

UAV LiDAR Mapping

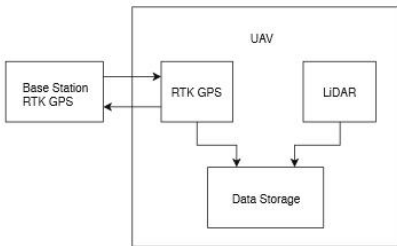
Benji Holen, Samuel Gertler, Victor Dinh, Emily Colwell, Joseph Besette-Denwood
Sponsored by Dan Rabinkin, MIT Lincoln Labs

The Problem

Design a cost effective and accessible way to create topological maps. Traditional LiDAR based systems are mounted on aircraft, and are very expensive. Mounting a LiDAR system on a UAV allows for a very cheap and fast alternative, at the expense of maximum surveyable area.

	Traditional LiDAR Platform	UAV LiDAR Platform (this work)
Aircraft		
Sensors	 Multi-Pixel LiDAR	 Single Pixel LiDAR Differential GPS

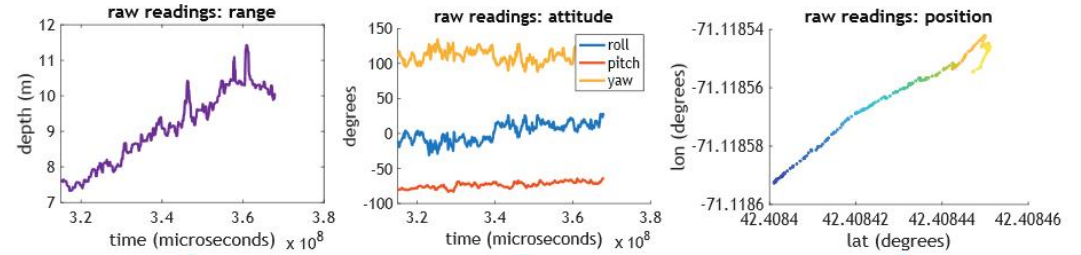
System Diagram



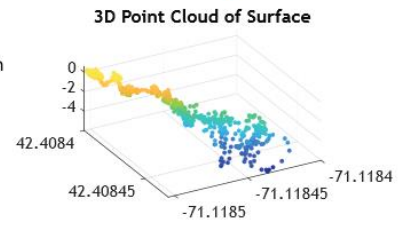
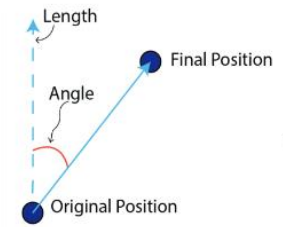
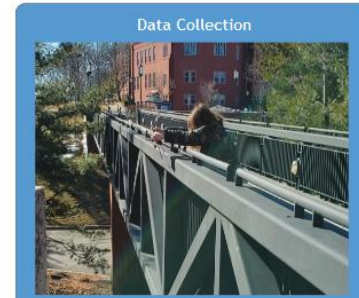
LiDAR: A system for measuring distances using time-of-travel calculations with infrared light.

RTK (Differential) GPS: An improvement on the standard GPS system that uses orbital satellites, as well as a stationary base station to estimate the drone's location with centimeter accuracy.

Data Processing Pipeline



Linear Interpolation + Calculation of Relative Offsets



Inverse Distance Weighted Interpolation

$$\hat{Z}(x, y) = \frac{\sum \phi_{x,y} \frac{Z_i}{R_i}}{\sum \phi_{x,y} \frac{1}{R_i}}$$

Where $R_i = \left\| \begin{bmatrix} x_i \\ y_i \end{bmatrix} - \begin{bmatrix} x \\ y \end{bmatrix} \right\|$
and $\phi_{x,y} = \{i | R_i < Z_i \tan(2^\circ)\}$

