

REPORT OF RESEARCH WORK

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YEAR 2017/2018

PHD STUDENT AT UNIMORE
INDAM DOCTORAL PROGRAMME IN MATHEMATICS

Research activity

The aim of the project I have been working on is to investigate the putative suitability of cerebral functional connectivity patterns obtained by non invasive resting state BOLD fMRI as biomarkers for fibromyalgia.

Fibromyalgia (FM) is a chronic pain condition, typically associated with other symptoms such as fatigue, sleep and mood disturbances. However nowadays, the pathophysiology of FM is not fully understood. A highly relevant goal of such brain mapping studies is the identification of central biomarkers of chronic pain that would allow a more reliable diagnosis and the unraveling of the underlying neural mechanisms.

We used a dataset of 45 fibromyalgic patients and 38 healthy controls (all females, age- and education-matched) in a machine-learning computational framework, aimed at automatic classification of subjects into the patient/control categories. The classification and predictive algorithms use as input partial correlation matrices of a 120-node parcellation of the whole cerebral cortex, thus allowing an anatomically unbiased investigation and a reasonably high degree of spatial specificity.

For the time being, our algorithms are not yet able to predict the presence of the disease for a given subject, but different feature selection techniques are being investigated with the aim of detecting which connections are mainly responsible for discriminating patients from healthy controls. Clustering strategies are also about to be considered in a future work.

Courses attended

1. **Deep learning specialization** ; Coursera ; e-learning ; 11/17-02/18
2. **Reinforcement learning** ; Udacity ; e-learning ; 04/18-06/18
3. **Elaborazione numerica di segnali e immagini** ; S. Bonettini ; UNIMORE ; 02/18-06/18
4. **Calcolo parallelo 2** ; L. Zanni, M. Spallanzani ; UNIMORE ; 03/18-05/18

5. **Metodi numerici** ; M. Prato ; UNIMORE ; 03/18-06/18
6. **Summer School “Computational Methods for Inverse Problems in Imaging”**
; J. Nagy, L. Reichel, R. Chan, JC Pesquet ; Università degli studi dell’Insubria (Como)
; 21/05/18-25/05/18
7. **Course and Seminars on “Reconstruction methods for sparse-data tomography”**
; S. Siltanen, E. Piccolomini ; Università degli studi dell’Insubria (Como) ;
25/06/18-28/06/18
8. **Representation of high dimensional data** ; J. Blanchard, B. Hunter, D. Needell ;
MSRI (Berkeley) ; 09/07/18-21/07/18
9. **Variational methods for imaging** ; L.Zanni ; UNIMORE ; 19/09/18 - 22/09/18
10. **Italian language course** ; C.Cagliaris ; UNIMORE ; 03/18-06/18

Teaching/tutoring activities and given talks

1. Lightning talk given during the Summer school ‘Representation of high dimensional data’ (MSRI, Berkeley), about ‘Numerical methods for the identification of central biomarkers of fibromyalgia’.
2. Talk given during the Summer school ‘Computational Methods for Inverse Problems in Imaging’ (Como), about ‘Quantification of fiber width in biological images’.
3. Lesson and laboratory about Discrete Cosine Transform and JPEG compression provided to first-year Master students in the framework of the course ‘Elaborazione numerica di segnalie immagini’. (4 hours)
4. Preparatory course given to bachelor students at UNIMORE (4 hours)
5. Participation to the event of popularisation of science ‘European Night of researchers 2018’ at Modena : talk, poster, experimental activities.

Seminars and conferences attended

1. **Seminars on “Optimization techniques for imaging”** ; P. Ochs, S. Gazzola, S. Villa, V. Ruggiero, L. Zanni ; Università degli studi dell’Insubria (Como) ; 11/06/18-14/06/18
2. **SIAM Conference on Imaging Science** ; Università di Bologna ; 05/06/18-08/06/18