Call for applications for a residency and grant for a project within a research laboratory

Introduction

The Embassy of Foreign Artists residency programme is partnering with Campus Biotech and Flux Laboratory to offer the opportunity to apply for research and production residencies for a project linked with the work of three laboratories active within Campus Biotech (see pp. 4-8).

1 Project

The purpose of the call is to offer residencies to professional artists from all fields (visual arts, dance, theatre, music, writing, comic books, film, etc.), whose project would take inspiration from the cutting-edge research conducted by the partner laboratories active within Campus Biotech.

The goal of these residencies is to promote exchanges and intersections between scientific practices and artistic practices. They are intended to encourage the emergence of new ways of formulating, perceiving and using both scientific and artistic research. Through connections between two fields, they will foster a better understanding of their respective fields of research.

The reflections and exchanges will lead to the creation of new works, or the adaptation of pre-existing works that could be integrated with, or adapted to, the experiments conducted in the laboratories, and/or complement them. The results of each residency will be presented at a public event within Campus Biotech or in a partner institution. They could be the subject of a publication in specialised scientific journals.

2 Partners

Campus Biotech

With its 40,000 square metres of scientific talent, equipment, skills and collaborations located in the heart of Geneva, Campus Biotech has made the Lake Geneva region into one of the world's leading research hubs in the field of neuroscience and of digital and global health.

It brings together more than one thousand specialists, favouring multidisciplinary approaches and broadening the field of human knowledge. Genomic research can now benefit from Switzerland's first high-speed DNA sequencing platform. And in the cognitive sciences, our understanding of emotions has been transformed by the work of the Affective Sciences NCCR (National Centre of Competence in Research).

Many academic and industrial partners are contributing to the success of Campus Biotech, including teams at the University of Geneva (UNIGE), the École Polytechnique Fédérale de Lausanne (EPFL), the Geneva University Hospitals (HUG), the Wyss Center for Bio and Neuroengineering, the Human Brain Project (HBP), the Swiss Institute of Bioinformatics, and the Haute école du paysage, d'ingénierie et d'architecture (HEPIA). They share the same goal: to place science in the service of concrete progress that will have a positive impact on society and the world.

https://www.campusbiotech.ch/

Le Flux Laboratory

Le Flux Laboratory constitutes Fluxum Foundation's multidisciplinary artistic spaces and its production tool. Fluxum Foundation's goal and mission is to support the performing arts, with dance being its favourite form of expression. The Flux Laboratory is an artistic incubator in Switzerland and abroad, whose purpose is to encourage innovative collaborative dynamics through experimental and transdisciplinary artistic projects.

www.fluxumfoundation.org.
www.fluxlaboratory.com

Embassy of Foreign Artists

The Embassy of Foreign Artists is a residency programme founded and administered by the Laps Association in collaboration with the Office cantonal de la culture et du sport. The goal of our organisation is to welcome artists, cultural actors, active citizens, and researchers, either individually or collectively, and to offer them logistical and financial support to develop their activities. We take advantage of our network to help spread their practices and projects. Our spaces accommodate the various stages of the creative process, from the first thoughts and tentative steps and to its presentation in a completed form. The EoFA also organises meetings between local artists and residents at events revolving around different artistic practices.

https://www.eofa.ch

3 Conception and launch dates

1 June: deadline for applications
15 July: winners announced

4 Budget

4,200.00 CHF allowance divided into three monthly grants of 1,400 CHF per month.
2,000.00 CHF production budget

5 Application requirements

Document 1 : The Application Questionnaire fully completed with Adobe Acrobat.

Document 2 : Your Application File in one PDF document, maximum 15 pages, which includes :

- A text explaining the artistic approach and the link with the theme of the call.
- A description of the project likely to be developed during the residency, providing as much detail as possible
- A portfolio of recent works
- An up-to-date CV
- A copy of a valid ID card

6 Contacts

For the residency: Richard Le Quellec, residence@eofa.ch
For Campus Biotech: Carole Varone, Carole.Varone@unige.ch

7 The laboratories

Charting emotion components and dynamics in the human brain using naturalistic movies

Project Aim

We are currently working on a large-scale project to chart emotion components and dynamics in the human brain. The goal of the project is to demonstrate and chart the complex and dynamic phenomena in the brain that constitute the subjective experience of emotion. To this end, we will use functional Magnetic Resonance Imaging (fMRI) of the brain and state-of the art analysis techniques on the level of overlapping dynamic functional networks in the brain.

