Univ. Grenoble Alpes
*Université de l'innovation*

**FICHE NAVETTE: DOCTORANTS IDEX**

SECTOR **:** Higher Education Institution

LOCATION: France, Grenoble

RESEARCH FIELD: SEISMIC **RISK MODELLING, ASSESSMENT AND MANAGEMENT**

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 vibrant 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 its natural setting and offers 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 facilitates the arrival and installation of international students, PhDs and researchers.

In 2016, Univ. Grenoble Alpes was labeled with an "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
- Noted the 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: **An integrated seismic risk modelling approach including human behaviour**
PRIMARY SCIENTIFIC DEPARTMENT (LABORATORY'S NAME): **ISTERRE**
SECONDARY SCIENTIFIC DEPARTMENT (LABORATORY'S NAME): **PACTE, LIG**
PRIMARY DOCTORAL SCHOOL (where the candidate will be registered): **TUE**
SECONDARY DOCTORAL SCHOOL: **MSTII**
SUPERVISOR NAME(S)*:* **Cécile Cornou, Elise Beck, Julie Dugdale**

**SUBJECT DESCRIPTION:**

Most of the today's seismic risk scenarios aim at estimating the economic and human losses during an earthquake, without however fully accounting for the human component (mobility, behaviour, perception*).* However, through detailed questionnaires, in-depth interviews, online videos, and analysing posts on social networks, we now have access to how people act during a crisis and the reasons behind these actions (e.g. Beck et al., 2014).

This PhD research proposal thus targets the development of an interdisciplinary multi-model of the seismic risk, integrating different models of hazard, physical and social vulnerabilities together with the impact of people's perception and behaviours with respect to uncertain hazard and risk. More specifically, it aims at improving transdisciplinary modelling of seismic risk accounting for both the limited knowledge and the a priori difficulty of ranking its various elements (hazard, social and physical vulnerability, and human behaviour).

Besides methodological improvements in hazard and vulnerability assessment at the spatial local scale (typically tens to hundreds of meters), the main originality of this proposal is to apply artificial intelligence tools (namely multi-agent systems and simulation) combining both social factors (human behaviour and mobility) and physical factors (hazard dependant of buildings shaking and related damages). By integrating various elements (hazard, social and physical vulnerability, human behaviour), such modelling will allow us to identify the key vulnerability factors (either physical or social), and the associated uncertainties for various ground shaking levels. The final goal is to develop operational risk management tools tuned to the specificities of local situations.

After having carried out a state of the art on seismic risk indices, the first step will be to refine the model, to take into account various ground shaking levels, of the buildings' damage at the city and neighbourhood scales accounting for the dynamic vibrational properties of both soils and buildings. Following Salameh et al. (2017), the non-linear behaviour of soils for strong ground shaking, time-dependant shaking (main-shock and aftershocks), and multi-modal vibrational properties of buildings will be included in building shaking and damage estimation, together with a clear quantification of uncertainties. High-resolution satellite images will be used to infer building properties and population distribution at urban scale.

Next, for a series of seismic scenarios related to various hazard levels, the multi-agent model and simulator developed by LIG/PACTE (Bañgate et al. 2017) (Truong et al., 2013) will be used to integrate models of both human behaviour and mobility during a crisis, building shaking and damage estimates. After calibrating the model, hundreds of simulations, with varied parameters will be performed for each of the scenarios. The large dataset of simulation results will be analysed by using statistical analysis tools (e.g. data-mining, sensitivity analysis, etc.) in order to identify and rank the key vulnerability factors (either physical or social) and related uncertainties that control the seismic risk. The final goal is to propose a seismic risk index that quantitatively incorporates the social component of risk, and operational risk management prototypes tuned to the specificities of local situations.

These methodological developments will be applied to Beirut (Lebanon), which exhibits large hazard variability due to geological conditions and near-fault ruptures, heavy constraints on the physical and social vulnerabilities, and fuzzy and variable perception of a long-term risk. Data from Earth, Engineering and Human Sciences have already been collected in Beirut (e.g. Beck et al., 2014; Salameh et al., 2016).

This PhD will be supervised by 3 different UGA laboratories (ISTerre, PACTE, LIG) and will involve collaboration with universities in Lebanon (Saint-Joseph university, Notre-Dame university), within the framework of the International Associate Laboratory O-LIFE (LIA O-LIFE).

Bibliography.

Bañgate, J., Dugdale, J., Beck, E. and Carole Adam. (2017). SOLACE a multi-agent model of human behaviour driven by social attachment during seismic crisis. International Conference on Information and Communication Technologies for Disaster Management (*ICT-DM*'2017).

Beck, E., Dugdale, J., Truong, H.V., Adam, C. and Ludvina Colbeau-Justin. (2014) Crisis mobility of pedestrians: from survey to modelling, lessons from Lebanon and Argentina. Information Systems for Crisis Response and Management in Mediterranean Countries. Lecture Notes in Business Information Processing. Volume 196, 2014, pp 57-70. Springer.

Salameh, C., P.-Y. Bard, B. Guillier, J. Harb, C. Cornou, J. Gérard, M. Almakari, 2017. Using ambient vibration measurements for risk assessment at an urban scale : from numerical proof of concept to Beirut case study (Lebanon), Earth, Planets and Space, 69(1), 60.

Salameh, C., Guillier, B., Harb, J., Cornou, C., Bard, P. Y., Voisin, C., & Mariscal, A. (2016). Seismic response of Beirut (Lebanon) buildings : instrumental results from ambient vibrations. Bulletin of Earthquake Engineering, 1-26.

H.V. Truong., E. Beck., J. Dugdale., C. Adam. (2013). Developing a model of evacuation after an earthquake in Lebanon. In Proc. ISCRAM Vietnam 2013. Oct 30-Nov 1. Hanoi, Vietnam.

**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*: solid background in earthquake seismology with strong interest in social sciences field and modelling; or solid background in modelling with strong interest in social sciences and earthquake seismology; or solid background in social sciences and strong interest in earthquake seismology and modelling.
- *Methodological skills*: knowledge of programming is required. Skills in data mining and/or, agent-based modelling are expected.
- *Behaviour skills*: strong interest to interact with researchers from various research fields.
- *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: cecile.cornou@univ-grenoble-alpes.fr, elise.beck@univ-grenoble-alpes.fr and Julie.dugdale@univ-grenoble-alpes.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 year 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): none**