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Laboratory for Human Brain Dynamics

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Short Term Scientific Mission (STMS) on connectivity in the brain

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Background: The laboratory for Human Brain Dynamics (LHBD) of AAISCS has one of the most sophisticated magnetoencephalography (MEG) recordings and software for identifying in real time regional brain activations from a series of MEG experiments performed at the Brain Science Institute, RIKEN in Japan, where the core of the team was working from 1998 to 2009. The connectivity analysis of some of the data has revealed new insights about the way the brain processes external stimuli and how its mode of operation changes in different states (e.g. awake state with eyes open or closed and in each one of the five sleep stages). This analysis was performed using only a small number of areas that were known to be important for each one of the cases studied. In line with the usual practice in neuroimaging today, the previous studies of connectivity at LHBD ignored two factors that may play an important role. Specifically the analysis did not take into account the possible roles played by either the overall pattern of electrical activity in the brain or the underlying anatomy. The effort to add the missing elements form the brain connectivity analysis can be guided by expertise from connectivity analysis in areas where the continuity across space and the terrain formation play a key role, which of course is the case for the key disciplines involved in the COST Action ES1306. In return the expertise from neuroscience connectivity analysis can contribute significantly to the effort of the COST Action to unify connectivity analysis from cross-fertilization of ideas from the fields of Hydrology, Soil Science, Geomorphology and Ecology, by introducing dynamic connectivity that is becoming a key area in neuroimage-based connectivity analysis. The proposed STSM is part of the long-term objective to integrate the connectivity work based on MEG tomographic analysis to the mainstream work of connectivity in ES1306.

Type of scientific work we are offering: To perform connectivity analysis of one or more sets of time series extracted from tomographic analysis of MEG data, using software that is used routinely by one, or ideally more, ES1306 partners. Evaluate the outcome from two perspectives: that of neuroscience and that of the mother discipline where the software is routinely used. From the neuroscience perspective the evaluation will include the effectiveness of the analysis to provide new insights and the efficiency of the software implementation for tackling the overall problem. From the perspective of the mother discipline the experience will be evaluated in terms of new insights provided in the treatment of brain connectivity problems particularly in studying the dynamic changes in the mode of operation and the way the mechanisms can be understood at different time scales.

Immediate objective: In addition to the foundational role of the STSM in establishing a longer term collaborative effort, the data to be used in the connectivity analysis will be chosen so that successful completion of the project will lead to one or more good publications. The choice of topic will be made after discussions between the parent and host Institutions. Some of the available topics can be found in the web pages of LHDB (http://aaiscs.com/LHBD/projects.html).

Possible duration of STSM: Minimum of two months up to the maximum allowed of three months.

Best time for STSM: It is possible to start the STSM in early July, however there are two good reasons for delaying the start until early Autumn of 2016.   First, the months of July and August are very hot in Nicosia and especially in August the city is almost empty as most people take their vacation. Second, to ensure that the project proceeds with gusto basic preparations should be completed before the start of the STSM; it is especially important to settle potentially time-consuming issues like input output formats and ensuring that all software to be used (for computations and displays) runs smoothly on the local machines of the host.