Type d'offre : Laboratory offer

Post date : 14.11.25

Laboratoire IBISC (Université Evry Paris-Saclay)

Internship Offer - Hetero-modal encoder for generation of coherent hypoperfused volume across MRI sequences

Informations générales

Contract type : Stage

Contract length : 5-6 months

Contact :

Vincent Vigneron / **Hichem Maaref** / **congej@yahoo.fr**

Starting date : Wed 01/04/2026 - 12:00

Trade : Technicien

Topic : Analyse et traitement d'images

Laboratoire IBISC (Université Evry Paris-Saclay) :

Research conducted at the IBISC laboratory focuses on the modeling, design, simulation, and validation of complex systems, whether living or artificial. The laboratory is organized into four teams (AROBAS, COSMO, IRA2, SIMOB), enabling two cross-disciplinary research areas to be defined: ICT & Life Sciences (computational biology, bioinformatics, personal assistance, signals and images for biomedicine) and ICT & Smart Systems (autonomous and intelligent systems, open and secure systems). IBISC not only has platforms referenced and supported by Genopole: EVR@ (Virtual and Augmented Reality Environments) and the EvryRNA bioinformatics software platform, but also various platforms related to intelligent systems: two-wheeled vehicles, drones, robots.

Détail de l'offre (poste, mission, profil) :

Scientific supervisors: Hichem Maaref and V. Vigneron (IBISC)
Partners: IBISC (Université d'Évry–Paris-Saclay), Centre Hospitalier Sud-Francilien, WILLIS-AI
Basic AI and Data Science: machine learning theory, high-dimensional statistics, imaging, uncertainty, information theory
Specialized ML and AI: medical imaging, MRI preprocessing
Duration: 5 to 6 months, starting between January and April 2026
Funding: FAUST maturation project led by SATT Paris-Saclay
Location: IBISC laboratory
Application domain: precision medicine
Keywords: deep learning, multi-modal imaging, weakly supervised training, modality fusion
Key-words: machine learning, deep tech, neuroimaging, precision medicine, stroke

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Subject

Hypoperfusion in acute ischemic stroke indicates a hemodynamic disturbance visible across multiple MRI contrasts [Forkert et al., 2013].

Each modality provides complementary information: susceptibility-weighted imaging (SWAN/SWI) and phase highlight venous deoxygenation, time-of-flight (TOF) angiography captures arterial inflow and distal signal loss, diffusion-weighted imaging (DWI) shows early cytotoxic injury, and FLAIR reveals hyperintense vessels and edema [Mittal et al., 2009].

In practice, however, complete perfusion protocols are often missing or inconsistent. Time constraints, patient motion, contrast contraindications, protocol variability, and scanner differences frequently limit acquisition.

This project builds on the observation that even without perfusion imaging, other MRI sequences contain physiologically related cues that can be combined to infer the hypoperfused volume [Oktay et al., 2018]. The main scientific goal is to develop a hetero-modal encoder that integrates any subset of sequences into a unified latent representation, from which a realistic hypoperfusion map can be reconstructed while preserving anatomical, physical, and inter-sequence consistency.

Problem

Generating coherent hypoperfusion maps from heterogeneous MRI inputs presents several challenges [Liu et al., 2023].

1. **Missing-modality problem:** patients rarely undergo identical MRI protocols—each case may lack one or more key sequences (e.g., PWI or TOF), making it difficult to learn consistent cross-modal correspondences.

2. **Domain shift:** scanners, vendors, and acquisition settings introduce strong variability in intensity distributions and spatial resolution, which can confound generative models trained on limited datasets.

3. **Anatomical and physiological consistency:** reconstructed hypoperfusion patterns must remain compatible with vascular territories, tissue diffusion constraints, and known hemodynamic principles [Copen et al., 2011].

4. **Data imbalance:** the disproportion between normal and ischemic regions complicates loss design and evaluation metrics.

