Univ. Grenoble Alpes
Université de l'innovation

FICHE NAVETTE: DOCTORANTS IDEX

SECTOR **:** Higher Education Institution

LOCATION: France, Grenoble

RESEARCH FIELD: **RISK MODELLING, ASSESSMENT AND MANAGEMENT ; DETERIORATION MODELLING ; PROTECTION SYSTEMS & STRUCTURES ; PREVENTIVE MAINTENANCE ; MONITORING ; TORRENT CHECK DAMS ; DECISION MAKING**

RESEARCHER PROFILE:

□ *First stage researcher (Master Degree level required)*

INSTITUTION: Univ. Grenoble Alpes, University of Innovation

One of the major research-intensive French universities, Univ. Grenoble Alpes[1] enjoys an international reputation in many scientific fields, as confirmed by international rankings. It benefits from the implementation of major European instruments (ESRF, ILL, EMBL, IRAM, EMFL[2]). The vibring ecosystem, grounded on a close interaction between research, education and companies, has earned Grenoble to be ranked as the 5th most innovative city in the world. Surrounded by mountains, the campus benefits from a natural environment and a high quality of life and work environment. With 7000 foreign students and the annual visit of more than 8000 researchers from all over the world, Univ. Grenoble Alpes is an internationally engaged university.

A personalized Welcome Center for international students, PhDs and researchers facilitates your arrival and installation.

In 2016, Univ. Grenoble Alpes was labeled “Initiative of Excellence". This label aims at the emergence of around ten French world class research universities. By joining Univ. Grenoble Alpes, you have the opportunity to conduct world-class research, and to contribute to the social and economic challenges of the 21st century ("sustainable planet and society", "health, well-being and technology", "understanding and supporting innovation: culture, technology, organizations", "Digital technology").

Key figures:

- + 50,000 students including 7,000 international students
- 3,700 PhD students, 45% international
- 5,500 faculty members
- 180 different nationalities
- 1st city in France where it feels good to study and 5th city where it feels good to work
- ISSO: International Students & Scholars Office affiliated to EURAXESS

[1] Univ. Grenoble Alpes

[2] ESRF (European Synchrotron Radiation Facility), ILL (Institut Laue-Langevin), IRAM (International Institute for Radio Astronomy), EMBL (European Molecular Biology Laboratory), EMFL (European Magnetic Field Laboratory)

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MANDATORY REFERENCES:

CDP TITLE: **RISK@Univ. Grenoble Alpes**
SUBJECT TITLE: **Deterioration modelling and performance assessment of protection systems/structures against natural risks: application to monitoring and preventive maintenance of torrent check dams**
PRIMARY SCIENTIFIC DEPARTMENT (LABORATORY'S NAME): **GIPSA-lab**
SECONDARY SCIENTIFIC DEPARTMENT (LABORATORY'S NAME): **IRSTEA**
PRIMARY DOCTORAL SCHOOL (where the candidate will be registered): **EEATS**
SECONDARY DOCTORAL SCHOOL: **TUE**
SUPERVISOR NAME(S**): Christophe BERENGUER (GIPSA-lab) and Jean-Marc TACNET (IRSTEA)**

SUBJECT DESCRIPTION:

Protection structures against natural hazards (e.g. torrent check-dams, avalanche barriers, …) play a major role in risk prevention and mitigation on the protected people and assets (critical infrastructures, urban areas, roads, …). But, to some extent, these protection structures constitute themselves a complex system of structures in interaction with their environment and can be considered as critical infrastructures: they age, deteriorate and can be damaged, which modifies their effectiveness and protection performance, and the risk level on the protected assets is thus not reduced as much as it should be. It is thus important to be able to characterize, assess and eventually improve (by e.g. maintenance and overhaul) the dependability and resilience of these protection structures which requires to i) model and assess their dependability through a dynamic deterioration-based approach, and ii) to develop dynamic decision-making strategies for maintenance and dependability improvement.
To this aim, this PhD research work seeks to propose methodological contributions to answer the following issues:
1-Analyze, assess and compare the possible deterioration scenarios of the protection structures, both from the structural and functional point of views, using partial information and incomplete knowledge on the structures
2- Characterize the local and distant effects of the deterioration of an element of the system of structures, both on the system itself (in both directions upstream and downstream) and on the protected assets
3-Support maintenance decision-making for maintenance strategies choices and dependability improvement prioritization.
This work program requires to go beyond the state-of-the-art in system/structures deterioration modelling for dynamic dependability assessment and maintenance decision and several original methodological contributions are expected. A new modelling approach is required to integrate the specific features of the deterioration of the protection "system of structures":
-Lack of direct monitoring information on the deterioration from sensors: synthesis of deterioration indexes from partial & imperfect information
-Complex and partially "unknown" intrinsic deterioration dynamics
-Bi-directional deterioration interactions and dependencies
-Common cause events affecting all the structures of the system
-Common cause deterioration modes
For the dynamic dependability assessment of the protection structures and the related risk on the protected assets, we will propose a model for the link between the structural deterioration level dependability & performance level and an integrated modelling framework to take into account all the phenomena involved the system evolution at different scales, with the most appropriate formalisms for each level: physics-based modeling when possible, stochastic modeling for the variability and uncertainty (stochastic processes with copula for dependence modelling) and system level models (event-based approaches, cascade event modeling).

