St. Anthony Falls Laboratory

UNIVERSITY OF MINNESOTA

Undergraduate Summer Research Symposium

Accuracy Assessment of LIDAR Data

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Introduction

The removal of the Marmot Dam in 2007 was an attempt by Portland General Electric (PGE) to restore the Sandy River, Oregon to its natural state. Since the dam's removal, numerous elevation changes due to sediment transport have occurred. To observe these elevation changes, scientists have collected Light Detection and Ranging (LIDAR) data for the years 2006-2008.

Objective: To determine possible sources of uncertainty in LIDAR data and to discern any uncertainty (in feet) in the Sandy River's Revenue Bridge area LIDAR data.

Research Area: Revenue Bridge area (Reach B1) of the Sandy River, Oregon.

Reach B1

Aerial photo of research area

Background

•LIDAR is a remote sensing system used to collect topographic data.

•Data is collected with aircraft-mounted lasers which have the capability of recording elevation measurements at a rate of 2,000 to 5,000 pulses per second.

• A LIDAR sensor records the time elapsing between the release of the laser beam and the return of the reflected laser to the aircraft, thus, creating LIDAR data.

Figure 1: Laser -Scanning

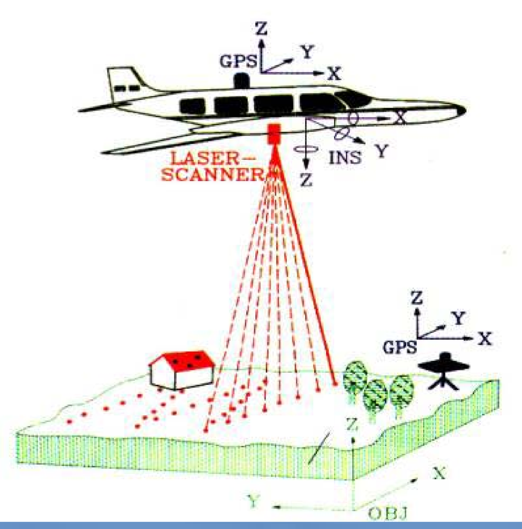


Figure 2: Reach B1 LIDAR Data 2008

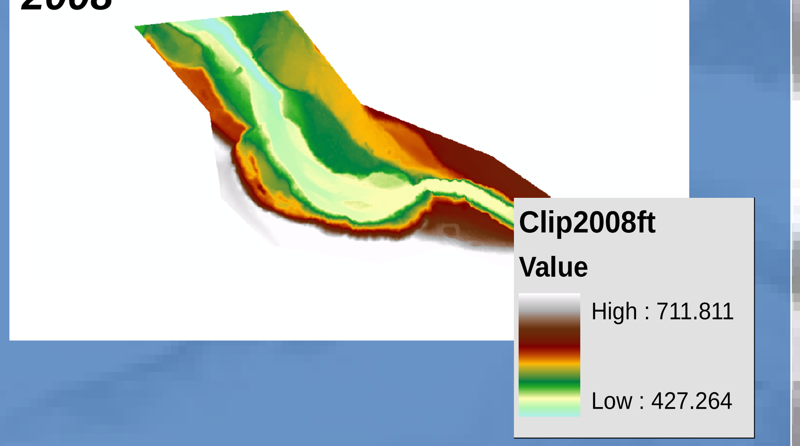


Figure 1: Depiction of LIDAR data being captured.

Figure 2: Example of a Sandy River LIDAR data DEM

Possible Errors in LIDAR Data

•When dealing with bedrock, the physical position of the bedrock will not change; however, pieces of bedrock can chip off causing elevation changes.

•Range errors are the errors that occur as a result of atmospheric distortion.

•Position errors are errors due to GPS uncertainty.

•Orientation errors are errors that relate to the positioning of the aircraft-mounted laser.

Methodology

•Reach B1 LIDAR data for the years 2006-2008 was provided by Chuck Podolak.

