



Optimizing Mobile Structure-from-Motion Photogrammetry Models for Rock Slope Characterization

Kurri Reich (1), D. Jean Hutchinson (1), Angus MacPhail (1,2)

(1) Queen's University, Department of Geological Sciences and Geological Engineering, Canada (18krlr@queensu.ca), (2) BGC Engineering, Vancouver, British Columbia, Canada

The Ministry of Transportation Ontario (MTO) in Canada, manages 16,500 km of highway, of which, a significant proportion is located adjacent to rock slopes. These rock slopes are prone to rockfall events that threaten both linear infrastructure and motorists. To manage these active hazards, the MTO has developed and implemented a risk assessment system called the Ontario Rockfall Hazard Rating System (RHRON) that helps to prioritize and delegate where mitigation measures are placed (Franklin, et al, 2012). The RHRON first groups rock slopes into three categories, Class A, B, and C, with Class A slopes being the most hazardous. The five RHRON parameters used for categorization are; Magnitude of possible rockfall; Instability or likelihood of rockfall; Reach of the rockfall; Consequences of the rockfall; and the Crest Angle, which is the angle taken from the shoulder of roadway to the highest point of instability. Slopes with an RHRON classification of Class A are then chosen for a detailed inspection that factors in twenty unique parameters.

Parameters input into the detailed RHRON require inspectors to manually assess the rock slope which is time intensive and dangerous, exposing inspectors to traffic and rockfall hazards. Results from inspections may vary depending on inspector's training and experience. Therefore, the objective of this research is to extract RHRON parameters from three-dimensional Structure-from-Motion (SfM) photogrammetric models in order to reduce an inspector's exposure to site-related hazards. In addition, a three-dimensional model captures the geometry of the slope at the time of each inspection, permitting retrospective analysis if required. Methodologies have been developed to optimize photogrammetric surveys based on three camera parameters; shutter speed; ISO; and aperture. These parameters are used to maximize photo quality in poor lighting conditions or in the eventual application of mobile SfM photogrammetry.

To preserve image quality during mobile SfM photogrammetry the camera's shutter speed must operate at a sufficient speed, such that blur is not present in images. However, as shutter speed increases to accommodate faster vehicle speeds, light contact with the camera's sensor is reduced, resulting in darker images and lower model quality. Therefore, a balance must be achieved between shutter speed, ISO, and aperture, such that speed induced blur is reduced and brightness optimized to produce sufficient photogrammetric models. The effects of vehicle speed on the generation of SfM photogrammetry model quality will be presented. While recommendations for optimal and acceptable minimal lighting conditions for mobile surveys are also discussed.

References:

Franklin, J. A., Wood, D. F., Senior, S. A. B., & Blair, J. A. (2012). RHRON: Ontario Rockfall Hazard Rating System: Field Procedures Manual.