



Offer #2024-07231

PhD Position F/M Estimating/Modelling the statistical degradation laws of the secondary road network from video-based pavement monitoring

Contract type : Fixed-term contract

Level of qualifications required : Graduate degree or equivalent

Fonction : PhD Position

About the research centre or Inria department

The Inria Centre at Rennes University is one of Inria's eight centres and has more than thirty research teams. The Inria Centre is a major and recognized player in the field of digital sciences. It is at the heart of a rich R&D and innovation ecosystem: highly innovative PME's, large industrial groups, competitiveness clusters, research and higher education players, laboratories of excellence, technological research institute, etc.

Context

Scope

The ROAD-AI challenge is a collaborative project between INRIA and Cerema, started in 2021. The objective is to study some innovative solutions that may ease the management of transport infrastructures (roads, structures).

Within this context, the following PhD thesis is proposed to develop a specific solution for the maintenance of secondary road assets, i.e., low-traffic roads, from video-based surface monitoring data only, namely, pavement images.

[1] <https://www.inria.fr/fr/road-ai-defi-infrastructures-routieres-durables-sures-resilientes>

Keywords: Statistical modeling, image segmentation, machine learning, non-destructive testing.

Assignment

Thesis objectives and contents

To manage and maintain the performance of road assets, stakeholders have been using statistical models to predict road degradations with time and traffic, namely, roadway evolution and/or survival law models. These models are based on measurements of different specific physical quantities, which are related to pavement management and carried out in situ by specialized operators. This management approach prevails on the high-traffic national network and might be adapted to the secondary road network. Compared to the national network, the secondary road network experiences lower traffic and is less instrumented and documented.

The objective of the thesis will be, on the one hand, to assess the feasibility of updating the statistical degradation model laws of roadway from video-based imaging the pavement surface conditions; and on the other hand, to adapt the latter approach to the secondary road network.

The expectations of the thesis require a large enough data base of labelled pavement images along with the corresponding detailed knowledge of the underlying pavement structure. Images labelling (with annotation, record of disorders, etc.) will be provided for the study and may cover a 5 years period at least.

To meet the objectives of the thesis, the following issues are considered:

- Bibliographical survey:

- o the existing survival/evolution laws which are based on both the structural and the surface conditions of the roadway.

o the existing automatic image processing techniques, e.g., segmentation and feature engineering, to estimate surface condition indicators.

o the simplifying hypotheses that could be applied on the secondary road network

- The selection and the computation of the surface condition indicators within pavement images which then serve as input parameters to the statistical degradation laws.

- The determination of the relevant image analysis scale being adapted to the estimation of the roadway degradation laws; it will be determined in relation with the diagnostic needs, the gridding scale at which the pavement structure and data on road surface conditions can be provided, etc.

- The development of the model versatility for further adaptation to various roadways context and specific management issues, e.g., climate changes, mid-mountain vs. sea-shore climate.
- The performance assessment of the statistical model laws should take account of the accuracy on the estimated surface indicators. The performance of the algorithms will be compared to some benchmark method which is routinely used at the operational level.

Host teams: joint Inria/UGE project team (I4S) and Cerema research team (ENDSUM)

Working location: Strasbourg (Cerema)

Start: fall 2024

Duration: 3 years

Application deadline: 30th of June 2024

Management

- **Director:** laurent.mével@inria.fr
- **Supervisors:** philippe.foucher@cerema.fr; vincent.baltazart@univ-eiffel.fr
- **Associated experts:** alain.hebting@cerema.fr; fabien.menant@univ-eiffel.fr

Skills

Good writing and communication skills in English.

Mastery of Latex, Word, Python, Overleaf, Matlab are a plus.

Benefits package

- Subsidized meals
- Partial reimbursement of public transport costs
- Possibility of teleworking (90 days per year) and flexible organization of working hours
- Partial payment of insurance costs

Remuneration

Monthly gross salary amounting to 2100 euros for the first and second years and 2200 euros for the third year

General Information

- **Theme/Domain :** Optimization, machine learning and statistical methods
Statistics (Big data) (BAP E)
- **Town/city :** Strasbourg
- **Inria Center :** [Centre Inria de l'Université de Rennes](#)
- **Starting date :** 2024-10-01
- **Duration of contract :** 3 years
- **Deadline to apply :** 2024-05-07

Contacts

- **Inria Team :** [I4S](#)
- **PhD Supervisor :**
Mével Laurent / laurent.mével@inria.fr

About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

The keys to success

Required Skills and scientific background

- Statistics, applied mathematics, pattern recognition and/or machine learning.
- Computing skills in Python and/or Matlab and/or R and/or Julia languages.
- Background on physics, mechanics and non destructive testing would be appreciated.
- Good writing skills and communication reporting.

Warning : you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

Instruction to apply

Please submit online : your resume, cover letter and letters of recommendation eventually

Defence Security :

This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST). Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

Recruitment Policy :

As part of its diversity policy, all Inria positions are accessible to people with disabilities.