Docket #: S17-374

Method to visualize and quantify transitions in brain activity using topological data analysis

Dr. Manish Saggar at Stanford University has developed a new method to visualize and quantify transitions in brain activity, which may be used as a diagnostic tool for mental illness. Understanding how the brain adapts from one task to another is vital for understanding typical and atypical brain functioning. The brain's ability or inability to adjust to various demands has been associated with a variety of neurological disorders, such as schizophrenia, attention deficit disorder, and depression. Neuroimaging methods have been developed to study how the brain adapts to tasks, but current methods are not optimal as they collapse (and therefore lose) data with respect to space and time. To overcome this limitation the inventors have developed this novel method to represent the brain's overall dynamic organization. The method uses topological data analysis to distill complex brain dynamics into interactive and behaviorally relevant representations, at the single participant level, without collapsing data in space or time. This technology may be developed into a diagnostic tool for mental illness.

Stage of research
Method has been validated using publically available fMRI neuroimaging data and shows great promise. Additional development is ongoing.

Applications

- Mental illness- tool to:
    - Help diagnose mental illness
    - Track treatment response
- Study brain dynamics

Advantages

- Does not collapse data in space or time- uses original temporal and spatial scales of the data
- Distills data into simple, vibrant, and behaviorally relevant representations that can be interactively explored
- Captures transitions in whole-brain activity maps at faster time scales (4-9 seconds) than existing methods
- Uses whole-brain voxel-level activation maps to reveal the overall shape of brain dynamics
- Tracks transitions in brain states at highest temporal resolution

Publications

- Saggar M, Sporns O, Gonzalez-Castillo J, Bandettini PA, Carlsson G, Glover G, Reiss AL. Towards a new approach to reveal dynamical organization of the brain using topological data analysis. Nat Commun. 2018 Apr 11;9(1):1399.

Patents

- Published Application: 20190120919
- Published Application: WO2019084327
- Published Application: 20220365157
- Issued: 11,333,730 (USA)
- Issued: 11,693,071 (USA)

Innovators

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