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Application of the Unity Rockfall Model to Variable Surface Material Conditions

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Rockfall is a geological process that poses risks to the safe operation of transportation infrastructure in mountainous environments world wide. The Unity rockfall model was created as a tool for 3D rockfall simulation as part of the Railway Ground Hazards Research Program, studying the impact of geotechnical hazards affecting Canadian railways [1]. The Unity rockfall model demonstrates the applicability of 3D video game engines for the development of realistic simulations, leveraging high-resolution site data collected using remote sensing techniques.

Currently work is being done to further calibrate the model as an engineering tool for decision support. Calibration datasets include high-resolution terrestrial LiDAR and helicopter photogrammetry data collected as part of an ongoing rockfall monitoring program along the Thompson River Valley in south-central British Columbia, Canada. Change detection techniques developed as part of the program have been used to construct a database of rockfall event history and to develop magnitude-frequency relationships for rockfalls in the area [2][3].

Data collected as part of a controlled rock-rolling field program in Christchurch, New Zealand [4] is also being utilized for model calibration. Data on block dynamics for the artificially triggered rockfalls were collected through the use of embedded motion sensors and a sixteen camera setup. These experiments provide detailed information on block kinematics, and capture each impact point of the rockfall with the slope, thus offering a valuable dataset for comparison with modelling results.

The research reported here explores the ability of the game engine based modelling technique to simulate rockfall under the variable slope conditions present at each of the sites where calibration data was collected. This includes steep natural rock slopes, with debris-talus cover, as well as shallower slopes with soil cover and vegetation. The varying slope conditions in each environment affect the dominant processes controlling rockfall movement downslope. In comparison to rock on rock collisions, impacts with soil and talus exhibit lower restitution values, with more energy loss occurring, but less overall fragmentation expected. The current modelling efforts present example workflows for each case, showing the steps taken to run realistic simulations using the Unity rockfall model. A comparison of the setup, model inputs and methods implemented in the model for each case study demonstrates the adaptability of the tool to different rockfall environments.

References:

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