

Preface

In recent years, the increasing impacts of landslide hazards on human lives and life-line facilities worldwide has advanced the necessity to find out both economically acceptable and useful techniques to predict the occurrence and destructive power of landslides. Though many projects exist to attain this goal, the current investigation set out to establish an understanding of the initiation and propagation mechanisms of landslides via numerical simulations, so that mitigation strategies to reduce the long-term losses from landslide hazards can be made.

This book summarizes some of the recent researches on landslides via the Discrete Element Method (DEM) and Computational Fluid Dynamics (CFD). These two methods have been used to investigate the mechanical and hydraulic behaviour of granular materials involved in landslides. The main challenge is to provide rational analyses of large-scale landslides via small-scale numerical simulations. To solve this problem, dimensional analyses have been performed on a simple granular column collapse model. The influence of governing dimensionless groups on the debris runout distance and deposit height has been studied for the terrestrial and submerged granular flows.

3D DEM simulations of granular flows in plane strain conditions have been performed in this research. The input parameters of the DEM model have been calibrated by the numerical triaxial tests, based on which, the relationships between the microscopic variables and the macroscopic soil strength properties were analysed. Using the simple granular column collapse model, the influences of column aspect ratio, characteristic strain, model size ratio and material internal friction angle on the runout distance and deposit height of granular materials have been examined. Additionally, the deformation and energy evolution of dry granular materials are also discussed. The DEM–CFD coupling model has been employed to study the mechanical and hydraulic behaviour of highly mobilized terrestrial/submarine landslides. This model has been validated via numerical simulations of fluid flow through a porous soil sample and grain batch sedimentations. The simulations of granular flows in the submerged environment have led to some meaningful insights into the flow mechanisms, such as the mobilization of

sediments, the generation and dissipation of excess pore water pressures and the evolution of effective stresses.

Overall, this study shows that the proposed numerical tools are capable of modelling the mechanical and hydraulic behaviour of terrestrial and submarine landslides.

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Flows

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