Python software developer position in functional neuroimaging

Application to be sent to: Florence Forbes (florence.forbes@inria.fr)

Scientific Contact:

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Localization: Equipe Mistis Inria Grenoble (http://www.inria.fr/equipes/mistis)

The candidate will be based mainly at INRIA team Mistis in Grenoble, France.

The work is jointly supervised with CEA Saclay NeuroSpin near Paris and regular visits to this partner are expected.

Starting date: as soon as possible, October 2016 by the latest

Duration: 12 months

Salary: **from 1611.77€ to 2315.50€ per month after taxes**
to be negotiated depending on the applicant experience and skills

Context:

Modern non-invasive neuroimaging techniques such as functional Magnetic Resonance Imaging (fMRI) explore brain mechanisms by providing metabolic-related measures of brain activity under controlled cognitive states. The most commonly used fMRI technique relies on the Blood Oxygen-Level Dependent (BOLD) contrast, namely the subsequent increase of oxyhemoglobin rate following the firing of neurons that occurs during an activation experiment along which the participant is submitted to various experimental stimuli. In this context, fMRI indirectly provides maps of neural activity by assuming that the BOLD response, via the HRF for Hemodynamic Response Function, is known and set to a fixed canonical shape. The clinical dissemination of fMRI, to detect functional anomalies is limited since normal ageing [Gauthier, NeuroImage 2013 ; Fabiani, NeuroImage 2013] and numerous pathologies such as Stroke [Attyé, HBM 2013 ; Krainik, Stroke 2005] and Alzeihmers's desease [Cantin, Neuroimage 2011] involve an altered vascular response. The analysis of such data with a canonical model limits the interpretation of the diminution or the absence of BOLD signal (see eg [1]). Unfortunately most currently available software (SPM, FSL, AFNI) do not take into account the variability of the HRF. Hence, we have developed the PyHRF software [2] in Python that implements a joint detection estimation (JDE) approach [3-5] able to jointly estimate activations and the unknown HRF. To build on this improvement, the current proposal therefore aims at overcoming the issues of (i) interpretability of the fMRI results by a better characterization of the neuro-vascular coupling and (ii) providing reliable dynamical functional measures of brain activity, exploitable in a clinical context.

Work Description:

Recently, the PyHRF functionalities have been extended to make it easier to use by non experts and clinicians. Preliminary tests have been carried out on clinical data. Under the supervision of the project

partners and in collaboration with neuroradiologists from the Grenoble Institute of Neuroscience (GIN), the work will mainly consists of :

- Continuing the software evaluation and implementing the required modifications ;
- Implementing an interface for a facilitated use, typically by clinicians ;
- Integrating the software into a pipeline for automatic reporting in a clinical context ;
- Participating in the setup of additional clinical experiments.

Required skills:

- Background in computer science (Master, PhD or equivalent level) ;
- Python and GitHub environment ;
- Linux software development ;
- Good interaction and reporting skills in a multidisciplinary group ;
- Signal and image processing background is a plus.

The application should include:

- A motivation letter specific to this position
- A detailed resume including the applicant working experience and academic background
- Recommendation letters or names and emails of potential references

References:

[1] Badillo S, Vincent T, Ciuciu P. **Group-level impacts of within-and between-subject hemodynamic variability in fMRI**. *Neuroimage*. 2013 Nov 15;82:433-48.
[2]Vincent T, Badillo S, Risser L, Chaari L, Bakhous C, Forbes F, Ciuciu P. **Flexible multivariate hemodynamics fMRI data analyses and simulations with PyHRF**. *Frontiers in Neuroscience*. 2014;8.
[3] Vincent T, Risser L, Ciuciu P. **Spatially adaptive mixture modeling for analysis of fMRI time series**. *IEEE Transactions on Medical Imaging*. 2010 Apr;29(4):1059-74.
[4] Risser L, Vincent T, Forbes F, Idier J, Ciuciu P. **Min-max extrapolation scheme for fast estimation of 3D Potts field partition functions. Application to the joint detection-estimation of brain activity in fMRI**. *Journal of Signal Processing Systems*. 2011 Dec 1;65(3):325-38.
[5] Chaari L, Vincent T, Forbes F, Dojat M, Ciuciu P. **Fast joint detection-estimation of evoked brain activity in event-related fMRI using a variational approach**. *IEEE transactions on Medical Imaging*. 2013 May;32(5):821-37.