A propos du centre ou de la direction fonctionnelle

Grenoble Rhône-Alpes Research Center groups together a few less than 800 people in 35 research teams and 9 research support departments.

Staff is localized on 5 campuses in Grenoble and Lyon, in close collaboration with labs, research and higher education institutions in Grenoble and Lyon, but also with the economic players in these areas.

Present in the fields of software, high-performance computing, Internet of things, image and data, but also simulation in oceanography and biology, it participates at the best level of international scientific achievements and collaborations in both Europe and the rest of the world.

Contexte et atouts du poste

TRIPOP is a joint research team of Inria Grenoble Rhône-Alpes and of the Laboratoire Jean Kunttmann 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 multi-body 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 Francis 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.

Mission confiée

Rockfall is one of the most common natural hazards in mountainous regions. The assessment of this hazard, related with block detachment conditions and propagation, is essential for mitigation strategies that include hazard zones determination and protection structures design. Block trajectory simulation models are routinely used for the quantitative assessment of rockfall hazard. In these models, one of the major difficulties is the development of physically consistent and field applicable approaches to model the interaction between the block and the natural terrain. The models either consider the block as a single material point or explicitly account for the fragment shape. The first approach, although largely empirical, has been extensively investigated and calibrated. Consequently, it is efficient for global hazard zoning purposes because of its reduced number of input parameters and its computational efficiency. However, it remains limited for a detailed analysis of the propagation process with the objective of designing protection structures. The second type of approaches, that explicitly accounts for the fragment shape, is either based on regularized Discrete Element Methods (DEM) or on nonsmooth contact dynamics methods. 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. As a consequence, they remain almost not used in practice.

Principales activités

The objective of this PhD is to improve the modeling of the interaction between the block and elastoplastic deformable obstacles, typically protection structures and trees. This topic has been extensively investigated using DEM approaches. These DEM models, although relevant, have several major limitations. In particular, they remain highly computationally demanding, they induce the use of compliant impact models, and they are not directly compatible with implicit finite Element Methods. In this PhD, we propose to tackle these issues using nonsmooth contact dynamics methods, that constitute promising alternatives to regularized DEM in this context.

The different phases of the PhD will be:

- 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 and on deformable obstacles.
- Numerical modeling the response of elastic beam and/or cables structures to impact using nonsmooth contact dynamics methods.
- Formulation and numerical implementation of a novel model of the response of deformable elastoplastic beam and/or cables structures to impact in the framework of second-order cone complementarity.

References

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
- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking (after 6 months of employment) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

Rémunération