The objective of this PhD is to improve the modeling of the dissipation processes occurring during the propagation of blocks through mountain slopes. These processes are related with momentum exchanges, friction at the interface, wave propagation through the soil, visco-plastic strains of the soil and the breakage of the rock. The novelty will consist in the development of contact laws with friction at the interface, set-valued (Coulomb-like) friction and impacts, or in continuum mechanics, ideal plasticity, fracture or damage. These approaches have not yet been extensively investigated and calibrated. They remain based on simple models of block interaction with the terrain that only partially integrate the energy dissipation processes during rockfall. As a consequence, they remain almost not used in practice.

The propagation of blocks through mountain slopes. These processes are related with momentum exchanges, friction at the interface, wave propagation through the soil, visco-plastic strains of the soil and the breakage of the rock. The novelty will consist in the development of contact laws with rolling friction, and with the integration of rock breakage due to impact.

Niveau de diplôme exigé : Bac + 5 ou équivalent
Fonction : Doctorant

Contexte et atouts du poste
TRIPOP is a joint research team of Inria Grenoble Rhône-Alpes and of the Laboratoire Jean Kuntzmann and started in January 2018 as a follow up of the BIPOP team. The team is mainly concerned by the modeling, the simulation and the control of nonsmooth dynamical systems. Nonsmooth dynamics concerns the study of the time evolution of systems that are not smooth in the mathematical sense, i.e., systems that are characterized by a lack of differentiability, either of the mappings in theirs formulations, or of theirs solutions with respect to time. In mechanics, the main instances of nonsmooth dynamical systems are multibody systems with Signorini’s unilateral contact, set-valued (Coulomb-like) friction and impacts, or in continuum mechanics, ideal plasticity, fracture or damage.

The members of the team have a long experience of nonsmooth dynamics modeling together with the development of simulation software. With the integration of Franck Bourrier as a new research member, a part of the activities of the theme is now focused in rockfall trajectory modeling and natural hazard mitigation.
Principales activités

- Literature review. This review will focus on the modeling approaches potentially usable for the integration of the dissipation processes during the impact of a block on a soil, modeling of contact law with rolling friction and of block breakage.
- Formulation and numerical implementation of a novel contact law integrating rolling friction in the framework of second–order cone complementarity.
- Modeling of block breakage. The approach proposed will be based on the modeling of the block as an assembly of rigid or deformable tetrahedron linked by cohesive contact laws. The challenge relies on the implementation of relevant cohesive contact laws, able to reproduce at the macroscopic level the main fracture phenomena.
- Dimensional analysis. This final phase of the project will consist in the assessment of the relevance of the models over large ranges of block size based on the joint use of dimensional analyses and simulations.

Compétences

The PhD candidate should have competences in solid mechanics and numerical modeling.

A strong theoretical background in solid mechanics is mandatory.

Furthermore, the applicant must show a strong interest for software development in computational Mechanics. He also has to be motivated by applied research in collaboration with researchers from different disciplines.

A good level of English and subsequent writing capacities are also requested.

Avantages sociaux

Restaurant on site
Financial participation for public transport
Social security
Social and sporting activities
Arranging working time
French courses