Proposition de sujet de post-doctorat

**Probabilistic approach and numerical associated methods for rupture phenomena. Applications to avalanches**

Équipe Projet Tosca (Inria Nancy Grand-Est)

- Location : Inria Nancy Grand Est research center – IECL Laboratory, Vandoeuvre-lès-Nancy, France
- Research theme : Applied Mathematics
- Project-team : Tosca-NGE-Post

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**Scientific context**

The rupture phenomena arise in many applicative fields as : in snow or rock avalanche, in geophysics, in crystallography, etc. The mathematical description is still not very well developed and many important questions need to be answered. Recently Madalina Deaconu and her co-authors Lucian Beznea and Oana Lupascu obtained significative results in this direction by giving a probabilistic interpretation to the fragmentation model for the avalanche. They considered the interpretation of the rupture in terms of fragmentation models. In a first work [1] they connect the probabilistic interpretation of the fragmentation equation by a stochastic differential equation with jumps to a branching process. Afterwards, by considering a particular fragmentation kernel [2], [3], which illustrates a physical characteristic of the snow avalanche, they construct a stochastic interpretation for the avalanche and also a new numerical techniques to approximate it.

In this first approach the model gives the evolution of a particle system which are characterized only by their masses. The aim is here to extend these approaches to the fragmentation process where the particles are both characterized by their mass and their position. Another step will be the introduction of the evolution of the avalanche before the rupture phase [4], [5] and [6], which can be interpreted as a a coagulation model, the detection of the rupture time and also the description of the rupture as a fragmentation process (the study done before). The implementation of the numerical stochastic methods will be crucial for the understanding of the phenomenon. This approach is new and proposes an alternative approach to avalanche modeling by stochastic processes. The success of this study will allow to give some insight on important problems concerning avalanches and the connected risk.

**Missions : (objectives, approach, etc)**

This project aims to develop the existing interest of Tosca Nancy in the probabilistic interpretation of rupture phenomena like avalanches in terms of fragmentation models.

More precisely we will construct a stochastic approach for the avalanche model by using some particular properties of an avalanche. This approach is an important issue in controlling the risk. The originality is here to include also the position of the particle (snow) one of the important parameters of the physical model. The numerical part of this work will be done in collaboration with researcher from Irstea, Grenoble.

Our aim is twofold. First, we intend to investigate the evolution equation of the fragmentation including both position and mass of the particle. This microscopic vision should conduce to a better understanding of this complex process. The second direction is to improve the model by considering coagulation/fragmentation models based on the physical properties of the avalanches in order to characterize the different stages of the physical phenomenon.
An important part of this project will be dedicated to the construction and the analysis of numerical probabilistic methods.

Bibliography


Skills and profile

Required qualification: PhD in applied mathematics and basis in numerical probabilistic methods

Additional information:

Supervision and contact: Madalina Deaconu, Madalina.Deaconu@inria.fr

Contacts: Madalina Deaconu (Inria, Madalina.Deaconu@inria.fr)