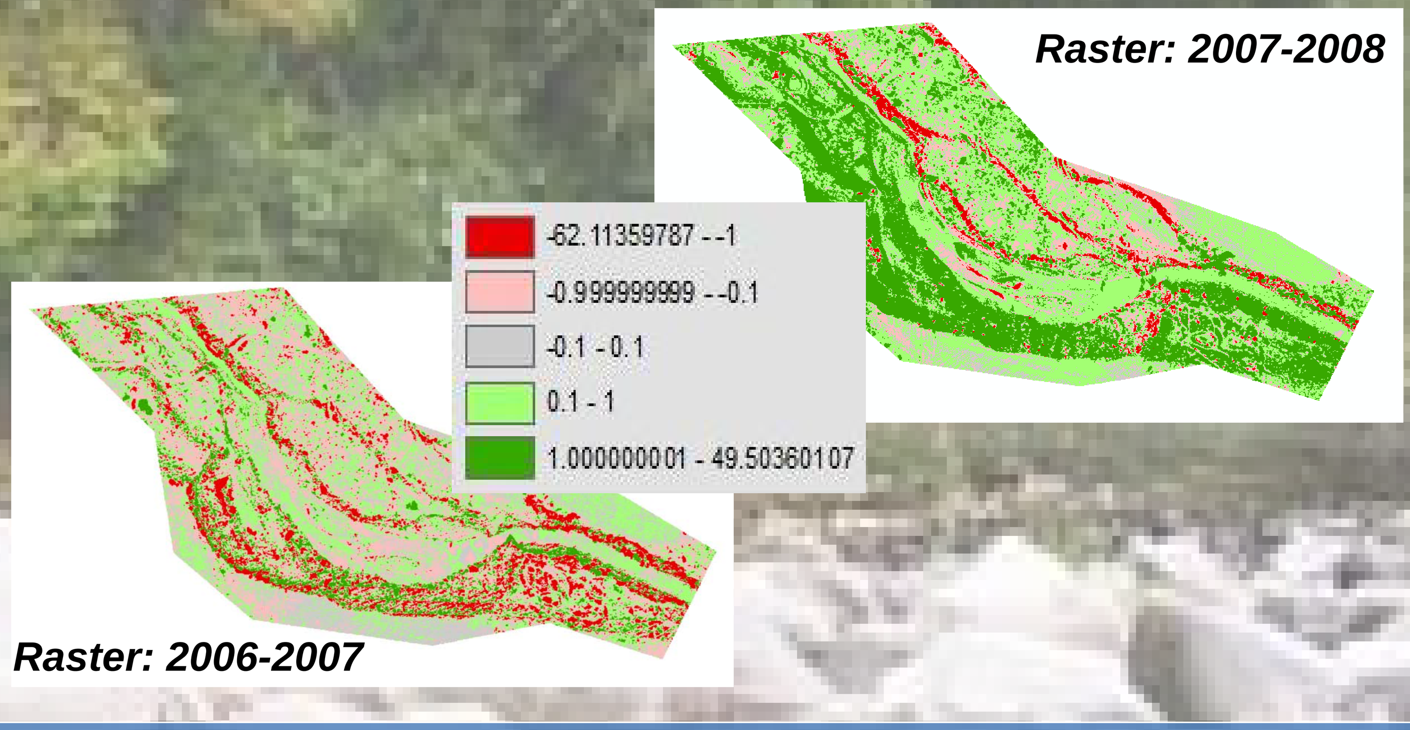
• Digital elevation models (DEMs) of the LIDAR data were visually compared in ArcGIS.

•The DEMs were compared with the "Identify" tool in ArcGIS. This tool allows one to find elevation at any selected location on a DEM or any selected location on multiple DEMs.

•Elevations from year to year of 30 various stationary objects in reach B1 were determined and placed in a spread sheet in Microsoft's Excel.

•The elevations from the year of 2006 were subtracted from those of 2007 to determine elevation differences that should be the same. Calculations were repeated for 2007 and 2008.

•Rasters which show elevation differences between two years were created and analyzed.



Raster: 2007-2008

Raster: 2006-2007

Results

Coordinates (ft)	2008 (ft)	2007 (ft)	2006 (ft)	Category	Dif. b/t 2008 & 2007	Dif. b/t 2007& 2006
7,756,464.824 / 639,615.554	431.59	445.89	434.16	Bedrock	14.30	11.73
7,755,314.819 / 639,867.631	507.12	506.95	506.14	Building	0.17	0.81
7,755,889.980 / 639,484.577	520.28	520.14	519.42	Road	0.14	0.72
...						
Overall Mean (ft)	511.54	512.01	511.32		0.75	0.94
Bedrock Dif. Mean (ft)					7.40	5.97
Building Dif. Mean (ft)					0.27	0.60
Road Dif. Mean (ft)					0.28	0.55
Mean Dif. Excluding Bedrock (ft)					0.27	0.58

Summary

According to the LIDAR data of Reach B1, it can be said that between the years 2007 and 2008 the Sandy River's surroundings saw much more elevation changes than the elevation changes it experienced during the years of 2006 and 2007. Most of this change being an increase in elevation.

Furthermore, the results of this Light Detection and Ranging data project have shown that LIDAR data may consist of a vertical error ranging from approximately 0.27-1.0 feet. When considering that along the Sandy River there are numerous places that had elevation change within this range, one could say that LIDAR is not appropriate for this overall project. However, there are areas along the Sandy that exceed elevation changes in this interval. Also when considering other data collection options, there are few that would give significantly better results. Because of its technology and new developments, LIDAR is one of the most accurate elevation detectors.

Acknowledgments

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REU SITE ON RIVER AND COASTAL RESTORATION