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Visualizing and modelling complex rockfall slopes using game-engine hosted models

Matthew Ondercin, D. Jean Hutchinson, and Rob Harrap
Queen's University, Geological Sciences and Geological Engineering, Kingston, Canada (matthew.ondercin@queensu.ca)

Innovations in computing in the past few decades have resulted in entirely new ways to collect 3d geological data and visualize it. For example, new tools and techniques relying on high performance computing capabilities have become widely available, allowing us to model rockfalls with more attention to complexity of the rock slope geometry and rockfall path, with significantly higher quality base data, and with more analytical options. Model results are used to design mitigation solutions, considering the potential paths of the rockfall events and the energy they impart on impacted structures. Such models are currently implemented as general-purpose GIS tools and in specialized programs. These tools are used to inspect geometrical and geomechanical data, model rockfalls, and communicate results to researchers and the larger community.

The research reported here explores the notion that 3D game engines provide a high speed, widely accessible platform on which to build rockfall modelling workflows and to provide a new and accessible outreach method. Taking advantage of the in-built physics capability of the 3D game codes, and ability to handle large terrains, these models are rapidly deployed and generate realistic visualizations of rockfall trajectories. Their utility in this area is as yet unproven, but preliminary research shows that they are capable of producing results that are comparable to existing approaches. Furthermore, modelling of case histories shows that the output matches the behaviour that is observed in the field.

The key advantage of game-engine hosted models is their accessibility to the general public and to people with little to no knowledge of rockfall hazards. With much of the younger generation being very familiar with 3D environments such as Minecraft, the idea of a game-like simulation is intuitive and thus offers new ways to communicate to the general public.

We present results from using the Unity game engine to develop 3D voxel worlds and terrain models from detailed LiDAR and photogrammetric data obtained at a complex slope above a railway corridor in British Columbia, Canada. The data was collected with sufficient frequency that single event rockfall paths were detectable, permitting the impact points and the final resting spots to be determined using LiDAR change detection methods. These specific case histories, including the high resolution, detailed slope geometry from the LiDAR data sets were modelled using game engines, as well as the conventional GIS based and specific rockfall modelling packages. The game engine results compare favourably and in some case outperform conventional tools in terms of rockfall trajectory and slope accuracy, physical realism, data handling capacity, and performance.