



ABCDE



Scientific Report

First name / Family name

Jija Syamla James

Nationality

INDIAN

Name of the *Host Organisation*

INRIA, France

First Name / family name

David Guiraud

of the *Scientific Coordinator*

Period of the fellowship

01/03/2014 - 28/02/2015



I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

The scientific research during my fellowship period was organized as a collaborative project between INRIA (Team Demar) and the Neuroradiology department of Hôpital Gui de Chauliac (CHU). This collaborative work was initiated by **Dr. David Guiraud** and **Dr. Francois Bonnetblanc**, at DEMAR and Prof. Hugues Duffau and Dr. Nicolas Menjot de Champfleury at CHU to apply advanced non-invasive neuroimaging techniques to map the changes in functional and structural connectivity networks in human brain in the preoperative and postoperative Diffuse low grade glioma (DLGG). Under the aegis of this collaborative work, the research hypothesis for ERCIM project was framed by me in collaboration with **Dr. Anirban Dutta**, Starting Research Scientist of the DEMAR team of INRIA.

Title of the ERCIM project: Modelling of resting-state functional connectivity networks in preoperative and postoperative Diffuse Low Grade Glioma (DLGG)

Study background: The impairment of functional brain connectivity networks in Diffuse Low Grade Glioma (DLGG) subjects can lead to distinct functional deficits where the challenge remains in greater understanding of the changes in the functional connectivity networks in the brain. The goal of the one-year ERCIM project was to evaluate the pre- and post- operative changes in the functional connectivity networks in DLGG subjects using resting-state functional Magnetic Resonance Imaging (rsfMRI).

Objectives :

- a) To evaluate the feasibility of rsfMRI technique to map the sensory-motor resting state connectivity in DLGG.
- b) To investigate longitudinal alterations in the topographic organization and strength of functional connectivity in pre- and post- operative DLGG.

Methodology: In order to identify resting-state sensory-motor functional connectivity networks, we analyzed rsfMRI data of 27 left mesio-frontal DLGG subjects (Age range: 20-40 years; 19 males and 8 females). For each participant, rsfMRI data was acquired across three time periods ; i) Preoperative (before glioma surgery), ii) Postoperative (3 hours after glioma surgery), and iii) Follow-up (3 months after glioma surgery). Spatial Independent Component Analysis (ICA) on the rsfMRI time series was performed with FMRIB Software Library (FSL Version 5.0.7; <http://www.fmrib.ox.ac.uk/fsl/>) Then, “ROI-to-ROI (Region of Interest) bivariate correlation” was applied on the spatial ICA components using CONN functional connectivity toolbox (www.nitrc.org/projects/conn). The topological properties of the functional connectivity networks among the spatial ICA components were extracted with graph theoretic methods in the CONN

functional connectivity toolbox. All possible functional connectivity between each pair of 'seed' ROIs were explored.

Results: rsfMRI technique to map the sensory-motor resting state connectivity in DLGG was found feasible where different topological pattern of functional connectivity were observed in the sensory-motor areas across three different time periods - Preoperative, Postoperative, and Follow-up. This supported our hypothesis on longitudinal alterations in the topographic organization of sensory-motor connectivity. Statistically significant ($P < 0.05$) differences in the degree of functional connectivity was noticed postoperatively from Preoperative baseline, with an initial dip in the immediate Postoperative period, and then a subsequent recovery during Follow-up (Figure 1).

