# Postdoc position: Deep learning and data mining for multimodal image analysis in neuroradiology and histopathology

**Mi*EDGE project - ERACoSysmed**[1,2]

[1]ICube laboratory, Data science and Knowledge, Illkirch, France
[2]IRIMAS institute, Modeling and Data Science, Mulhouse, France

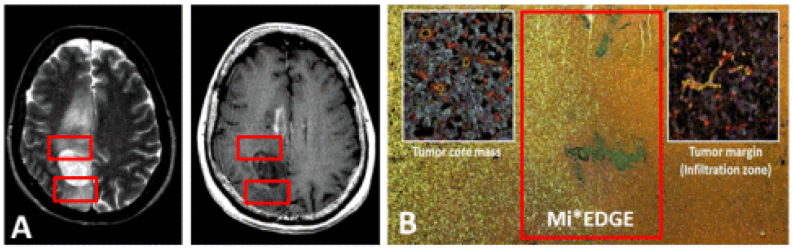
## ABSTRACT

Glioblastoma (GBM) is a malignant brain tumor with poor prognosis despite aggressive treatment. The biological behavior of cells at their invasive edge is of major importance for clinical course and patients' quality of life. The **Mi*EDGE** project is based on existing mathematical models of glioma invasion that predict tumor cell behavior based on critical density ("allee-effect") and local metabolic-driven phenotypic plasticity ("go or grow" decision). It is aiming at predicting whether malignant cells at the margins of surgical resection transform into diffusely invasive or tumor-forming proliferative phenotypes. Considering that tumor cells at the border to normal tissues are interacting with local immune cells, microglia activation and tumor-associated macrophages will be included in the models and repeated cycles of datadriven modelling will clarify the functional role of this crosstalk. To demonstrate the relevance of the resulting predictive computational models for medical practice, the project will translate it to the clinical reality of medical decisions, specifically addressing the questions whether pre-surgical neuroimaging, when included into the model, can predict biological behavior of marginal cells at the tumor edges, and if imaging 3, 6, and 9 months after primary therapy will reflect the prediction with either diffuse tumor invasion, local relapse, or reactive changes (pseudo-progression). The knowledge gained by integrating transnational expertise in neuroradiology, neuropathology, image analysis driven by deep learning, and macrophage biology into validated and iteratively improved versions of existing mathematical models will help to optimize the timing of second-line surgical interventions, radiotherapy and chemotherapy and reposition established anti-cancer therapy in order to reduce risk of early relapse and improve the diagnostic accuracy of neuroradiological findings at the resection margins of GBM.

## Job description

The Engineering science, computer science and imaging laboratory (ICube, Strasbourg, France), associated with the Institute of Research in Computer Science, Mathematics, Automatics and Signal processing (IRIMAS, Mulhouse, France), opens a **postdoctoral position** for a computer scientist, in the field of artificial intelligence and histopathological whole slide images and MRI analysis, with a duration of **36 months (2020/07/01 - 2023/06/30)**.

In the context of the Mi*EDGE project described above, the appointee will work in close collaboration with all the partners of the project to develop the methodology for WSI analysis, spatial patterns extraction and the machine learning approach to classify automatically histopathological and MRI images. More specifically, the objective is to develop a complete methodology enabling to generate quantitative neuroimaging and histopathology data to calibrate the model, including spatially resolved data on tumor cell density and spatial distribution of macrophages, microglia and tumor cells in histology. Image analysis will automatically define and delineate GBM regions (core, invasion/transition zones) and exclude irrelevant areas (necrosis, bleeding, artefacts). Densities and interaction patterns of GBM in a spatially resolved, region specific way are provided to inform mathematical modeling and analyze biopsy-based and in-vitro data.




*Mi*EDGE translational approach: Integration of the neuroradiological features (A) with quantitative multiplexed neuropathology considering cell density, vascular proliferation and macrophages at primary diagnosis (B)*

The work will also consist in developing a deep learning-based tool to distinguish relapse from pseudo-progression. Based on MRI-neuroimaging, the objective is to develop a new deep learning approach to automatically obtain a 3D segmentation of the GBM at each time and automatically analyse the evolution to differentiate between relapse and pseudo-progression.

This research will be part of a collaboration between AI researchers of ICube and IRIMAS, and pathologists of the Medical School of Hannover (Germany). Regular exchanges will take place either by videoconference or during stays in their structures, to benefit from their expertise. Interactions with the other teams of the project (Germany, Luxembourg, Italy) are also planned. Within the ICube laboratory, the postdoctoral researcher will be integrated into the Data and Knowledge Science team under the supervision of Cédric Wemmert and Benoît Naegel, and co-supervised by Germain Forestier, Jonathan Weber and Maxime Devanne (IRIMAS).

## Job summary

- Postdoc position in artificial intelligence and histopathological and MRI image analysis in the ICube laboratory (Strasbourg, France) and IRIMAS Institute (Mulhouse, France).
- The candidate should hold a PhD in computer science (preferably in computer vision or machine learning) and have excellent English skills (both written and oral).
- Demonstrated experience in Python programming and Keras/Tensorflow or Pytorch libraries will be mandatory.
- Salary: around €3000 (monthly gross) depending on the experience of the candidate.

## Contact

Please contact Pr. Cédric Wemmert by email (wemmert@unistra.fr) for any further question or application.