Offer #2025-08790

Post-Doctoral Research Visit F/M Postdoctoral fellowship: Metabolic modelling of the rumen microbiome for guiding strategies of methane reduction

Contract type : Fixed-term contract

Renewable contract : Yes

Level of qualifications required : PhD or equivalent

Fonction : Post-Doctoral Research Visit

About the research centre or Inria department

The Inria center at the University of Bordeaux is one of the nine Inria centers in France and has about twenty 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 SMEs, large industrial groups, competitiveness clusters, research and higher education players, laboratories of excellence, technological research institute...

Context

The fellowship is associated to the ANR-funded H2Rumen project, led by Rafael Muñoz-Tamayo.

The fellowship is organised in two parts: this 18-months contract, hosted at Bordeaux (Inria PLEIADE), followed by a 14-month extension at Paris Saclay (INRAE, AgroParisTech).

The postdoc fellow will collaborate with Clémence Frioux, Simon Labarthe and David James Sherman from the PLEIADE team (Inria, INRAE, Bordeaux) and with Rafael Muñoz-Tamayo from the MoSAR team (INRAE, AgroParisTech, Université Paris-Saclay). Pleiade hosts researchers in mathematics, computer science and computational biology working on developing approaches for microbial community characterisation.

Project description. Ruminants play a significant role in human nutrition and food security. Ruminants can harvest nutrients from forage diets rich in fibres and transform them into human-edible products with high-quality proteins. Feed transformation occurs mainly in the rumen through a metabolic cascade of hydrolytic and fermentative reactions carried out by a complex microbial community (rumen microbiota) constituted by hundreds of species that include bacteria, archaea and eukaryotes. During rumen fermentation, methane (CH4) is produced and eructed by the animal. This CH4 contributes to 44% of greenhouse gas emissions from the livestock sector.

Reducing methane (CH_4) emissions from ruminants is a major challenge for the livestock sector. An optimal CH_4 mitigation strategy should also induce co-benefits such as enhanced animal productivity and health. CH_4 is produced during the fermentation of feeds in the rumen. This process is carried out by a complex microbial community (rumen microbiota) and mediated by hydrogen (H_2) in the rumen ecosystem. Our knowledge on the drivers that shape H_2 flows is still incomplete. **H_2Rumen aims to generate fundamental knowledge on H_2 flows in the rumen ecosystem and to translate this knowledge into predictive mathematical models of rumen fermentation**. Our scientific outputs will be of high value for the optimal design of CH_4 mitigation strategies with co-benefit for the animal. Our hypothesis is that thermodynamics and microbial interactions jointly control hydrogen transactions in the rumen ecosystem. H2Rumen addresses the following fundamental scientific question: Where does H_2 go? We will answer this question with an integrative approach that combines *in vitro* experiments, *in silico* modelling and omics approaches. In addition to the impact on ruminant livestock, our methods might be applicable to other ecosystems such as the human gut, engineering bioreactors and fermented food ecosystems.

Assignment

The postdoc project aims at developing metabolic models of rumen microbiota with capabilities for designing microbial strategies for reducing methane emissions and improving rumen fermentation. It will contribute to fill the existing gap on how to integrate microbial genomic information into rumen fermentation models [1].

Genome-scale network reconstructions will be done with state-of-the-art methods and pipelines developed in PLEIADE. Metabolic capabilities of rumen microbial communities will be explored using Metage2Metabo [2]. Kinetic models will be

built on the basis of existing models developed at MoSAR [3,4]. Models will be constructed using experimental data produced by our partners at UMRH and MoSAR.

[1] Muñoz-Tamayo R, Davoudkhani M, Fakih I, Robles-Rodriguez CE, Rubino F, Creevey CJ, et al. Review: Towards the next-generation models of the rumen microbiome for enhancing predictive power and guiding sustainable production strategies. animal. 2023;17: 100984. doi:10.1016/J.ANIMAL.2023.100984

[2] Belcour A, Frioux C, Aite M, Bretaudeau A, Hildebrand F, Siegel A. Metage2metabo, microbiota-scale metabolic complementarity for the identification of key species. Elife. 2020;9: e61968. doi:10.7554/eLife.61968

[3] Muñoz-Tamayo R, Chagas JC, Ramin M, Krizsan SJ. Modelling the impact of the macroalgae Asparagopsis taxiformis on rumen microbial fermentation and methane production. Peer Community J. 2021;1: e7. doi:10.24072/PCJOURNAL.11

[4] Fakih I, Got J, Robles-Rodriguez CE, Siegel A, Forano E, Muñoz-Tamayo R. Dynamic genome-based metabolic modeling of the predominant cellulolytic rumen bacterium Fibrobacter succinogenes S85. mSystems. 2023;8: e01027-22. doi:10.1128/msystems.01027-22

Main activities

The postdoc fellow will be part of the project H2Rumen funded by the French National Agency for Research (ANR). The specific objectives are

i. To obtain metabolic models of the species constituting a rumen microbial mini-consortium.

ii. To derive a bag-of-genome model of a complex rumen consortium.

iii. To develop a community-scale kinetic models of mini and complex consortia accounting for H2 transactions and thermodynamic control.

The work is organized in two parts. 18 months in PLEIADE to work on the objectives (i,ii) and 14 months at MoSAR to work on the objective (iii).

Skills

Technical skills and level required:

- Experience in metabolic modelling with willingness to learn dynamic modelling or viceversa
- Expertise in programming: Python, R or Scilab/Matlab

Languages:

- Proficiency in English

Relational skills:

- Excellent communications skills, willing to discuss with scientists with different backgrounds

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 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

The gross monthly salary will be 2788€ (before social security contributions and monthly witholding tax)

General Information

- **Theme/Domain :** Computational Biology
  Biologie et santé, Sciences de la vie et de la terre (BAP A)
- **Town/city :** Talence
- **Inria Center :** Centre Inria de l'université de Bordeaux
- **Starting date :** 2025-10-01
- **Duration of contract :** 1 year, 6 months
- **Deadline to apply :** 2025-04-30

Contacts

- **Inria Team :** PLEIADE
- **Recruiter :**
  Frioux Clemence / clemence.frioux@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

We are seeking a researcher with a PhD in applied mathematics, computational biology, or process engineering. The ideal candidate should have expertise in metabolic modelling and a strong willingness to expand their skills in dynamic modelling, or alternatively, experience in dynamic modelling with an eagerness to develop proficiency in metabolic modelling.

In addition to technical expertise, the candidate should have a demonstrated ability to write and publish research articles in peer-reviewed journals. Strong communication skills are essential, as the role involves effectively presenting scientific results to both academic and interdisciplinary audiences.

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

If you are interested by this job, please could you apply on website jobs.inria with the following documents :

- cv
- cover letter
- recommendation letter

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.