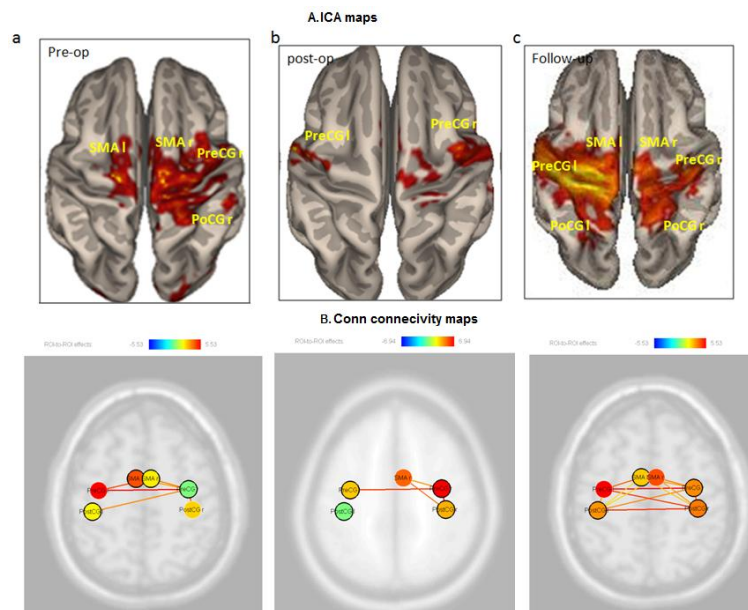


Figure 1: An illustrative figure on longitudinal alterations in the topographic organization and strength of functional connectivity in pre- and post- operative DLGG. (A) Results of spatial Independent Component Analysis. SMA= Supplementary Motor Area, PreCG=PreCentral Gyrus, PoCG=PostCentral Gyrus. l=left hemisphere, r=right hemisphere. a) Preoperative DLGG; b) Postoperative DLGG; c) Follow-up DLGG. (B) Functional connectivity networks found with CONN toolbox.

Outcome of the study

- We demonstrated an automated method (spatial ICA coupled with functional connectivity analysis) for mapping functional connectivity networks and its topological characteristics.
- The study hypothesized that intra and inter hemispheric sensory-motor connectivity would be susceptible to alterations in pre- and post- operative DLGG.
- The increased network connectivity during follow-up period is postulated to be a biomarker of neuroplastic changes in the brain and functional recovery following glioma surgery.



II – PUBLICATION(S) DURING YOUR FELLOWSHIP

Jija James et al., "Identification of sensory motor functional connectivity using resting state functional Magnetic Resonance Imaging (rsfMRI) in preoperative and postoperative Diffuse low grade glioma (DLGG)" (under submission)

III – ATTENDED SEMINARS, WORKHOPS, CONFERENCES

1. Attended ABCDE seminar IV that took place at the CNR Research Campus in Pisa, Italy from October 23rd to 24th, 2014.
2. Attended "Alpine Brain imaging Meeting 2015 " from January 11- 15, 2015 in Champéry, Switzerland and presented a poster titled: "Identification of Default Mode Networks using resting state functional Magnetic Resonance Imaging in patients with Diffuse Low-Grade Glioma (DLGG) before and after surgery"

IV – RESEARCH EXCHANGE PROGRAMME (REP)

REP1:

Organization: Antwerp University Hospital and Vision Lab ,University of Antwerpen, headed by Prof. Dr. J. Sijbers

Country: Belgium

Dates of visit : 20/08/2014 to 26/08/2014.

The research group mainly works on image reconstruction, image denoising, higher order diffusion tensor imaging (DTI) parameter estimation and fibre tractography. I interacted with the neuroimaging researchers regarding the novel reconstruction, processing and analysis algorithms to process anatomical, functional and diffusion-weighted Magnetic Resonance Imaging data.

REP2:

Organization: Department of fundamental Neurosciences, University of Geneva, headed by Prof. Patrik Vuilleumier

Country: Switzerland

Dates of visit: 16/02/2015 to 20/02/2015

Visited Geneva Neuroscience multidisciplinary centre and interacted with doctoral and postdoctoral scholars concerning the current aspects of advancing neuroimaging techniques and their applications in various neurodegenerative disorders. Familiarized with new neuroanalysis algorithms for probing resting-state functional connectivity networks in human brain. During this period, I attended the internal seminar taken by the visiting Prof. Dr. Stefan Moratti on "Adaptation of the visual sensory system to changing fear related contingencies".