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.

Ce projet examine la faisabilité de l'utilisation d'images vidéo acquises au moyen d'un véhicule aérien sans pilote (UAV) pour obtenir des nuages de points tridimensionnels (3D) en utilisant un logiciel de structure à partir du mouvement (SfM). Des missions ont été effectuées avec un Aeryon Scout, un micro UAV léger à décollage et atterrissage vertical propulsé par quatre rotors et équipé d'une caméra vidéo miniature. La mission initiale a permis de capter des images de scènes urbaines utilisées pour évaluer la performance du système alors que la mission principale a mis l'accent sur des parois rocheuses où des images 3D ont été utilisées pour mesurer avec succès l'orientation des fractures. Les nuages de points générés à partir de cette combinaison de technologies étaient clairsemés, mais à l'avenir des améliorations de la résolution des images vidéo originales se succéderaient dans le traitement et amélioreraient les résultats globaux. Un tel système pourrait avoir une multitude d'applications dans l'industrie minière et contribuer à des considérations en matière de coût et de sécurité.

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