Enhanced Access to High-Resolution LiDAR Topography through Cyberinfrastructure-Based Data Distribution and Processing

Christopher J. Crosby, J Ramón Arrowsmith
Jeffrey Connor, Gilead Wurman
Efrat Jaeger-Frank, Vishu Nandigam,
Ashraf Memon, Chaitan Baru
Han S. Kim

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LiDAR (Liight Detection And Ranging)  
*a.k.a* ALSM (Airborne Laser Swath Mapping)

- Airborne pulsed laser scanning system + differential GPS + inertial measurement unit (IMU)
- > 30,000 points/second
- Ground sampled at multiple points/sq. meter
- ~ 15 cm vertical accuracy
- ~$300 - $500 per sq. km acquisition cost

http://coastal.er.usgs.gov/hurricanes/mappingchange/
**Survey**

- GPS Satellite
- NOAA DeHavilland DHC-6 Twin Otter
- 30 Degree Cone Angle
- Aircraft Elevation ~700 meters
- Overlapping Swaths
- Direction of Flight (parallel to beach)
- Combined Swath Width ~700 meters

**Complete LiDAR Workflow**

**Interpolate / Grid**

**Point Cloud**

\[ x, y, z, \ldots \]

**Analyze / “Do Science”**
LiDAR coverage of the southern San Andreas and San Jacinto faults

- ~ 36 billion LiDAR returns
- Very high-res., supports 25-50 cm DEMs
• Multi-institution collaboration between IT and Earth Science researchers
• Funded by NSF “large” ITR program

• GEON Cyberinfrastructure provides:
  – Authenticated access to data and Web services
  – Registration of data sets and tools, with metadata
  – Search for data, tools, and services, using ontologies
  – Scientific workflow environment
  – Data and map integration capability
  – Visualization and GIS mapping

• “GEON was designed as an equal collaboration between Information Technology (IT) and Geoscience researchers, with the goal of developing an enabling IT platform to facilitate the next generation of Geoscience research.”
The Vision:

- Utilize cyberinfrastructure developed by GEON to offer online data distribution, DEM generation, and analysis of large LiDAR datasets.

- Completely internet-based workflow:
  - Point cloud to visualization

- Utilize modular web services to complete a variety of processing and analysis tasks.

- Offer users control of processing and analysis parameters.
Current GLW features:

- Interactive polygon data selection via WMS map
- Attribute selection (ground returns, vegetation returns)
- Rapid estimate of points within selection area
- Point cloud download
- DEM generation via two pathways:
  - local binning algorithm (*see G53C-0921*)
  - Spline interpolation algorithm (GRASS GIS web service)
- User defined grid resolution and processing parameters
- Products produced in multiple, user-defined, file formats
- User provided job title and description
- Dynamically generated and customized metadata file
- Email notification
LiDAR Processing Workflow Outputs

Processing of 908930 points in Lidar point cloud.

Elevation (spline)

Below you can download an archive file (tgz format) with the results of your job.

Raw data for bounding box selection: MinX = 6204521.346137068, MaxX = 6207425.849352351, MinY = 1950008.5712301359, MaxY = 1953553.0744445194 is available at

Download LView - A free application for visualization of LiDAR point cloud and interpolated surface data developed in the Active Tectonics Research Group at Arizona State University.

G53C-0921 – An efficient implementation of a local binning algorithm for digital elevation model generation... Kim et al.
Implementation Overview:
The GLW utilizes advanced spatial databases (IBM DB2), GRASS Open Source GIS, custom DEM generation code, Kepler Workflow manager and web service technology to distribute, interpolate, and analyze LiDAR data.
Current GLW Status

Datasets online:
1. Northern San Andreas Fault
2. West Rainier Seismic Zone
3. Eastern California Shear Zone
4. Full B4 Dataset (Southern SAF and SJF)

Total of ~38 billion LiDAR returns available via GLW
A cyberinfrastructure-based model for managing the flood of community LiDAR datasets
Implications

• GLW is a proof of concept for utilization of cyberinfrastructure to democratize access to the next generation of community geoscience datasets and processing tools.
  – Generic and scaleable GEON architecture applicable to numerous (geo) science datasets.

• GLW proposed as distribution pathway for forthcoming GeoEarthscope LiDAR datasets:
  – 5 more B4 style data acquisitions in next 2 years.

• Discussions underway with USGS EROS Data Center to expose their LiDAR archive (CLICK) via the GLW.
GEON LiDAR Workflow Access Instructions:
http://www.geongrid.org/science/lidar.html

More information on the GLW:


Crosby, C.J. et al., A geoinformatics-based approach to LiDAR data distribution and processing in preparation.

Abstracts, posters & presentations:

http://lidar.asu.edu/