The Use of Small Unmanned Aerial Vehicles (sUAVs) to Evaluate Freestanding Rock Slope Stability and Assess Performance of Rockbolts on an Inaccessible Slope

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DESCRIPTION

Our rock slope assessment workflow combines desktop and field reconnaissance with UAV-based photogrammetric methods. After studying available data, we design a series of UAV flights meant to maximize visual coverage of the rock slope by changing elevation, camera angle, and distance from the rock face, and timing the flights to minimize shadowing. Flights are programmed in the office for efficient deployment in the field but can be easily adjusted on the fly to accommodate unexpected field conditions.

Photogrammetry generates high-density, georeferenced, three-dimensional point clouds in true color. For kinematic analysis, we virtually map large numbers of discontinuity features that would otherwise be inaccessible in a safe manner. Hoek and Bray methodology is applied to the discontinuity stereonets to identify sliding wedge and block, and toppling block hazards. Volumetric measurements can be made on discrete hazardous blocks to support rock fall simulation studies. In support of rockbolt inspection efforts, the “virtual” rock slope enables us to assess the performance of bolts in detail and prioritize repairs.

We applied this workflow at a rock slope on the north shore of the Monongahela River in Glassport, Pennsylvania, and to support inspection of the rock bolts below the Boulevard of the Allies in Pittsburgh.