads and trails under forest canopies, satellite LiDAR for bathymetry, and a Monte Carlo model of laser propagation through a tree. These research projects undertook the modeling and testing of analytical processing using fieldwork to obtain ground-truth measurements.



(Above) Rule image for trail classified pixels generated during maximum likelihood classification, higher values represent a higher likelihood that a pixel belongs to trail class. The upper portion of the image shows a trail segment, and the intermittent long diagonal corresponds to a stream bed.



(Above) Indian Creek point cloud, all returns. Colors show relative elevation values in meters.

Work on LiDAR for elevation and tree height mapping was also included in the Earthquake Response Project. See that tab for more information.

Future projects include a map of the NPS campus using recently acquired terrestrial LiDAR scanners.

Related Theses

Automating Identification of Roads and Trails Under Canopy Using LiDAR
Charles F. Harmon III, Space Systems Operations and Remote Sensing Intelligence
September 2011
Thesis Advisor: Richard C. Olsen
Second Reader: Kristen Tsolis

Evaluation of LiDAR for Automating Recognition of Roads and Trails Beneath Forest Canopy
Steven L. Muha, Space Systems Operations
September 2011
Thesis Advisor: R. C. Olsen
Second Reader: Cajun James

Utility of Satellite LiDAR Waveform Data in Shallow Water
Neal Battaglia, Applied Physics
June 2010
Thesis Advisor: Richard C. Olsen
Second Reader: David M. Trask

Simulating Full-Waveform LiDAR
Angela M. Kim, Applied Mathematics
September 2009
Co-Advisor: Carlos F. Borges
Co-Advisor: Richard C. Olsen

Point Density Effects on Digital Elevation Models Generated from LiDAR Data
Richard L. Duldulao, Applied Physics
June 2009
Thesis Advisor: R. C. Olsen
Second Reader: David M. Trask

Assessing Accuracy in Varying LiDAR Data Point Densities in Digital Elevation Maps
Brian C. Anderson, Space Systems Operations and Applied Physics
September 2008
Thesis Advisor: R. C. Olsen
Second Reader: James H. Newman

Identifying Roads And Trails Hidden Under Canopy Using Lidar
Fermin Espinoza, Space Systems Operations
Robb E. Owens, Space Systems Operations
September 2007
Advisor: Richard Christopher Olsen
Second Reader: Mark C. Abrams

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