Abstract Submission – The use of UAV collected imagery in a semi-automated workflow to generate geologic structure information; a master’s research project.

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ABSTRACT

This abstract submission is being done at the commencement of research activities, as such the results are yet to be determined.

The primary desired outcome of this research project is the creation of a method to use low-cost, highly deployable UAVs combined with a low-cost multispectral capture device to generate actionable geologic structural information from photographs of rock outcrops that may be directly used in regional and local mapping projects.

A research study area has been selected west of Calgary Alberta in a region where extensive geologic mapping has already been undertaken. A small UAV will be equipped initially with a 2 sensor multispectral camera apparatus created by the author that records imagery from 400 – 900nm into a single 4-channel image.

Structure from Motion (SfM) photogrammetry methods will then be applied to this imagery to generate a 3-dimensional point cloud and mesh from which surface normal may be calculated on a pixel-by-pixel basis for each input image. These normal can be exported in the form of a 3-channel image which then may be combined with the original 4 channel image for a total of 7 channels of information that includes both spectral and spatial information. It is on this image, or rather on all of these images, that a range of unsupervised image classification methods will be performed. Manual accuracy assessments will be done using a confusion matrix to determine the most effective combination of spectral channels and classification methods.

Canny and Phase Symmetry edge detections will be run on the best classified images to create binary edge images. Edges with vectors that fall within the tolerance window determined by the average vectors for bedding planes calculated from the image classification will be retained, while those that fall outside the predetermined range will be discarded. This may further be refined to generate bedding plane trends in small blocks within the imagery to better account for complex geologic structures or datasets that cover larger geographic regions.

In the event the initial multispectral camera is not able to generate the spectral information required for reliable image classification, a commercial multispectral sensor (Parrot Sequoia) will be evaluated and the relative performance compared. If this also does not meet the necessary performance required to generate accurate structural information, the workflow will be altered to increase the involvement of the human operator. In this scenario, the human operator will specify a general direction for bedding planes in the image set, bypassing the image classification at the expense of the additional granularity afforded by the image classification method.

This author expects two primary results of interest; the evaluation of the performance of a highly affordable home-brew multispectral camera, and the creation of a new mapping workflow that may enhance the accuracy and reduce the time requirements of traditional geologic mapping. This methodology is easily scaled up for use on full size aircraft and helicopters.