Offer #2025-08961

Post-Doctoral Research Visit F/M Ocean dynamics emulation with Koopman operator

Contract type : Fixed-term contract

Level of qualifications required : PhD or equivalent

Fonction : Post-Doctoral Research Visit

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 PMEs, large industrial groups, competitiveness clusters, research and higher education players, laboratories of excellence, technological research institute, etc.

Context

The Odyssey team is offering a 18 month postdoc position on ocean modelling funded by a national initative on machine learning for ocean dynamics. Odyssey (Ocean DYnamicS obSErvation analYsis) is a joint research team between CNRS, Inria (Rennes, France), University. Rennes, Ifremer (Brest), IMT Atlantique (Brest) and Univ. Western Britanny (Brest).

Inria is one of the leading research institute in Computer Sciences in France, and Odyssey is also affiliated to the mathematics research institute of the Rennes University (IRMAR).

The team expertise encompasses mathematical (stochastic) and numerical modelling of ocean flows, observational and physical oceanography, data assimilation and machine learning.

Gathering this large panel of skills, the team aims at improving our understanding, reconstruction and forecasting of ocean dynamics, and more specifically to bridge model-driven and observation-driven paradigms to develop and learn novel representations of the coupled ocean-atmosphere dynamics ocean models.

Assignment

Research project description:

This project aims to emulate complex dynamical systems, such as ocean currents simulated in GLORYS12, by leveraging recent approaches based on the Koopman operator and reproducing kernel Hilbert spaces (RKHS). Unlike classical machine learning methods that require long time series, the proposed approach learns the system's dynamics locally from an ensemble of realizations, making it better suited to high-dimensional chaotic systems.

The project builds on recent work (Dufée et al. 2024) showing that system dynamics can be captured by linear operators in RKHS, enabling better physical interpretability, temporal scale separation, and the estimation of Lyapunov exponents. The approach also incorporates ensemble and temporal techniques to reconstruct a pseudo-ensemble of trajectories around the available time series.

The expected outcomes include a robust emulation of the system’s dynamics, improved forecasting of recurring events, and the incorporation of the continuous spectrum of the Koopman operator, all while aligning with the practical constraints of the DC1 challenge (https://github.com/ppr-ocean-ia/data-challenges-info). The project will be conducted at Inria Rennes, within the Odyssey team, in close collaboration with Ifremer and IMT Atlantique.

Dufée, Benjamin, Bérenger Hug, Étienne Mémin, et Gilles Tissot. 2024. « Ensemble forecasts in reproducing kernel Hilbert space family ». *Physica D: Nonlinear Phenomena* 459 (mars):134044. https://doi.org/10.1016/j.physd.2023.134044.

Skills

The candidate should have a solid background in applied mathematics related to dynamical systems and/or in fluid mechanics and/or in geophysical dynamics. She/he must have a good knowledge of Fortran, C/C+/ Python, Pytorch

Benefits package

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking (after 6 months of employment) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)

- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

Remuneration

Monthly gross salary from 2 788 euros.

General Information

- **Theme/Domain :** Earth, Environmental and Energy Sciences
- **Town/city :** Rennes
- **Inria Center :** Centre Inria de l'Université de Rennes
- **Starting date :** 2025-09-01
- **Duration of contract :** 2 years
- **Deadline to apply :** 2025-07-31

Contacts

- **Inria Team :** ODYSSEY
- **Recruiter :**
  Memin Etienne / etienne.memin@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.

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.