LA Statewide Lidar Acquisition

Amar Nayegandhi, CP, CMS, GISP, Vice President, anayegandhi@dewberry.com

Ryan Ligon, Project Manager, rligon@dewberry.com
Introduction to Lidar
Airborne LiDAR System Components

- LiDAR Transmitter, Scanner, and Receiver
- Aircraft Positioning – Differential GPS (with post-processing)
- Aircraft Attitude – Pitch, Roll, Yaw – Inertial Navigation System (GPS-Aided)
- Data System
LiDAR produces a point cloud dataset
DSMs and DTMs

Digital Surface Model (DSM)

• Tree and rooftops

Digital Terrain Model (DTM)

• Bare-earth terrain, void of trees & manmade features

LiDAR technology enables high-resolution DSMs and DTMs
Urban Area DSM and DTM/DEM
LiDAR Intensity Images

- Shows the intensity of LiDAR reflectance for each laser pulse, normally 1st return pulse intensities
- Similar to a B/W photo image

Downtown Baltimore, MD
LiDAR Foliage Penetration

Major LiDAR advantage

• Best technology for mapping the bare earth beneath trees

Imagery/photogrammetry

• Needs to see the bare earth from two different perspectives …
• but the trees themselves prevent stereo views of the ground
Benefits of Lidar - Bare Earth under dense vegetation

Hillsborough County, FL
Mass Points, Breaklines & DEMs

- LiDAR mass points are irregularly-spaced
- Manually-derived breaklines show feature edges or disrupt changes in slopes
- DEMs are uniformly-gridded DTM
Hydro Flattening

Hydro Flattening

- Streams and lakes are level from shore to shore

Stream Hydro Enforcement

- Bridges are cut; deck elevations on different layer from terrain
- Shoreline elevations are monotonic, i.e., they continuously flow downstream without undulating
Hydro-flattened stream & lake w/bridge/overpass cut; a cartographic product. Std. USGS requirement.

Hydro-enforced to include addition of culverts; a hydrologic modeling product. Much more labor intensive.
Contours

Semi-automated but still requires breaklines

- Single-line stream centerlines
- Dual-line stream centerlines
- Road casings/edge of pavement

For human interpretation of the 3D terrain only
Many people now prefer hillshades for 3D visualization
LiDAR User Applications

Geologic Mapping
Seismic Fault Detection
Other Risk Analyses (Volcanoes and Landslides)
Soils Mapping and Engineering
Hydrologic & Hydraulic Modeling
Flood Risk Management
Sea Level Rise Mitigation
Sewer & Storm Water Planning
Post-Disaster Debris Estimation
Electric Reliability

Infrastructure Management
3D City Models
Line-of-Sight Analysis
Building Footprints
Renewable Energy Potential
Urban Planning
Forest Management
Change Detection
Aviation Safety
Route Planning
Precision Farming

Every dollar spent on LiDAR has a minimum of $5 in benefits
Final Report of the National Enhanced Elevation Assessment

Revised March 29, 2012

The National Enhanced Elevation Assessment (NEEA) was performed to document national requirements for improved elevation data, estimate the benefits and costs of meeting these requirements, and evaluate multiple national enhanced program implementation scenarios. The study was sponsored by member agencies of the National Digital Elevation Program and was completed December 2011. Study participants included 34 federal agencies, 50 states, and selected local governments and tribes, as well as private and not-for-profit organizations. An analysis of the results showed that an improved national program has the potential to generate $1.2-billion to $13-billion in new benefits each year once fully operational. The report was developed by Dewberry under contract to the USGS. The findings build on similar results documented by the National Research Council, federal agencies, and numerous state reports. Questions regarding the report should be directed to Greg Snyder, USGS, at gsnyder@usgs.gov.

Blueprint for the 3D Elevation Program (3DEP)
NOAA/USGS 3D Nation Study (Ongoing)

Inland, Nearshore, Offshore and Topo, Bathy, Topo/Bathy

Coastal Zone Requirements

Technology Neutral Approach
Supporting LADOTD

• Dewberry Engineers Inc is contracted to provide guidance and assist in the creation of GIS data as outlined by the DOTD.

• Dewberry will develop with DOTD an updated Master Program Management Plan

• To provide guidance on planning lidar acquisition, sensor operation, data qc, and lidar processing.

• Training the DOTD staff is a critical part of Dewberry’s task. Develop training documents.
Supporting LA DOTD

- Data acquisition to be conducted by DOTD’s staff under the supervision of Dewberry staff in place at the DOTD headquarters.

