Geophysical Research Abstracts, Vol. 8, 04157, 2006
SRef-ID: 1607-7962/gra/EGU06-A-04157

TIN-based 3D deterministic simulation of rockfall taking trees into account

C. le Hir (1), E. Dimnet (2), F. Berger (1) and L. Dorren (1)

(1) Cemagref Grenoble, France, (2) LCPC Paris, France

(frederic.berger@cemagref.fr / Phone : +33 4 7676 2800)

Two identical rocks falling from the same position on a cliff face will never follow the same trajectory. Their shape, interactions with the slope surface during rebounds and rebounds against obstacles, such as trees, will influence their fall direction. Present model simulation technology permits to take these effects into account and could therefore contribute to better rockfall hazard zonation.

We used the deterministic rockfall simulation model STAR3D, which is based on the percussion theory that has been developed at the LCPC. Within STAR3D, a falling rock is simulated in 3D. Two reference systems, one for the rock and one for the Triangular Irregular Network (TIN) that represents the terrain, allow calculating the parabolic flight of the falling rock and its impact positions. During each of the small simulation time steps, the model checks whether one of the edges of the rock impacts the TIN. If this is the case, the rebound, which could include multiple rapid consecutive rebounds, is calculated using a normal and tangential coefficient of dissipation. Since we integrated trees stems as obstacles in the TIN, tree impacts are realistically simulated. For example, a rotating rock that hits and subsequently turns around a tree can be reproduced by STAR3D.

The added value of STAR3D is that the effect of the shape of the rock on the rotational and translational energy as well as on its trajectory can be taken into account in rockfall hazard assessment studies. To improve the application of STAR3D, we plan to focus our work at:

1. understanding and integrating the mechanical behaviour during rockfall impacts of different types of trees and other types of obstacles in the model

2. taking into account local variations in the slope surface by stochastic algorithms
3. developing an objective method for estimating the coefficients of dissipation in the field should be developed
4. linking rockfall trajectory modelling to dynamic forest growth modelling to study the evolution of protective forest stand in time