PhD Thesis proposal – 2026

Spatial Generative Models of Vascular–Tumor Interactions in Glioblastoma from Histopathology

Keywords: Computational Pathology, Whole-Slide Imaging (WSI), Generative Modeling, Diffusion Transformers, Cross-Modal Integration, Representation Learning, Spatial Transcriptomics, Neuropathology, Model Interpretability, Uncertainty Estimation.

Introduction

We invite applications for a PhD position at the **ARAMIS Lab**, Paris Brain Institute (*Institut du Cerveau – ICM*), at the interface of computational pathology, spatial transcriptomics, and responsible AI. The project aims to develop generative AI models and multimodal foundation models integrating histopathological imaging with spatial transcriptomic data while ensuring robustness, interpretability, and fairness in biomedical AI protocols.

Through an established partnership between the **Paris Brain Institute** and **Owkin**, the project will exploit data from **MOSAIC**, an international initiative combining H&E whole-slide images, 10x Genomics Visium spatial transcriptomics, and complementary omics and clinical modalities.

Additional resources include **ONCONEUROTEK 2**, a prospective neuro-oncology cohort from **Hôpital de la Pitié–Salpêtrière** with well-annotated glioblastoma samples. Together, these datasets support both focused studies in glioblastoma and methodological validation across other tumor types.

Project Overview

Neuropathological diseases such as glioblastoma require data-driven diagnostics beyond traditional histopathology. While histology captures rich morphology, it does not directly convey molecular function. Spatial transcriptomics (ST) provides spatially resolved gene-expression data, but integration with whole-slide histopathology is challenging due to data sparsity, noise, and scale mismatch.

This PhD will bridge morphology and molecular function by developing a generative cross-modal modeling framework. Using diffusion-based generative models and multiscale representation learning, the candidate will integrate histology with sparse ST data to enable *in silico* molecular map synthesis and uncertainty-aware spatial predictions.

The project will use unsupervised and weakly supervised approaches to discover novel vascular phenotypes and tumor–vascular interaction motifs driving microenvironmental heterogeneity and prognosis.

Glioblastoma is the most frequent primary adult brain cancer and retains poor prognosis despite intensive care. The project aims to identify therapeutic targets and companion biomarkers to guide inclusion of relevant patient groups in clinical trials addressing these targets.

Objectives:

1. Develop generative models to infer ST profiles from H&E whole-slide images.
2. Learn joint representations of paired ST and histology data using un- or weakly-supervised learning.
3. Characterize vascular phenotypes across large histology cohorts via dedicated models.
4. Associate vascular phenotypes and tumor–vessel interaction motifs with local transcriptomic programs and clinical outcomes.

These methods will advance interpretable, uncertainty-aware molecular inference from histology and inform new hypotheses on glioblastoma vascular organization and tumor evolution.

Candidate Profile

Required:

- Master's or engineering degree in computer science, image/signal analysis, or applied mathematics
- Interest in medical and biological applications
- Solid knowledge of machine/deep learning and digital image processing

- Proficiency in Python as well as good written and oral communication skills

Desired Expertise:

- Background in ML, AI, computational pathology, bioinformatics, or computational neuroscience
- Experience with generative, diffusion, or foundation models
- Familiarity with biomedical or histopathology datasets
- Understanding of AI evaluation metrics and responsible-AI frameworks

Environment

The PhD candidate will join the **ARAMIS Lab** (`https://www.aramislab.fr`) at the **Paris Brain Institute** (`https://institutducerveau-icm.org/en`), one of the world's leading neuroscience centers located within the Pitié–Salpêtrière Hospital, Paris. ARAMIS is affiliated with Inria and bridges machine learning, neurology, and neuro-radiology.

This study is in close collaboration with the **BRIGHT** team of the Paris Brain Institute, focusing on brain-tumor evolution, resistance to chemotherapy, development of therapeutic strategies, and tumor–immune system interactions.

The thesis will be co-directed by **Prof. Daniel Racoceanu** (HDR, PhD - Sorbonne University / ICM) and **Dr. Franck Bielle** (MD, PhD - Sorbonne University / AP-HP). The candidate will benefit from high-performance computing resources and unique multimodal datasets within an ecosystem combining AI, computational pathology, and neuroscience.

Application

Application materials:

- CV highlighting relevant academic and technical experience
- Motivation letter (max 2 pages) describing research interests and alignment with this project
- Contact details of two references
- Optional: publications, GitHub profile, or previous research outputs

Send applications to: `daniel.racoceanu@sorbonne-universite.fr` and `franck.bielle@aphp.fr`

Expected start: October 2026 ; Duration: 3 years, fully funded

Selected References

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