Constructing 3D Models from 2D Drone Photographs

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Aerial Applications

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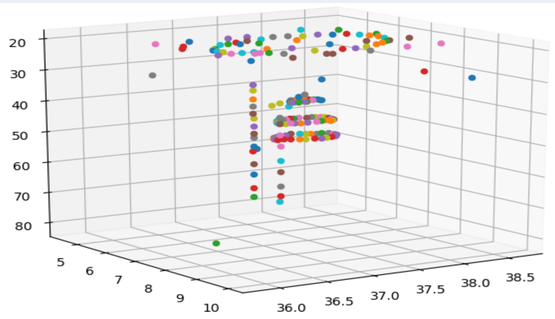
Aerial Applications
The Commercial Drone Industry, Explained.

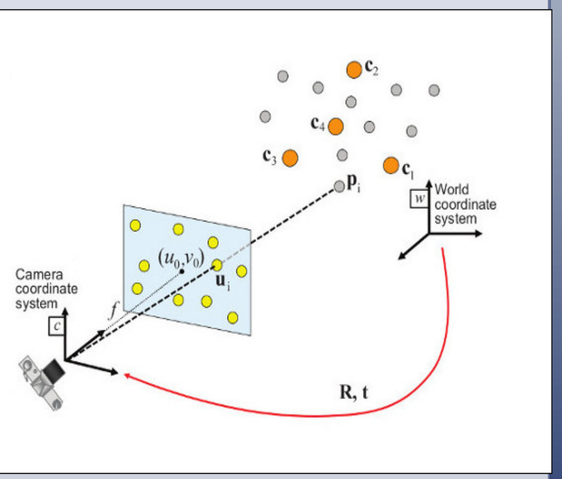
Introduction

3D reconstruction starts with a series of 2D images. The implementation of photogrammetry techniques help us pair similar images together to create a consistent overlap. With all images having a smooth overlap between them, key features within these images can then be projected and form a 3D cloud rendering of the targeted environment



Multi-view Geometry

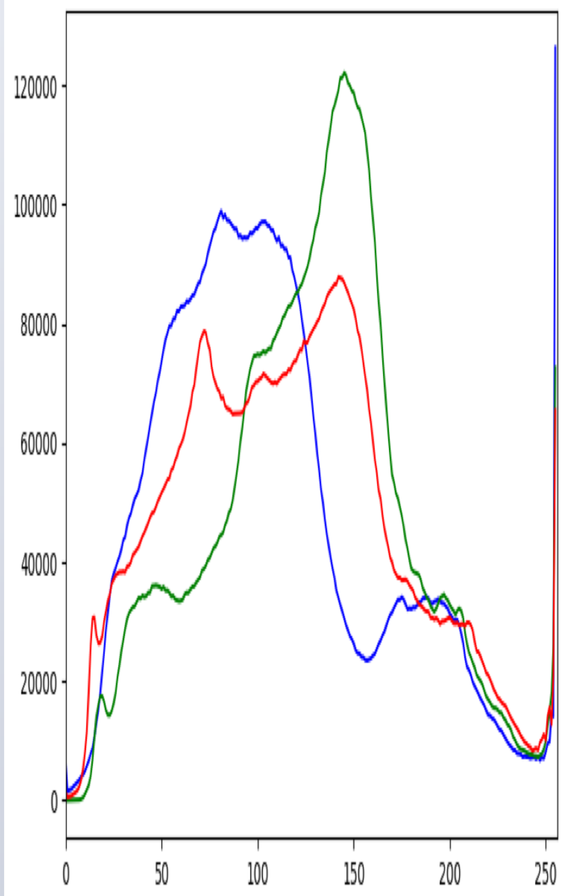
Fields such as Multi-view Geometry and linear algebra are the mathematical backbone of reconstructing software. Functions such as the Fundamental and Camera matrix are responsible for calculating and estimating the camera position of each image, which in turn helps orient and create a more accurate point cloud rendering.



Color Histograms

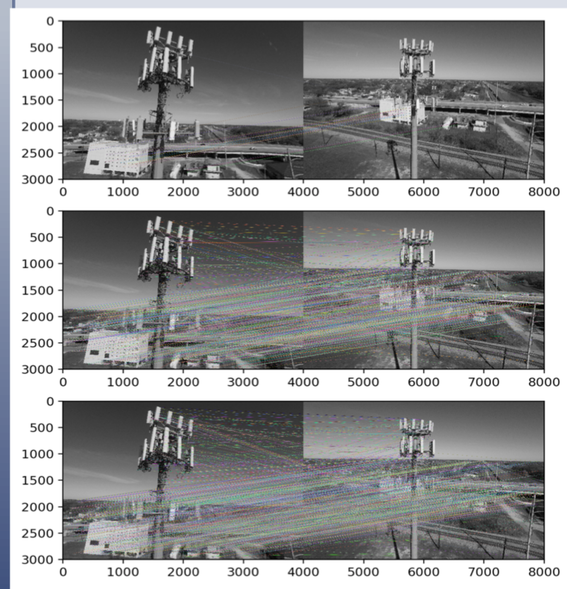
The histogram can be considered as a graph or plot, which gives you an overall idea about the intensity distribution of an image. It is a plot with pixel values (ranging from 0 to 255, not always) in X-axis and a corresponding number of pixels in the image on Y-axis.

It is just another way of understanding the image. By looking at the histogram of an image, you get intuition about contrast, brightness, intensity distribution etc. of that image. There are many comparisons for the histogram. Using those comparisons can sort the pictures very quickly. Therefore, we use this technology to roughly orient the pictures.



Feature Matching

A very important step in the reconstruction process is to figure out where and what images correlate with each other. Feature matching is the primary method to achieve this type of image pairing. Algorithms that help conduct these matches would be the SIFT and RANSAC algorithms. These algorithms detect unique edges and use different Gaussian filters to find key points between two images with seven or more inputs of data points. Other feature matching algorithms include ORB and SURF (shown below); however, SIFT is the most accurate.



Conclusion

With these complex functions and algorithms, accurate and detailed point cloud renderings and 3D reconstruction models can be calculated and projected from an album of 2D images. The downside of this technique resides in the runtime of these reconstruction software. This is a critical aspect as this software is used to assist relief crews in targeting areas in need of immediate repair and response. However, when runtime is reduced the clarity of a point cloud can also decrease, With more time, the next step for our research group would be to use the customized camera position calculation program to develop software that plots key features from 2D images into 3D point clouds while attempting to minimize runtime and maximize clarity.