USING VIDEO ACQUIRED FROM AN UNMANNED AERIAL VEHICLE (UAV) TO MEASURE FRACTURE ORIENTATION IN AN OPEN-PIT MINE

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This project explored the feasibility of using video images acquired with an unmanned aerial vehicle (UAV) to obtain three-dimensional (3D) point clouds using structure from motion (SfM) software. Missions were flown using an Aeryon Scout: a lightweight, vertical take-off and landing quadrotor micro UAV with a miniature video camera. The initial mission captured urban scene images that were used to assess system performance while the main mission focused on rock walls where 3D images were used to successfully measure fracture orientations. Point clouds generated from this combination of technologies were sparse, but in the future, improvements in the resolution of original video images would cascade through the processing and improve the overall results. Such a system could have a multitude of applications in the mining industry, contributing to both safety and financial considerations.

Introduction and Research Objectives

Obtaining detailed aerial images in 3D is challenging. While planes or helicopters mounted with LiDAR (Light Detection And Ranging) are typically used, the equipment, fuel, maintenance and pilot’s time can be very expensive. UAVs, which are cheaper and easier to fly and maintain, are promising alternative to traditional methods [Bento 2008] even though there have been some issues with reliability and weight limitations that UAVs can handle (most airborne LiDAR systems weigh on the order of 50 to 100 kg) (as in Frueh and Zakhor [2003]). To circumvent weight constraints, a few research teams have flown still cameras on UAVs (weight ≈ 5 kg) and applied photogrammetric principles, combined with laser altimetry data and the use of cooperative target points, to construct 3D images and digital elevation models [Lambers et al. 2007; Eisenbeiss 2008; Haarbrink and Eisenbess 2008].

The project described in this paper explored the feasibility of an even lighter system: a miniature video camera (weight ≈ 100g) mounted on a small UAV (take-off weight ≈ 1.3 kg) that acquired 2D images that were used to obtain 3D point clouds with SfM software, rather than relying on a large UAV carrying heavy sensors [McLeod 2012]. The proof-of-concept project linked several existing technologies together—a UAV, SfM software and 3D image processing tools—to demonstrate that multiple technologies can be combined effectively, and to assess their strengths and limitations for imaging geological scenes.

Aeryon Scout UAV

System Description

The UAV selected for the project was an Aeryon Scout, a vertical take-off and landing