Docket #: S22-403

Solving brain circuit function and dysfunction with computational modeling and optogenetic fMRI

Stanford researchers at the Lee Lab have developed a method to understand whole-brain circuit mechanisms underlying neurological disease and its application to predict the outcome of therapeutic interventions.

By combining optogenetic fMRI with computational modeling, cell type-specific, large-scale brain circuit function and dysfunction are now starting to be quantitatively parameterized. These new findings can pave the path for future therapeutics developments based on a systems engineering approach aimed at directly restoring brain function.

Figure:

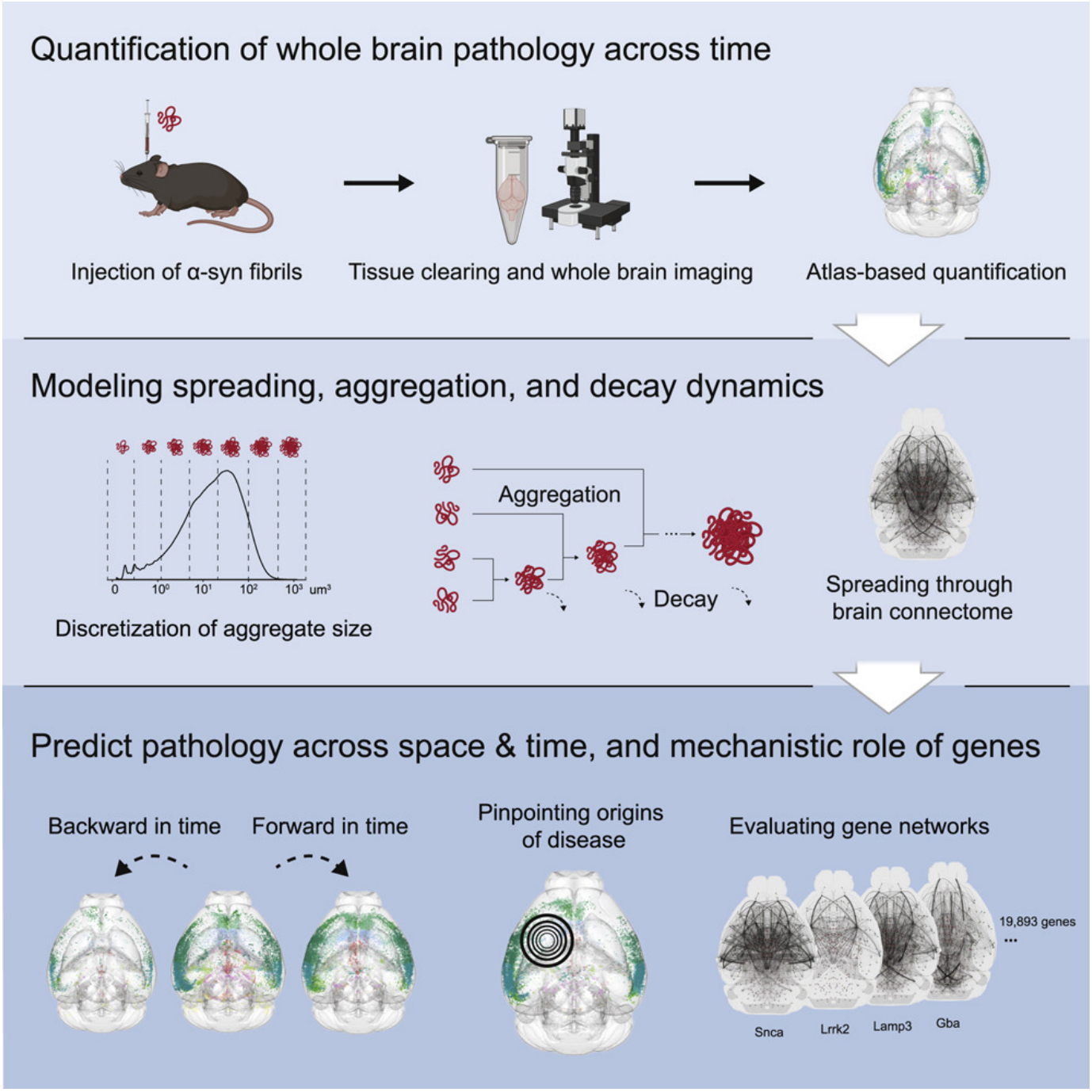


Figure description: Graphical Abstract

Image credit: https://doi.org/10.1016/j.celrep.2022.111631

Stage of Development

- Proof of Concept

Applications

- **Neuromodulation therapy design** for neurogenerative diseases
- The method can be applied to predict the optimal targets and parameters of the neuromodulation treatments for a number of neurological disorders, including but not limited to Parkinsons disease (PD), dystonia, and epilepsy

Advantages

- **Systematically designed treatments for brain disorders**
- **Enables virtual neuromodulations** for the treatments of neurological disorders
- By implementing such virtual neuromodulations, rapid optimization and customization can be achieved that **saves the time and financial costs of carrying out *in vivo* experiments**
- **Incorporates cell-type information to modeling**

Publications

- Lee, Jin Hyung, Qin Liu, and Ehsan Dadgar-Kiani. "Solving brain circuit function and dysfunction with computational modeling and optogenetic fMRI." *Science* 378, no. 6619 (2022): 493-499.
- Dadgar-Kiani, Ehsan, Gregor Bieri, Ronald Melki, Aaron D. Gitler, and Jin Hyung Lee. "Mesoscale connections and gene expression empower whole-brain modeling of ?-synuclein spread, aggregation, and decay dynamics." *Cell Reports* 41, no. 6 (2022): 111631.

Patents

- Published Application: WO2024073593
- Published Application: 20250325707

Innovators

- Jin Hyung Lee
- Qin Liu

Licensing Contact

Evan Elder

Associate Director, Licensing and Strategic Alliances, Physica

Email