At the maintenance decision level, towards condition-based & predictive maintenance, dynamic deterioration-based maintenance rules will be developed and cost/performance maintenance models will be derived to assess the relevance of the proposed decision rules and to provide information for the prioritization of maintenance actions under cost or delay constraints.

Deliverables

This PhD project will contribute to the CDP project Risk@Univ.Grenoble Alpes with original methodological contributions on:

-Integrated modelling framework for living safety and risk assessment for protection structures
-High dimensional dependences modelling for system of structures deterioration (copula and stochastic processes)
-Metrics for dynamic assessment of safety performance
-Predictive maintenance decision-making based on partial information

The proposed methodological contributions will be illustrated as much as possible on studied torrent check dams systems and protection devices in the Grenoble Alps area, e.g. Torrent du Saint-Antoine, Modane, France

References

1) Deloux, E., Castanier, B. & Bérenguer, C., 2012. Environmental information adaptive condition-based maintenance policies. Structure and Infrastructure Engineering, 8(4), pp.373–382
2) Huynh, K.T., Barros, A. & Bérenguer, C., 2012. Adaptive condition-based maintenance decision framework for deteriorating systems operating under variable environment and uncertain condition monitoring. Proceedings of the Institution of Mechanical Engineers, Part O: Journal of Risk and Reliability,226(6), pp.602–623.
3)Li, H., Deloux, E. & Dieulle, L., 2016. A condition-based maintenance policy for multi-component systems with Lévy copulas dependence. Reliability Engineering and System Safety, 149, pp.44–55
4)Nan, C. & Sansavini, G., 2017. A quantitative method for assessing resilience of interdependent infrastructures. Reliability Engineering and System Safety, 157, pp.35–53.
5)Tacnet, J.-M. et al., 2014. How to manage natural risks in mountain areas in a context of imperfect information? New frameworks and paradigms for expert assessments and decision-making. Environment Systems and Decisions, 34(2), pp.288–311.

ELIGIBILITY CRITERIA

Applicants:
- must hold a Master's degree (or be about to earn one) or have a university degree equivalent to a European Master's (5-year duration),

REQUIRED SKILLS

- *Theoretical skills* : Good knowledge in one or several of the following fields : reliability & maintenance theory, modelling and engineering ; data analysis and decision sciences ; civil and hydraulic engineering ; protective structure engineering.
- *Methodological skills*: Autonomy, initiative and critical thinking; Independent working; Academic writing and presentations ; Documenting and reporting ; Research methods
- *Language*: A good level in French and English is an asset

APPLICATION PROCEDURE

Applicants will attach a file including:
- Their CV

- A cover letter / letter of motivation
- A summary of previous work done/publications in Master 1 and Master 2
- A record of the grades of Master 1 and Master 2
- A copy of their last diploma

Address to send their application: Jean-Marc TACNET (IRSTEA) and Christophe BERENGUER (GIPSA)
jean-marc.tacnet@irstea.fr
Christophe.Berenguer@grenoble-inp.fr

SELECTION PROCESS
Application deadline: **May 31, 2018** at 17:00 (CET)
Applications will be evaluated through a three-step process:

1. Eligibility check of applications on **June 7, 2018**
2. Selection: the applications will be evaluated by a Review Board in June 2018
3. Results will be given by **July 12, 2018**.

TYPE of CONTRACT: temporary-3 years of doctoral contract
JOB STATUS: Full time
HOURS PER WEEK: 35
CONTRACT STARTING DATE: **October 1, 2018**
APPLICATION DEADLINE: **May 31, 2018**
Salary: 1768.55 € gross per month

Thesis cofunding (if applicable): No cofounding available