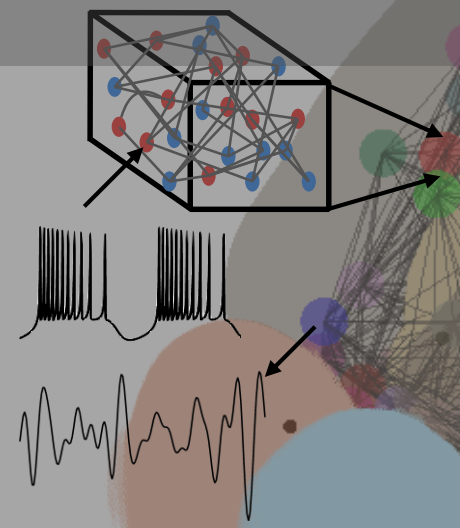
Human Brain Project

THEVIRTUALBRAIN.

Institut de Neurosciences des Systèmes

Aix*Marseille université

The Virtual Mouse Brain



Institut de Neurosciences des Systèmes (INS), Aix-Marseille University (AMU)

A Computational Neuroinformatics Platform to Study **Whole Mouse Brain Dynamics**

TECHNOLOGY DESCRIPTION

We have extended the open-source simulation software The Virtual Brain (TVB) to whole mouse brain network modeling. It utilises individual diffusion magnetic resonance imaging (dMRI) or tracer-based detailed mouse connectomes from the open access mice brain tracing data from the Allen Institute.

Connectome-based modeling of large-scale brain network dynamics enables causal in silico interrogation of the brain's structure-function relationship.

This platform can be used to simulate brain activity, such as seizure propagation, stroke and resection and the resting state dynamics in health and disease. The Virtual Mouse Brain (TVMB) enables theoretically driven experimental planning and ways to test predictions in the numerous strains of mice available to study brain function.

Connectome-based modeling of the brain dynamics enables causal *in silico* interrogation of the *structure-function* relationship, necessitating the close integration of diverse neuroinformatics fields.

Modeling various brain modalities e.g., calcium imaging, EEG, fMRI.

AREAS

Brain Network Modeling | Neuroinformatics platform

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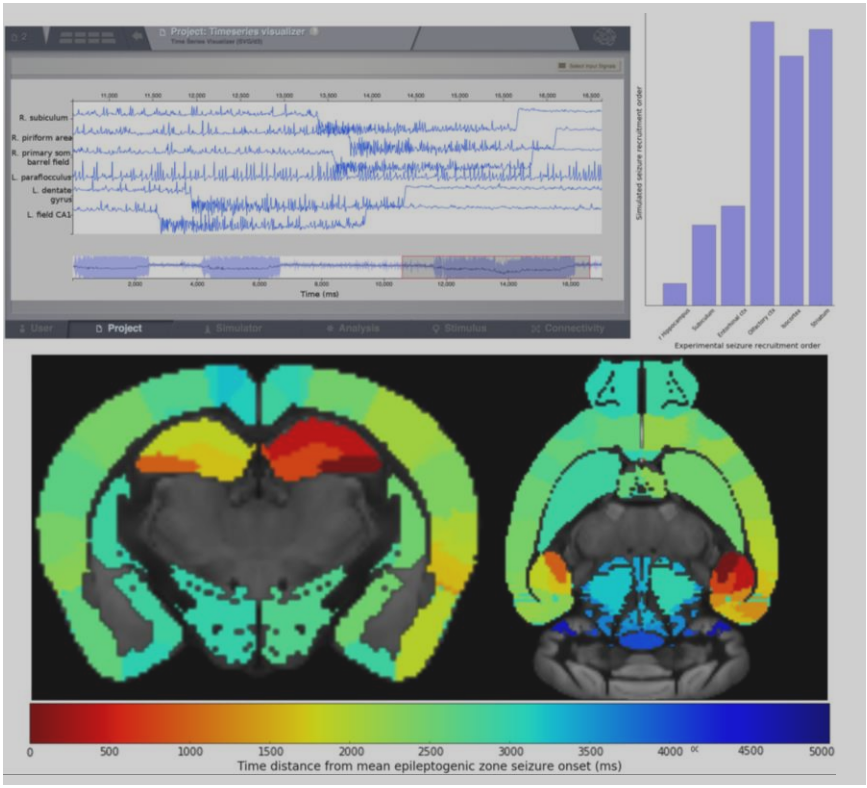
COMPETITIVE ADVANTAGES

- Allows building specific individual mouse brains using various resolutions and parcellations, in order to simulate different dynamical behaviors (using diverse neural population models, numerical integration schemes, and simulated neuroimaging modalities) and finally to analyze the results.
- A highly generic framework: Underlying mathematical framework and simulation techniques make standard assumptions, among which the two most essential are that (1) the average activity of large populations of neurons is a meaningful quantification of the phenomena to be modeled and (2) the statistics of white matter fibers sufficiently describes how regions interact.
- The proposed Allen Mouse connectome builder of TVMB is validated against gold standard dMRI data, and it improves reproducibility of individual brain signal variance from 60 to 80%.

TVMB allows systematic in-silico analysis of the impact of various structural or dynamical pathologies on the spatiotemporal dynamics of the brain.

APPLICATION & MARKET POTENTIAL

- Preclinical research: TVMB offers not only a conceptual framework to interpret neuroimaging data but, combined with experimental approaches, it also offers an operative framework to investigate the causal links between structure and function in the brain.
- Individualized medicine: TVMB allows testing of the predictability of the individualized connectome which is of high relevance for treatments for diseases such as epilepsy and stroke.
- TVMB as part of TVB is being integrated with the Neuororobotic and Neurinformatic platforms of the HBP.



TECHNOLOGY READINESS LEVEL

1 2 3 **4** 5 6 7 8 9

REFERENCES

- The Allen Connectivity Builder is a pipeline developed by INS and fully integrated within TVB.
- TVB is a joint platform of several international institutes for computational neuroscience. https://www.thevirtualbrain.org
- F Melozzi et al. *The Virtual Mouse Brain: A Computational Neuroinformatics Platform to Study Whole Mouse Brain Dynamics*. eNeuro 4(3), 2017.

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