WearFLOW: a portable laser speckle imager for microcirculation dynamic monitoring

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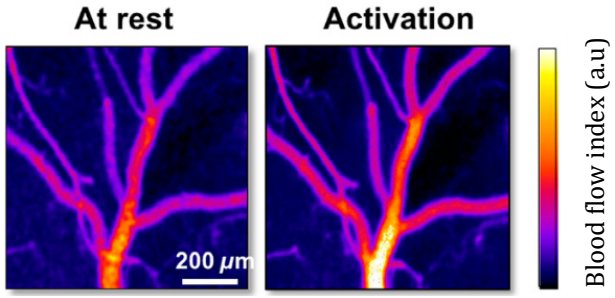
Internship location: Palaiseau, IOGS, 2 Av Fresnel
Thesis possibility after internship: **YES**
Funding: Not yet secured (funded asked to ANR, will be asked to ED EOBE)
Dates et durée : à déterminer selon la formation/ **Indemnités légales + Navigo.**

Project summary:
Laser speckle contrast imaging (LSCI) is an optical imaging modality that allows the recording of 2D blow flow maps at high spatio-temporal resolution. Currently the devices used in clinics are either fixed on a stand or handheld by the practitioner and are thus limited in their applications and prone to strong bias due to unwanted movements[1]. The group of Biophotonics at Laboratoire Charles Fabry has developed several imagers based on variants of LSCI[2,3]. These systems have been used to study the neurovascular coupling and the effect of obesity on cerebral blood flow[2,4]. Building on these previous developments, we propose during the internship, ***to design and evaluate a wearable system, strapped on the arm,*** to avoid the bias related to the movements, distance and angle between the subject and imager. The device will be based on miniaturized photonics components including a laser diode and associated electronics and optics. A prototype set-up will be built on an optical bench and then fully integrated in a custom 3D-design enclosure, suited for the targeted application. The internship will develop the protocols to test the device on microfluidic phantoms simulating blood flow in capillaries and arterioles. These microfluidics phantoms are made in the lab using custom methods that allows fast prototyping of PDMS channels without the need of photolithography in a white room.



Relative blood flow maps of the microcirculation at rest and during activity

Altogether the intern will have the opportunity to develop skills in photonics instrument design and characterization as well as development of microfluidics chips development in the context of a well-identified biomedical application. T***he internship could lead to a PhD.*** A PhD funding has not been secured yet, but several applications have been (ANR) or will be (Ecole Doctorale) completed in this purpose.

References :

1. Chizari, A. *et al.* Handheld versus mounted laser speckle contrast perfusion imaging demonstrated in psoriasis lesions. *Sci Rep* **11**, 16646 (2021).
2. Soleimanzad, H. *et al.* Multiple speckle exposure imaging for the study of blood flow changes induced by functional activation of barrel cortex and olfactory bulb in mice. *Neurophotonics* **6**, 015008 (2019).
3. Chammas, M. & Pain, F. Synthetic exposure with a CMOS camera for multiple exposure speckle imaging of blood flow. *Sci Rep* **12**, 1–11 (2022).
4. Soleimanzad, H. *et al.* Obesity in Midlife Hampers Resting and Sensory-Evoked Cerebral Blood Flow in Mice. *Obesity (Silver Spring)* https://doi.org/10.1002/oby.23051 (2020) doi:10.1002/oby.23051.