Internship Objectives

To address these issues, the proposed method will rely on a hetero-modal encoder-decoder architecture trained within a variational or diffusion-based generative framework. The encoder will learn a shared latent space constrained by anatomical priors and mutual-information regularization to align representations across modalities.

Objectives:

- Design and implement a hetero-modal encoder-decoder trained in a variational or diffusion-based generative framework to synthesize hypoperfusion maps from routine MRI.
- Learn a shared latent space across modalities, constrained by anatomical priors and mutual-information regularization.
- Build robustness to missing sequences and scanner variability through modality dropout and adversarial domain adaptation.
- Preserve vessel detail and global perfusion coherence using multi-scale supervision during decoding.
- Enforce physiological plausibility via soft constraints (flow continuity, inter-hemispheric symmetry, empirical perfusion–diffusion links).

Application & Expected Impact

- Quantify the ischemic *mismatch* (penumbra) as the difference or ratio between perfusion deficit and diffusion core.
- Assess its clinical utility for reperfusion triage when stroke onset is uncertain.
- Evaluate prognostic value for treatment benefit.
- Deliverables: code, trained models, ablation studies, validation on retrospective cohorts, and a report suitable for a manuscript draft.

Candidate Profile

We seek highly motivated candidates:

1. From mathematics, physics, computer science, or engineering backgrounds.
2. With a strong mathematical foundation (linear algebra, analysis, probability and statistics), machine learning, and deep learning.
3. With solid programming skills in a scientific language, preferably Python.

Knowledge of medical imaging, particularly MRI, is not required but is a strong advantage. Knowledge of basic optimization theory is also appreciated.

Practical Information

The intern will be mainly hosted at the UFR Science and Technology (40 rue du Pelvoux), close to the city center.
Some periods may also be spent at the Corbeil Hospital.

Monthly internship compensation is approximately **€670**.

Application Procedure

Send a motivation letter, CV, and university transcripts (from the 1st year of BSc onward) to:
Vincent Vigneron / **Hichem Maaref**

What We Offer

- Hands-on experience with cutting-edge AI techniques for medical imaging.
- The opportunity to tackle real-world, high-impact healthcare problems.
- Close mentorship from experienced researchers at IBISC.
- Opportunities to co-author publications and present at conferences.
- Potential continuation into PhD studies.

References

[Copen et al., 2011] Copen, W. A., Schaefer, P. W., and Wu, O. (2011). Mr perfusion imaging in acute ischemic stroke. Neuroimaging Clinics of North America, 21(2):259–283, x.

[Forkert et al., 2013] Forkert, N. D., Kaesemann, P., Treszl, A., Siemonsen, S., Cheng, B., Handels, H.,Fiehler, J., and Thomalla, G. (2013). Comparison of 10 ttp and tmax estimation techniques for mr perfusion-diffusion mismatch quantification in acute stroke. American Journal of Neuroradiology, 34:1697–1703.

[Liu et al., 2023] Liu, C.-F., Hsu, J., Xu, X., Kim, G., Sheppard, S. M., Meier, E. L., Miller, M. I., Hillis, A. E., and Faria, A. V. (2023). Digital 3d brain mri arterial territories atlas. Scientific Data, 10(1):74.

[Mittal et al., 2009] Mittal, S., Wu, Z., Neelavalli, J., and Haacke, E. M. (2009). Susceptibility-weighted imaging: technical aspects and clinical applications. AJNR American Journal of Neuroradiology, 30(2):232–252.

[Oktay et al., 2018] Oktay, O., Schlemper, J., Folgoc, L. L., Lee, M., Heinrich, M., Misawa, K., Mori, K., McDonagh, S., Hammerla, N. Y., Kainz, B., Glocker, B., and Rueckert, D. (2018). Attention u-net: Learning where to look for the pancreas. arXiv preprint arXiv:1804.03999.

URL de l'offre : https://www.dataia.eu/sites/default/files/sujet_stage-VV.pdf

Lien vers l'offre sur le site dataia.eu :https://da-cor-dev.peppercube.org/node/1461