PREPROCESSING AND SMOOTHING OF SURFACE MODELS FOR ROCKFALL SIMULATION

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Today highly detailed surface representations are available. These data stem from Laser scanning, photogrametry or different surveying methods and are formulated as digital surface models. Modern computer technology allows to incorporate this surfaces representations without further adaptation in simulation software. First experiences with rockfall simulations based on digital surface models showed the scale dependency of the modeled process. Theoretical considerations and some preliminary research done on this topic showed that the model parameter roughness is not directly comparable to the actual slope surface. The necessity to smooth the actual surface in order to apply a appropriate roughness which meets the demands of the present simulation approach will be discussed.

Keywords: Rockfall simulation, surface representations, surface roughness

INTRODUCTION

Every model is a simplified representation of reality. The processes, which determine the behaviour of a natural system, have to be simulated by the model. The capability of prediction of any numerical model can be endangered by an oversimplified model approach or uncertainties in our knowledge of the natural system due to sparse data. Here we do not want to deal with obvious errors in the model itself. Although obvious errors are not always that obvious, if we consider for example the numeric behaviour of highly complex models and their solution algorithm.

In numerical rockfall simulation model approach and the degree of detail i.e. the scale of surface representation can not be dealt with independently. The interaction between Block and surface is highly dependent of block form and surface features in the magnitude of the block size. Therefore modelers are not free to choose a scale as can be done within certain limits in other fields of numerical modeling.

The rockfall process is a series of sliding, toppling and impacts on the subsoil. With higher velocities and steeper gradients of the slope the rock can entirely lift of from the surface and follow a ballistic trajectory until impact on the slope again. Rolling, which is a possible movement in most simulation algorithms, is already an idealization of the natural process. In nature it will not occur in this form, because rock blocks are rarely spheres or have any circular forms. Neither is the surface exactly level.

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ANALYSIS OF SURFACE REPRESENTATION

The nowadays available higher resolution of surface models first led to the hope that it may be possible either to identify the relevant characteristics from the surface representations or to model the rockfall path on the actual real life surface without a stochastic model of surface roughness. In particular the first approach seemed promising. It was expected that the smoothing process in it self can result in the identification of the relevant surface roughness, if a sufficient resolution of the surface representation is given.

SCALE EFFECTS ON ROCKFALL SIMULATIONS

SIMULATION STRATEGY

In recent years up to now one of the possible strategies is the representation of the slope profile in a macro scale which is overlain by a micro roughness in the magnitude of the block size. Micro roughness is the stochastic model of zigzags. The spikes are characterized by length and amplitude. The roughness representation was and is due to the estimation and experience of the modeller. In effect this led to a rather detailed, explicit and computer power consuming simulation strategy.

ROUGHNESS VERSUS ROUGHNESS

The analysis of surface roughness by geostatics, yielded surface roughness which were not comparable to model parameters. Further more the resolution of the surface representation has an effect on simulation results. In the numerical model of rockfall every peak is likely to produce an impact. In addition every point of a surface model is likely to act as a peak even if it does not represent a peak of the real surface. Therefore we can state a direct effect of the resolution to energy dissipation. Different representations of the same slope surface which are only different in their resolution respectively scale will produce different simulation results because of the number of peaks which may produce impacts between block and subsoil.

Tab. 1 Event types (example of a small table)

Affected area	**region**	**community, town**	**single place**
Magnitude of event	**damaging event**	**almost damaging event**	**important not damaging event**

SMOOTHING TECHNIES

Our approach is to smooth out the slope profile and afterwards overlay it with a appropriate roughness. Two different methods for smoothing were tested and applied to real world projects. From this experience we are recommending only one of these.

Fig. 1 Strange illustration

CONCLUSIONS

Theoretical considerations and some preliminary research done on this topic showed that the model parameter roughness is not directly comparable to the actual slope surface. At the present state of the art the roughness concept also covers up for some additional effects, which are not explicitly taken into account in the model approach. This article discussed the necessity to smooth the actual surface in order to apply a appropriate roughness which meets the demands of the present simulation approach.

DISCUSSIONS

But the discussion of the influence of surface representation in different scales is leading to a better process understanding. This may open the way for model approaches, with a higher degree of abstraction. This is insofar from great importance as the present model approach with its roughness concept can not directly be transferred to a higher dimensional approach. The recent years showed a demand for more extensive rockfall simulations. This applies for risk mapping as well as for design and dimensioning of mitigation measures and rockfall protection structures.

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