SECTOR: Higher Education Institution

LOCATION: France, Grenoble

RESEARCHER PROFILE: □ First stage researcher,

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*). The dynamic 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 Alps 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").

* 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)

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

\(^1\) https://edu.univ-grenoble-alpes.fr/en/
MANDATOR

PROJECT TITLE: AIBot (AI and dynamical systems: new paradigms for control and robots), part of the new AI institute in Grenoble, MIAI @ Grenoble Alpes

SUBJECT TITLE: Model identification and control for mechanical vibrations: An approach based on machine learning techniques and systems theory

RESEARCH FIELD (cf mots clefs sur Euraxess Jobs): Control Systems Engineering

SCIENTIFIC DEPARTMENT (LABORATORY’S NAME): GIPSA

DOCTORAL SCHOOL’S: EEATS

SUPERVISOR’S NAME: Christophe Prieur, Francesco Ferrante

SUBJECT DESCRIPTION: The general context of this thesis is the model identification and boundary control of a class of infinite-dimensional systems. More precisely, we will focus on hyperbolic partial differential equations, as the wave equation with boundary sensing and actuation. This class of systems is of fundamental importance in many applications as, just to mention one, the control of mechanical vibrations in drilling pipes for oil extraction. Specifically, it is well known that vibrations are likely to impact efficiency in oil extractions processes and can possibly jeopardize the integrity of the drilling system itself.

The final goals of this PhD thesis are the identification of an infinite-dimensional model for the experimental laboratory device at Gipsa-lab and the design of a boundary control for vibration compensation based on the identified model. System identification for infinite-dimensional systems is a well-established topic; see, e.g., [6, 3, 1], just to mention a few results. One of the most challenging aspects of system identification pertains to the need of relying on experimental data that are often noisy. This makes it system identification a challenging problem to be faced.

In this thesis, we want to develop system identification techniques blending control theory and machine learning methods. First steps in this direction can be found in [2]. Following this approach, we aim at developing specific techniques for parameter identification in drilling pipe systems. As a second goal, we will make use of models identified via experimental data to design suitable control strategies enabling to limit structural vibrations in drilling pipes. Many techniques have been already developed for the control of drilling pipes; see the recent PhD manuscript [4] for an introduction of this problem. The first attempt to solve this problem will consist on the design of Proportional-Integral controllers for the wave equation, which is the most common model adopted to study vibratory dynamics. Such strategies have been already investigated in other transport dynamics; mainly in [5]. However, the development of controller tuning strategies for performance fulfillment is a largely unexplored territory. Again solutions coming from artificial intelligence will be compared and applied on the experimental test bench.

References


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),

Applicants will have to send an application letter in English and attach:
- Their last diploma
- Their CV
- A short presentation of their scientific project (2 to 3 pages max)
- Letters of recommendation are welcome.

Address to send their application: christophe.prieur@gipsa-lab.fr, francesco.ferrante@gipsa-lab.fr