Using Artifacts to Detect Systematic Errors in ALSM Observations

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Systematic errors in an ALSM system will appear as different artifacts in the ALSM data. For instance, the vertical line (indicated by the blue arrow) extending through the 3-D image below is caused by a poor GPS trajectory. The GPS receiver of the helicopter or laser platform may drift a small amount over the course of the flight, causing a straight line in the data collection. The straight line is caused by a systematic error in the trajectory and reveals itself as an artifact in the data collection. In this example, the offset is roughly 0.8 ft.

The difference of the DEMs produced by a commercial vendor and UF show several interesting artifacts. The 0.8 ft offset is obvious. Range walk related errors in the paint striping are noticeable on the runways. Currently, this problem can be eliminated by calibrating for each project. The results should be better. One obvious solution is to weight data close to nadir more than data at the edge of the strips. The following algorithm was developed at the University of Florida. Determine the scan angle for each data point. Compute the weighted average of the data. Subtract the average from each data node. This is currently being computed with grid nodes.

Conclusions

There are several things that can be done to create a more accurate airborne laser survey. Calibrating the system for each project does a better job of eliminating the systematic errors and produces a more accurate DEM but takes more time during the data collection. A lower flying height produces more accurate DEM but takes more time to collect and reduce the data. The greater accuracy is the result of a number of factors: systematic errors produce smaller artifacts; better able to collect data on dark surfaces; better able to penetrate vegetation canopy and reach the ground; less susceptible to weather-related problems. A larger overlap (~50%) between strips produces a better DEM. The reasons for this include: smaller strip separation avoids data voids; more points closer to nadir are better able to penetrate vegetation canopy and reach the ground; ability to use weighted averaging to create a DEM with fewer artifacts; the overlap can be used to calculate between-scan consistency; the inter-strip consistency is one way to estimate the precision of the technique.

Create the best possible trajectory. Inaccuracies introduced in the trajectory are difficult to remove later. Also, commercial GPS processing software doesn't always produce the best results. An estimate of the accuracy of the trajectory can be obtained by comparing trajectories determined from different base stations and comparing the forward and backward trajectories. Intensity look-up tables produce better results. If there is a problem with the results, you can always recalibrate the look-up table. The survey was affected by weather disturbances, but the data are still usable. Post-processing the ALSM data can improve the final product.