Physics for Medicine PARIS

**POSTDOC POSITION – 24 MONTHS**

# Real-time functional ultrasound imaging of stroke in awake mice

## PROJECT DESCRIPTION

The project involves different groundbreaking ultrasound modalities such as functional ultrasound imaging, ultrasensitive Doppler, Ultrafast Localization Microscopy, and functional connectivity measurements [1].

The candidate's role is to develop the modalities of imaging, processing, and analysis tools to support the investigation of stroke in awake mouse models. As it is known that anesthetics strongly influence a vessel's response to ischemia, it is critical for stroke reperfusion strategies to be evaluated and monitored in awake animals so that they can later on efficiently be translated to humans. The project is a collaborative project with the Denis Vivien's lab, which specializes in the physiopathology of stroke and has developed several mouse stroke models.

Ultrasensitive Doppler is a relatively new vascular imaging modality sensitive to local cerebral blood volume, with a very high spatial (100µm) and temporal (<1s) resolution, and promising for monitoring ischemic stroke from its onset to reperfusion. Preliminary work using a thrombin-induced stroke mouse model showed that it is possible to follow the ischemic stroke formation in real-time in the whole-mouse brain using ultrasensitive Doppler and to predict the lesion size as measured by MRI very early a day later [2].

The goals of this project are:

1. for the first time, follow a stroke formation in real-time in an awake animal during behavior.
2. to map functional alterations in the post-ischemic brain using functional ultrasound imaging and functional connectivity mapping.

There are significant challenges to imaging in awake mice and during a stroke. The candidate must work on the ultrasound sequences and the experimental setup and develop robust processing to avoid motion artifacts.

Most experiments will be performed by a Ph.D. student hired for the project in the PHIND laboratory in Caen. The postdoc candidate will be based in Paris and handle the imaging and analysis parts, but he is expected to participate in the pilot experiments in Caen with regular visits.

## PROFILE

We are looking for a postdoc, for 24 months, in the field of ultrasound imaging or neuroimaging preferentially, with expertise in image processing or advanced processing of neuroimaging data.

Good programming skills in Matlab. Knowledge of other imaging modalities (MRI, angio CT) and associated software suites (ITK, Slicer, or else) is also essential.

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## TASKS

- **Help develop the experimental setup for awake mouse imaging**: our lab and PHIND's laboratory already have several setups for fUS imaging and a setup for awake mice [3]. The candidate is expected to help develop the best setup with a creative mind. The setup will include behavioral tracking (e.g., Deep Lab cut).
- Acquire experimental data in Caen at least for the pilot experiments and process the data for each modality (Ultrasensitive Doppler, functional ultrasound, Ultrafast Localization Microscopy, functional connectivity) using existing codes.
- Develop improved modalities and improve our current software pipelines to support the project's goals and the collaborators' needs so they can efficiently conduct robust analysis.
- Investigate the stroke dynamics in different awake conditions, especially animal behavior.
- Investigate how functional ultrasound and connectivity mapping could be used to diagnose and characterize a lesion after reperfusion through functional alterations and compare it to MRI data.

## SKILLS

Matlab programming, neuroimaging data processing, acoustics, signal and image processing, experimental research

## REFERENCES


[1] *Deffieux, T., Demené, C., & Tanter, M. (2021). Functional ultrasound imaging: A new imaging modality for neuroscience. Neuroscience, 474, 110-121.*

[2] *Hingot, V., Brodin, C., Lebrun, F., Heiles, B., Chagnot, A., Yetim, M., ... & Vivien, D. (2020). Early Ultrafast Ultrasound Imaging of Cerebral Perfusion correlates with Ischemic Stroke outcomes and responses to treatment in Mice. Theranostics, 10(17), 7480.*

[3] *Bertolo, Adrien, et al. "Whole-brain 3D activation and functional connectivity mapping in mice using transcranial functional ultrasound imaging." JoVE (Journal of Visualized Experiments) 168 (2021): e62267.*


## CONTACT


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