# Offer #2026-10546

# Post-Doctoral Research Visit F/M Generalisable early classification of bovine embryo morphokinetic profiles from time-lapse videomicroscopy

**Contract type :** Fixed-term contract

**Level of qualifications required :** PhD or equivalent

**Other valued qualifications :** PhD thesis

**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

No funding yet but possibility to apply with the supervision team to BIENVENÜE funding during fall 2026.
Expected Starting date: september 2027.

## Assignment

### Supervision team

- Elisa Fromont, Professor, Univ Rennes / IRISA / Inria center Rennes, MALT Team
- Patrick Bouthemy, Emeritus director of research, Inria, MALT team
- Alline de Paula Reis, Associate professor, Veterinary school, Maison Alfort / INRAE BREED Team

## Main activities

# Context

The current practice for selecting viable in vitro fertilised bovine embryos relies on a single morphological assessment on the seventh day (D7) after in vitro insemination, and the performance obtained is highly variable across operators, embryos, and cohorts. We have developed [1] a fine-grained taxonomy of bovine embryos based on early morphokinetics (1-16 cell stages). It distinguishes profiles of developmentally incompetent embryos, called Non-Transferable (NT) because they cannot result in a live animal, and four profiles of developmentally competent embryos, called Transferable (T) because they can result in a live animal if transferred into a female uterus [2][3]. This early classification aims to identify the determinants of embryonic viability at a very early stage, taking into account the heterogeneity of developmental trajectories. A better understanding of these variations can contribute to improving production processes and, in the long term, breeding performance.

However, the manual classification of embryos is time-consuming (approximately 30 minutes of annotation per embryo) and requires a high level of human expertise.

In [1:1], we have already proposed an automated classification at D4 using random forest classifiers. This already represents a substantial improvement over the fully manual D7 assessment, moving the decision earlier (D4 instead of D7). However, these classifiers still rely on the embryo's morphokinetic events being manually annotated from the video, both for training and at inference time so the annotation bottleneck, while reduced in timeframe, is not removed.
Scaling up its use and transferring it to other laboratories require overcoming the limits of manual annotation. Methods are needed that provide standardised, reproducible, operator-independent annotation and classification, with high-throughput automated analysis that is, classification directly from the raw video, without manual annotation at inference time.

A PhD thesis (with the same supervision team) has already addressed the automation of this classification. It delivered (large) videomicroscopy datasets of increasing difficulty [4], deep learning classifiers for the embryo stage classification and for the simpler binary task (T / NT) [5][6], and fine-grained methods that exploit a larger part of the taxonomy (not only T/NT) after only four days (D4) of development (paper in review).

# Objective

The overall objective of this post-doctoral project is to develop real-time, deep-learning-based analysis tools that classify embryos according to the complete taxonomy [1:2] as early as possible, ideally before four days of development, while remaining robust across laboratory settings and species.

More specifically, the post-doctoral researcher will:

- Design early and online classification methods. He/she will develop models that process the video stream incrementally and output a prediction, with an associated confidence, at any time point. The models should be able to

decide when the evidence is sufficient (i.e. early-decision or “early classification” approaches) [7]. In particular, the candidate will need to quantify the earliness–reliability trade-off. He/she will define evaluation protocols and metrics that jointly capture accuracy and earliness, and identify the earliest time at which each profile can be reliably recognised.
- Ensure generalisation across laboratory settings. The candidate will assess and improve robustness to domain shift (different microscopes, acquisition protocols, culture conditions, image quality) using appropriate strategies such as data augmentation, domain adaptation or self-supervised pre-training. One direction could be to evaluate some components of the methods on publicly-available embryo datasets from other species (mouse, human) to assess how well the approach generalises beyond bovine data.
- Deliver usable and documented tools. The developed methods will be released as reproducible, documented software, together with scientific publications.

# Bibliography

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1. A. P. Reis, M. Belghiti, L. Laffont, S. Ruffini, C. Archilla, N. Le Brusq, A. Teste, B. Marquant-LeGuienne, E. Canon, L. Jouneau, Y. Jaszczsyn, A. A. Ponter, M. B. Caciarella, J. Unrug, E-M. Stamler, V. Duranthon, A. Trubuil. “Identification and mathematical prediction of different morphokinetic profiles of in vitro developed bovine embryos,” bioRxiv 2026.06.28.733532; doi: https://doi.org/10.64898/2026.06.28.733532. ?? ?? ??

