Practical Brain Network Modeling in Epilepsy with The Virtual Brain

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The Virtual Brain (TVB) [1,2] is a neuroinformatics platform that allows for the modeling of large-scale brain dynamics and simulation of brain signals including M/EEG, stereotactic EEG and fMRI. In this tutorial, we will learn in practice how to use TVB to model seizure propagation in a virtualized brain. We will experiment with a phenomenological neural mass model which is able to reproduce several features of seizure dynamics, the Epileptor model[3]. Using connectomes obtained from diffusion datasets of real patients, we will couple several Epileptors together, in particular with permittivity coupling [4], and reproduce the propagation patterns of partial seizures.

TVB allows for the testing of multiple virtual scenarios interesting for clinical epilepsy, such as simulation of electrical stimulation, or partial resection of a brain. TVB also includes a framework for data management (generation, organization, storage, integration and sharing) and a simulation core written in Python, accessible through both a Graphical User Interface and a Console Interface. TVB can interact with third-party toolboxes written in MATLAB, e.g. the well-known Brain Connectivity Toolbox.

After this tutorial, you should have a basic practical understanding of how to model a virtual epileptic patient in TVB. In the first one hour and a half session, we will give a theoretical introduction to The Virtual Brain (see [2] for details) and learn in a hands-on session how to use both the Graphical User Interface and the Console Interface of TVB, with time left for questions. The second session will be dedicated to the modeling of seizure propagation through the virtualized brain of a patient. Participants are encouraged to install a working version of TVB before attending this tutorial[5,6].

[1] Sanz Leon P, Knock S, Woodman M.M, Domide L, Mersmann J, McIntosh A, Jirsa V.K (2013) The Virtual Brain, a simulator of primate brain network dyanmics, *Frontiers in Neuroinformatics,* vol. 7, no. June, pp. 1-23
[2] Sanz-Leon P, Knock SA, Spiegler A, Jirsa VK (2015) Mathematical framework for large-scale brain network modelling in The Virtual Brain. Neuroimage 1;111:385-430.
[3] Jirsa V.K, Stacey W.C, Quilichini P.P, Ivanov A.I, Bernard C (2014) On the nature of seizure dynamics, *Brain,* vol. 137, no. 8, pp. 2210-2230
[4] Proix T, Bartolomei F, Chauvel P, Bernard C, Jirsa VK (2014) Permittivity Coupling across Brain Regions Determines Seizure Recruitment in Partial Epilepsy, *Journal of Neuroscience,* vol. 34, no. 45, pp. 15009-15021
[5] http://thevirtualbrain.org/tvb/zwei
[6] http://docs.thevirtualbrain.org/

IEEG Database Tutorial

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In this workshop we will present an update on IEEG.org and its capabilities. IEEG.org is a cloud-based, data management solution for storing, sharing and analyzing time series, imaging and metadata. We will also present development in progress and solicit constructive input from the community regarding features needed and vision.

In the second half of the workshop we will run a group experiment to upload, annotate, access, analyze and share data, code and results. Participants should bring their laptop computers for hands-on experience with the platform. This will require MATLAB to be installed on their computers. The workshop is intended to further collaboration, sharing and validation of science among the ISPW community. At the end of the workshop we will discuss future directions and our plan to sustain and expand this valuable resource long-term.