

Research internship proposal: Fragility analysis of ageing assets subject to natural hazards

Keywords:

Numerical modelling, fragility analysis, risks, Bayesian update, decision making

Societal and scientific context:

In the context of global change, natural phenomena are becoming increasingly threatening for people, infrastructures, and entire territories. This is especially true in mountainous areas, particularly exposed to rapid, sudden, and violent events such as rockfalls, torrential floods, snow avalanches, and landslides. The risk level for the exposed assets depends on the phenomena's nature, intensity and occurrence probability, but also on the physical vulnerability of each exposed element. In this context, managers of critical infrastructures and territories need a better knowledge of the level of risk, uncertainties, and improved risk-informed decision methods.

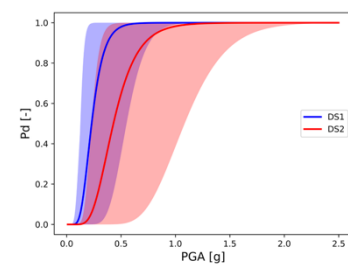
In this context, the research project PRISM (Predictive Risk-Informed asset Strategic Management), funded by the MIAI Cluster IA of University Grenoble Alpes, seeks to develop decision-support methods for the dynamic management of vulnerable assets under uncertainty and in the presence of heterogeneous information sources. The local authority in charge of infrastructure maintenance in the Isère department is interested in the project, providing access to existing data on the critical infrastructures at risks, such as bridges and natural risk protection works like check dams, or retaining walls. Defining reliability indices for these assets is of particular interest to help defining a relevant maintenance strategy. Moreover, a reliability approach is developed in the industrial chair Medelia, dealing with the ageing of the hydraulic works. One of the ideas in this chair is the updating of reliability indices, using new observations (monitoring and Non-Destructive-Examination (NDE) data) or reparation strategies, using also a Bayesian approach, as recently developed in [Rossat, 2023]. The purpose of the internship proposal is to develop a methodology contributing to both projects, using a reliability approach to assess the behavior of assets at risks.



*Roadway destroyed due to flooding,
Saint-Christophe-en-Oisans.
Credits: Jean-Louis Arthaud / Mairie de Saint-
Christophe-en-Oisans. Source :
www.francebleu.fr*



*Scouring phenomenon
downstream a check dam.
Saint Antoine torrent, France, 2014.
Source: [Chahrouh et al., 2021]*



*Example of fragility curves.
Source: [Stocchi et al., 2021]*

Scientific project:

The assessment of the structural performance of assets at risks faces several challenges. The first challenge lies in the heterogeneous and incomplete information on the asset itself (uncertainties related to geometry and material characteristics, as well as to the ageing state), and on the loading, coming from uncertain events. To address this issue, the objective of this proposal is to carry out a

fragility analysis leading to reliability indices. Thus, the research work of this internship will be structured around the following axes:

- Carry out the fragility analysis using a very simple model
- Analyze the existing data on the assets at risks and choose the relevant application(s)
- Develop a modelling strategy to lead the fragility analysis on the chosen application
- Update the reliability indices thanks to the provided data

Location: Laboratoire 3SR (Soils, Solids, Structures, Risks), Grenoble

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