TITLE: MUNCH – Multimodal Neuroimaging in Healthy Subjects and Neurological patients as a biomarker of healthy and abnormal brain functions.

ABSTRACT: Neuroimaging has profoundly advanced neuroscience research and clinical care rapidly in the past two decades. Multimodal neuroimaging advances the neuroscience research by overcoming the limits of individual imaging modalities and by identifying the associations of findings from different imaging sources. Since different approaches can reveal different physiological relation between the complex functionality aspects of the human brain in healthy and neurological conditions, the whole project can be divided in the following four subprojects:

Project 2 (PI: Bertoldo; co-PI: Corbetta, Thiébaut de Schotten) Tensor-Based Microstructural models to relate structural and functional connectivity.

In Diffusion Weighted MR Imaging (DWI), the signal is affected by the biophysical properties of neuronal cells and their relative placement, as well as extra-cellular tissue compartments. It is also known that there is a strong coupling between functional and structural connectivity. We are interested in modelling the relationship between functional and structural connectomes to understand how different microstructure indices (like those derived from spherical mean technique, Bingham NODDI¸ diffusion kurtosis imaging) [1-3] are related to brain function. We hypothesize that the characterization of the relation between microstructural tissue properties, fiber tracking and functional connectivity will improve the inferring of multi-scale neural mechanisms with brain network modelling.

REFERENCES:

1. Kaden E, Kruggel F, Alexander DC. "Quantitative mapping of the per-Axon Diffusion Coefficients in Brain White Matter". Magn Reson Med. 2016 Apr;75(4):1752-63. doi: 10.1002/mrm.25734.
2. Tariq M, Schneider T, Alexander DC, Gandini Wheeler-Kingshott CA, Zhang H. Bingham-NODDI: Mapping anisotropic orientation dispersion of neurites using diffusion MRI. Neuroimage. 2016 Jun;133:207-223. doi: 10.1016/j.neuroimage.2016.01.046.
3. Glenn GR, Helpern JA, Tabesh A, Jensen JH. Quantitative assessment of diffusional kurtosis anisotropy. NMR Biomed. 2015 Apr;28(4):448-59. doi: 10.1002/nbm.3271.

PARTICIPANTS (PI and co-PIs): PI: Alessandra Bertoldo, co-PI: Maurizio Corbetta. Additional: Michel Thiébaut.

EXPERIMENTAL DATA:

To be acquired	x
Already acquired (ready to be used)	x

If data need to be acquire, please provide a brief description of the Experimental setup, methods, instruments and scheduling (e.g. # of subjects, images/signals…):

Public data sets: Human Connectome Project, ADNI (only healthy subjects), Biobank, SchizConnect (only healthy subjects)

Additional FDG data sets are provided by Marco Aiello, Valentin Riedl, Paolo Zanotti-Fregonara.

In addition the following data set will be acquired, on the PET/MR or on 3T Ingenia Philips of the AOP, during the three years of the PhD: Total of 120 healthy subjects in which 20 patients will be scanned per decade (20-29, 30-39, 40-49, 50-59, 60:69, 70:79). The MR protocol will be composed by the following sequences: T1w iso-voxel 1x1x1 mm3, T2w iso-voxel 1x1x1 mm3, Flair, rs-fMRI (TR=2s, 30 min), DTI (3 shells, 14 B0). N=30 stroke patients + N=30 controls; N=30 tumor patients. HD-EGG will be also acquired.

Ethics committee:

Obtained	x
Conditioned submission*	Expected time response (in months): 2/3 months
Not required	

* request will be submitted only if a PhD student will be associated to the project