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Network curvature as a hallmark of brain structural connectivity

A novel method to quantify robustness for brain networks against damage caused by lesions, traumatic brain injury, or aging.

Technology No. 2021-032

IP Status: Copyrighted software

Applications

- MRI based biomarkers for disease development and progression.

Technology Overview

Researchers at the University of Minnesota have developed a novel method to quantify robustness for brain networks against damage caused by lesions or traumatic brain injury. In this method, the concept of graph curvature is used for studying brain structural connectivity networks. Specifically, the Ricci curvature and its contraction, the scalar curvature, is used on brain networks to assign curvature at each individual node. Using this, two distinct brain structural connectivity analysis can be performed. First, areas of the brain that significantly contribute to the overall brain robustness can be identified, and hence identify “important” nodes in brain networks. In this method, node curvature not only corroborates findings based on strength and centrality measures, but additionally finds other key areas (e.g., inferior-frontal gyrus, middle-frontal gyrus, and inferior-temporal gyrus), which are not identified by any other node measure, and are important parts of the brain network. Second, by looking at differences in node curvature, one can identify brain areas with changes due to age, or abnormal neurodevelopmental disorders such as autism spectrum disorders (ASD). In particular, researchers have shown that node curvature uniquely enables the identification of certain brain areas, with significantly affected structural connectivity in people with ASD.

Phase of Development

TRL: 4-5
Working prototype in MATLAB

Desired Partnerships

This technology is now available for:

- License
- Sponsored research
- Co-development

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Researchers

- **Christophe Lenglet, PhD,** Associate Professor, Department of Radiology

References

Farooq, Hamza, Yongxin Chen, Tryphon T. Georgiou, Allen Tannenbaum, and Christophe Lenglet., https://doi.org/10.1038/s41467-019-12915-x, Nature communications 10, no. 1 (2019): 1-11.

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