- Training of DOTD staff for processing lidar data conducted by Dewberry staff that are both permanently placed in Baton Rouge as well as traveling from Tampa, FL.

- Standard Operating Procedures are co-developed with input from DOTD and Dewberry specifically for use with the statewide acquisition program.
Desired Lidar Specifications

• Quality Level 1 (QL1) lidar containing at least 8 points per square meter.

• Produces highly accurate elevation data that can be used to create contours, DEMs, more accurate orthophotography…

• Rigorous QA/QC process testing data against surveyed accuracy checkpoints to ensure meeting ASPRS and USGS/3DEP specifications.

• Data and products shall be reviewed and accepted by the USGS for use in the 3DEP program
USGS and NRCS have significant interest in collecting data for the entire state.

Dewberry is partnering with LADOTD and USGS/NRCS for to produce standardized QL1 product.
Acquisition Flight Plan

- Optimized to take advantage of the ALS-80 lidar sensor and Beechcraft King Air C90 aircraft.
- Full blocks quartered to maximize acquisition season.
Acquisition Flight Plan

- Flight lines maximize efficiency per mission flying east/west lines for the majority of the state.
Baton Rouge Pilot Acquisition

- Proof of concept data collected to test the sensor and initially train DOTD staff
- Area of interest approximately 298 square miles
- 37 flight lines acquired in July 2017
- 6 tiles processed and submitted to USGS for acceptance as a QL1 deliverable
- USGS acceptance on January 18, 2018
Baton Rouge Pilot Acquisition

- The pilot acquisition area was chosen to contain an example cross section of many feature types: urban, industrial, commercial, residential, agricultural, forested, wetland, and containing hydrographic features.
Baton Rouge Pilot Submittal

• The 6 tile pilot submittal area was processed where these same features could be found in a smaller geographic area.
Sample Lidar data from Pilot

- State Capitol building
- Downtown
Sample Lidar data from Pilot

• LSU Tiger Stadium!
Sample Lidar data from Pilot

- USS Kidd, Convention Center, and River boat
DOTD Priority area 2017/2018

• Approximately 5930 square miles of land area
• 10 parishes in all
• Data will be acquired and processed to cover quarter blocks that touch all 10 parishes of the 2017/2018 acquisition season (shaded purple).
Processing/Deliverable Products

• **Raw Point Cloud**
  - ≥8 ppsm, (0.35-m ANPS)
  - RMSEz <10cm,
  - NVA <19.6 cm
  - VVA <29.4 cm
  - LAS v1.4

• **Classified Point Cloud**
  - Point Record Format 6
  - Points classified to:
    - Class 1 – Processed, but unclassified
    - Class 2 – Bare-earth ground
    - Class 7 – Low Noise (low, manually identified, if necessary)
    - Class 9 – Water
    - Class 10 – Ignored Ground (Breakline Proximity)
    - Class 17 – Bridge Decks
    - Class 18 – High Noise (high, manually identified, if necessary)

Note: Classes 7 and 18 are included as a convenience for the data producer. It is not required that all “noise” be assigned to those Classes.
Products/Deliverables Con’t

• **Bare Earth Surface (Raster DEM)**
  - Hydro-flattened (with inland ponds, lakes, streams and river stipulations from SOW)
  - Cell size shall be 1 m.

• **Intensity Images**
  - 8-bit 256 color gray scale and GeoTIFF format
  - Intensity values shall be 16-bit, linear rescaled
  - Cell size shall be tiled to match the Classified DEM files -1 m.

• **Tile Coverage**
  - 1500 x 1500 meters US National Grid tiling scheme

• **Breaklines**
  - Sufficient to support hydro-flattened DEMs in file geodatabase format
Products/Deliverables Con’t

- **QA/QC Checkpoints**
  - Check points shall be collected according to ASPRS Positional Accuracy Standards for Digital Geospatial Data, Version 1.0 (November 2014).

- **Metadata**
  - Compliant to USGS Lidar Base Specification Version 1.2; one per project, lift and tiled deliverable product group
  - Collection Report detailing mission planning and flight logs
  - Survey Report
  - Processing Report
  - QA/QC Report
  - Control and Check Points
Other lidar being acquired by Dewberry in Lousiana

- DOTD-Amite River Watershed, HUC-8
  - 1,884 square miles of QL1 lidar data
Other Louisiana lidar being acquired by Dewberry

- USGS-Sabine River Lidar
  - 10,535 square miles of QL1 lidar data
Questions/Open Forum Discussion Topics

Amar Nayegandhi, CP, CMS, GISP
Vice President
anayegandhi@dewberry.com

Ryan Ligon
Project Manager
rligon@dewberry.com