2. A. P. Reis, A. Jampy, A. Teste, B. Marquant-LeGuienne, L. Laffont, S. Ruffini, E. Canon, C. Archilla, L. Jouneau, A. Trubuil, V. Duranthon. “Bovine embryos with distinct early morphokinetic pathways present different post-embryonic genome activation transcriptomic patterns and different cryotolerance.” Reproduction, Fertility and Development, 2020, 32 (2):151. ??

3. A. P. Reis, D. Le Bourhis, V. Cotil, S. Lancelin, L. Le Berre, S. Lacaze, M. Verachten, G. Crozet, V. Duranthon, P. Salvetti. “Assessment of the viability of four morphokinetic categories of blastocysts: Preliminary results.” Reproduction Fertility and Development, 2024, 37(1): RDv37n1Ab54. ??

4. Y. Hachani, P. Bouthemy, E. Fromont, S. Ruffini, L. Laffont, A. P. Reis. Supervised contrastive learning for cell stage classification of animal embryos. Scientific Reports 2026. arXiv ??

5. Y. Hachani, P. Bouthemy, E. Fromont, S. Ruffini, L. Laffont, A. P. Reis. “Early prediction of the transferability of bovine embryos from videomicroscopy”. in Proceedings of the IEEE International Conference on Image Processing (ICIP), 2024. ??

6. Y. Hachani, P. Bouthemy, E. Fromont, V. Duranthon, L. Laffont, A. P. Reis. “From division to decision: leveraging temporal cell-stage segmentation for embryo transferability prediction”, in Proceedings of the IEEE International Conference on Image Processing (ICIP), 2026. ??

7. M Rußwurm, N Courty, R Emonet, S Lefèvre, D Tuia, R Tavenard. End-to-end learned early classification of time series for in-season crop type mapping. ISPRS Journal of Photogrammetry and Remote Sensing 196, 445-456 2023 ??

## 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

## Remuneration

Monthly gross salary from 2 788 euros.

## General Information

- **Theme/Domain :** Optimization, machine learning and statistical methods Biologie et santé, Sciences de la vie et de la terre (BAP E)
- **Town/city :** Rennes
- **Inria Center :** Centre Inria de l'Université de Rennes
- **Starting date :** 2027-09-01
- **Duration of contract :** 2 years
- **Deadline to apply :** 2027-03-31

## Contacts

- **Inria Team :** MALT
- **Recruiter :**
  Bouthemy Patrick / patrick.bouthemy@inria.fr

## About Inria

Inria, the French national institute for research in digital science and technology, supports the French government in national research and innovation strategies in the digital field, acting as Digital Programs Agency. Inria leads over 300 research and innovation projects with its 3,500 scientists, engineers, and support staff, in partnership with universities and the digital ecosystem (businesses, entrepreneurs, and public stakeholders). Together, we explore strategic fields such as artificial intelligence, cybersecurity, quantum computing, cloud technologies, digital transformation in healthcare, digital twins, and digital technologies for defence. We develop practical solutions such as software, tech startups, partnerships with national companies, and cutting-edge training programmes. Our goal is to drive scientific, technological, and industrial excellence to ensure France's digital sovereignty.

## The keys to success

# Candidate profile

We are looking for a candidate with a PhD in computer science, applied mathematics, machine learning / computer vision, or a related field.

- Required skills:
    - Strong expertise in deep learning for video or image sequences (e.g. CNNs, transformers, temporal models), with solid practice in PyTorch.
    - Sound experimental methodology: evaluation design, handling of class imbalance and small or heterogeneous datasets, statistical rigour.
    - Proven scientific track record (publications in machine learning, computer vision or biomedical imaging venues).
    - Ability to write clearly and communicate in English (French is a bonus).
- Appreciated skills:
    - Experience in early time-series classification, domain adaptation or generalisation, or self-supervised learning.
    - Experience with biomedical or microscopy data. Interest in, or knowledge of, developmental biology or reproduction.
    - Good software engineering practice (version control, reproducibility, code documentation).
- Personal qualities: autonomy, and the ability to work in an interdisciplinary team with biologists and computer scientists and, to supervise students.

**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.