About MIP:Lab

The Medical Image Processing Lab (MIP:Lab) is headed by Prof. Dimitri Van De Ville. The lab is jointly between the EPFL and the University of Geneva. At MIP:Lab, we pursue the development and integration of innovative data-processing tools at various stages of the acquisition, analysis, and interpretation pipeline of neuroimaging data, in particular, using (functional) magnetic resonance imaging, electroencephalography, and optical techniques. We aim at obtaining new insights into *brain function & dysfunction* by approaches that are based on modeling the brain as a *network* and as a *dynamical* system. (from our website https://miplab.epfl.ch)

The members of MIP:Lab have a wide range of scientific backgrounds, which creates an environment of interdisciplinarity and reciprocal learning. However, we also closely collaborate with other research groups. In the context of the project outlined below we are joining efforts with LABNIC, headed by Patrik Vuilleumier.

About the Project

Emotions are complex and multifaceted phenomena affecting both the mind and body, promoting adaptive behavior in response to challenging events. We will be using naturalistic movies to elicit emotions and investigate the neural response to these emotional stimuli. Parallelly, LABNIC will be using virtual reality and video games with the same overall goal to understand the representation of emotion in the brain.

This research is informed by a Component Process Model of emotion postulated by Klaus Scherer[1]. The Component Process Model predicts, that emotions are elicited by the cognitive appraisal of a given situation along a number of components as well as the integration of this appraisal with other elements of the situation (e.g. physiology, subjective feeling). This model of emotion addresses the shortcomings of approaches that consider emotions as discrete entities by accounting for the myriad of emotional experiences with distinct yet sometimes overlapping aspects. However, there is yet no comprehensive demonstration of the Component Process Model on a neural level.

fMRI is a non-invasive tool to probe whole-brain activity and enables the study of sophisticated processes that involve functional integration and segregation of different brain areas over time. We will use naturalistic stimuli (i.e., movies) to elicit emotions in participants while brain activity is recorded with fMRI, in principle similar to a previous study[2]. However, our research exceeds the scope of any previous work in the quality and volume of data acquisition as well as analysis. Participants will be watching 3.5 hours of full movies, covering a wide range of emotional

[1] K. R. Scherer, “Emotions are emergent processes: they require a dynamic computational architecture,” Philosophical Transactions of the Royal Society B: Biological Sciences, vol. 364, no. 1535, pp. 3459–3474, 2009.
[2] G. Mohammadi, K. Lin, and P. Vuilleumier, “Towards understanding emotional experience in a com- ponential framework,” in 2019 8th International Conference on Affective Computing and Intelligent Interaction (ACII), pp. 123–129, IEEE, 2019.

experience. These movies will have been continuously annotated with discrete emotions as well as aspects of the Component Process Model.

We will perform a number of analyses on the acquired data, to replicate previous work and to contribute novel insights on the neural representation of emotions. Data analysis and the interpretation of results are the main pillars of our work. We will try to replicate the results of a previous study that represented the semantic organization of the brain[3] and then apply the same analysis principle to emotion. Furthermore, we will apply sophisticated analyses that capture dynamic intersubject functional connectivity, as these are more appropriate to the study of dynamic phenomena like emotions.

Ultimately, our goal is to achieve a comprehensive understanding of how emotion is represented in the brain that is informed by state-of the art technology and a progressive understanding of how the brain works as a system of interdependent networks.

https://www.epfl.ch/research/domains/bioengineering/

[3] A. G. Huth, S. Nishimoto, A. T. Vu, and J. L. Gallant, "A continuous semantic space describes the representation of thousands of object and action categories across the human brain," Neuron, vol. 76, no. 6, pp. 1210–1224, 2012.

Medtronic Chair in Neuroengineering EPFL

The Medtronic Chair in Neuroengineering is a multidisciplinary environment promoting cross-fertilization among a variety of expertise. We bring materials science, computer science, engineering, life science, and medicine together by the convergence of physicists, engineers, neuroscientists, and ophthalmologists cooperating to accomplish innovative projects. Our mission is the development of application-driven solutions based on compliant, minimally invasive, and replaceable neuroprosthetic devices. Ultimately, we aim at translating our research findings into clinical practice.

Currently, our research program is organized in two research lines:

POLYRETINA: Injectable, self-opening, wide-field, photovoltaic epi-retinal prosthesis. Retinal prostheses were developed to fight blindness in people affected by outer retinal layer dystrophies. To date, few hundred patients have received a retinal implant. However, several challenges remain open, such as the improvement of visual acuity and the enlargement of the visual field above the thresholds of blindness. An agreed upon strategy to improve visual acuity is to increase the electrode density, while a large visual field could be attained by enlarging the retinal coverage with a larger prosthesis.

Inspired by intraocular lenses, we have designed a foldable and photovoltaic wide-field epiretinal prosthesis capable of stimulating wireless the retinal ganglion cells. Within a visual angle of 46.3 degrees, it embeds more than 10,000 stimulating pixels, it is foldable to allow implantation through a small scleral incision, and it has a hemispherical shape to match the curvature of the eye.

We demonstrate that it is not cytotoxic and respects optical and thermal safety standards; accelerated ageing shows a lifetime of at least 2 years (**Ferlauto et al., *Nature Communications* 2018**). Experiments with explanted blind retinas showed that POLYRETINA can achieve high focal stimulation of the retinal ganglion cell layer, because of the efficient recruitment of the lateral inhibition provided by Amacrine cells (**Chenais et al., *Journal of Neural Engineering* 2019**). In preparation to the first-in-men clinical trial, we further developed POLYRETINA to be sensitive to near-infrared illumination (**Airaghi Leccardi et al, *in Review*;doi:10.1101/2020.01.27.920819**). This is necessary to provide a better comfort to the implanted patients. Currently, our unpublished results show that POLYRETINA has high stimulation selectivity down to single retinal ganglion cell resolution.

The preclinical trails in blind minipigs shows that POLYRETINA can be safely injected and placed into the eye, is tolerated upon long term implantation, and restorers light sensitivity. Our research is a significant progress towards the improvement of both visual acuity and visual field with the same device, a current challenging issue in the field. In particular, POLYRETINA is the first (and still the only) retinal prosthesis able to restore a wide visual field (46.3). In the past year, we have developed a set of virtual and augmented reality scenarios to demonstrate in healthy subjects (under simulated prosthetic vision) the benefit provided by POLYRETINA during common daily activities. In particular, our unpublished results confirmed that the wide visual field provided by POLYRETINA is the key element to enable an efficient performance in common daily experience, like object finding and recognition, locomotion, general orientation, obstacle avoidance etc.

OPTICSELINE: Intraneural electrode array for optic nerve stimulation. Retinal prostheses were developed to restore a functional form of vision in patients affected by outer retinal layer dystrophies. In particular, retinal prostheses addressed patients affected by retinitis pigmentosa, a set of genetic diseases leading to blindness due to the death of retinal photoreceptors. In various clinical trials, retinal prostheses demonstrated the capability to restore a functional form of vision. However, only a small fraction of the profound blind patients affected by retinitis pigmentosa (approximately 12 % or less) is eligible for retinal prostheses due to exclusion criteria. Small eye size, retinal detachment, trauma, and severe strabismus are in fact among the contraindications for an epi-retinal prosthesis (e.g. Argus® II). Therefore, optic nerve stimulation is an attractive strategy since it bypasses the eye and, at the same time, still takes advantage of the high-level information processing occurring downstream in the visual pathway. Thus, optic nerve stimulation is a strategy to overcome issues

related to selection criteria and address a larger population of blind patients which currently has no medical solution.

Accordingly, we developed an innovative intraneural stimulator for the optic nerve (**Gaillet et al., *Nature Biomedical Engineering* 2019**). Our preclinical results showed that optic nerve stimulation can induce selective cortical activation patterns depending on the stimulating electrode used. In preparation to the first-in-men clinical trial, we are further refining the OPTICSELINE with three-dimensional concentric bipolar electrodes which allow for a more selective activation of the optic nerve fibres (unpublished results). These three- dimensional electrodes are based on a fabrication method previously developed in our laboratory (**Airaghi Leccardi et al, *Journal of Neural Engineering* 2019**).

Blindness is a widespread global public health issue affecting more than 39 million people worldwide (World Health Organization), and it represents a significant personal and societal burden, both in terms of reduced quality of life as well as costs. Our research goal is to reduce this burden by reverting blindness in a large fraction of affected people. To do so, we combined materials science, engineering, and neuroscience to develop and validate innovative neuroprosthetic devices going well- beyond the state-of-the-art of the research in the field. We are simultaneously innovating in neurostimulation technology for vision restoration, and translating our research findings towards clinical use.

https://www.epfl.ch/labs/lne/

Sleep and Cognition Neuroimaging Laboratory UNIGE

The Sleep and Cognition Lab is headed by Prof. Sophie Schwartz. The Lab is in the Department of Neuroscience, Faculty of Medicine at the University of Geneva.

Our team investigates the mechanisms of brain plasticity that underlie learning and memory in humans. In particular, our research focuses on the role of emotion and sleep in memory processes. We also study the content of dream reports, as an important source of information about what our brain and mind do while we sleep.

Our experimental approach includes the development of novel behavioral tasks, in combination with simultaneous measures of brain activity such as functional magnetic resonance imaging (fMRI) and high-density electroencephalography (EEG).

For specific details about our work, feel free to browse through our publications:

https://www.unige.ch/medecine/neuf/en/research/grecherche/sophie-schwartz/

We would be delighted to welcome an artist in our lab. We will share knowledge, present our experimental tools, explain our goals and results, etc. The artist will be invited to our lab meetings, and s.he might also attend (and possibly participate) to actual experiments. We are looking forwards to lively discussions between our lab and the artist.

A selection of recent media coverage:

In French: http://avisdexperts.ch/videos/view/10775/46306
https://avisdexperts.ch/videos/view/9335

In English: https://www.bbc.com/news/education-50563835
https://www.nytimes.com/2019/02/10/opinion/sleep-neuroscience.html