



BrainGraph: A Novel Visualization of MRI Data as a 3D Graph to Reveal Temporal Features of Disease Progression In Patients with Multiple Sclerosis

David Hughes BSN¹, Weidong Yang PhD², Kelly Leyden MRes¹, Michael Iv MD^{1,3}, Anisha Keshavan PhD¹

¹Octave Bioscience, Menlo Park, CA, United States of America, ²Kineviz, San Francisco, CA, United States of America

³Stanford University, CA, United States of America

DISCLOSURES



Kelly Leyden, MRes
Product Lead - MRI Insights
Employee of **Octave Bioscience**



David Hughes, BSN
Principal ML / Graph Data Engineer
Employee of **Octave Bioscience**



Weidong Yang, PhD
CEO
Kineviz Inc.



Anisha Keshavan, PhD
Senior Data Scientist
Employee of **Octave Bioscience**

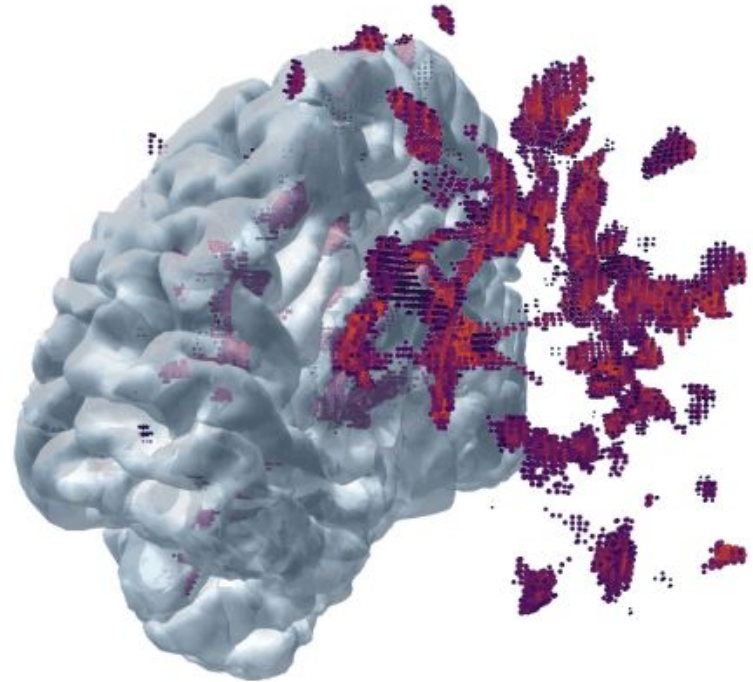


Michael Ivy, MD
Neuroradiologist
Octave Bioscience
Clinical Associate Professor of Radiology
Stanford University

Contribution to this study was as a paid consultant, and was not part of his Stanford University duties or responsibilities

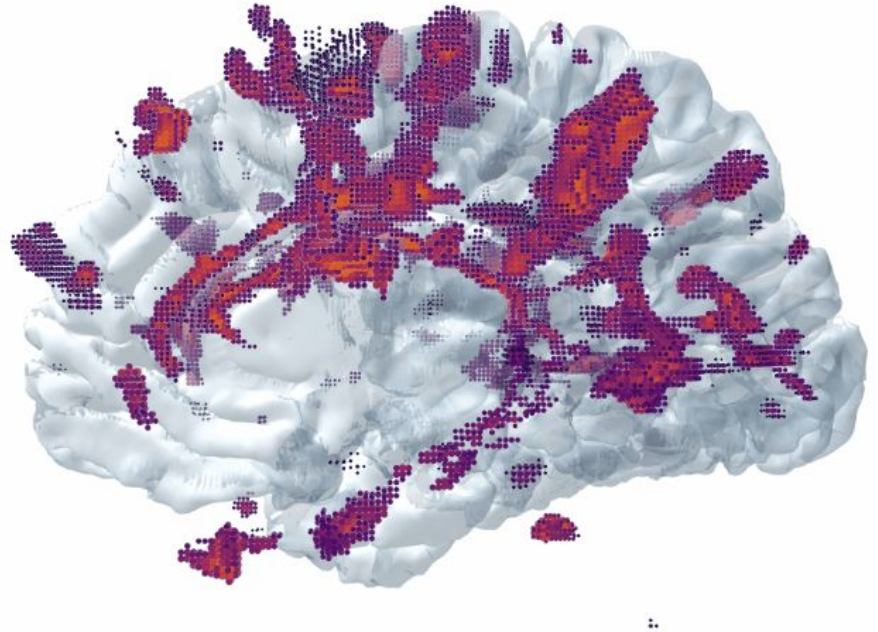
Data Visualization leads to insights

- Novel, interactive visualization of neuroimaging data can advance:
 - Patient education
 - Clinical insights
 - Image analysis capabilities



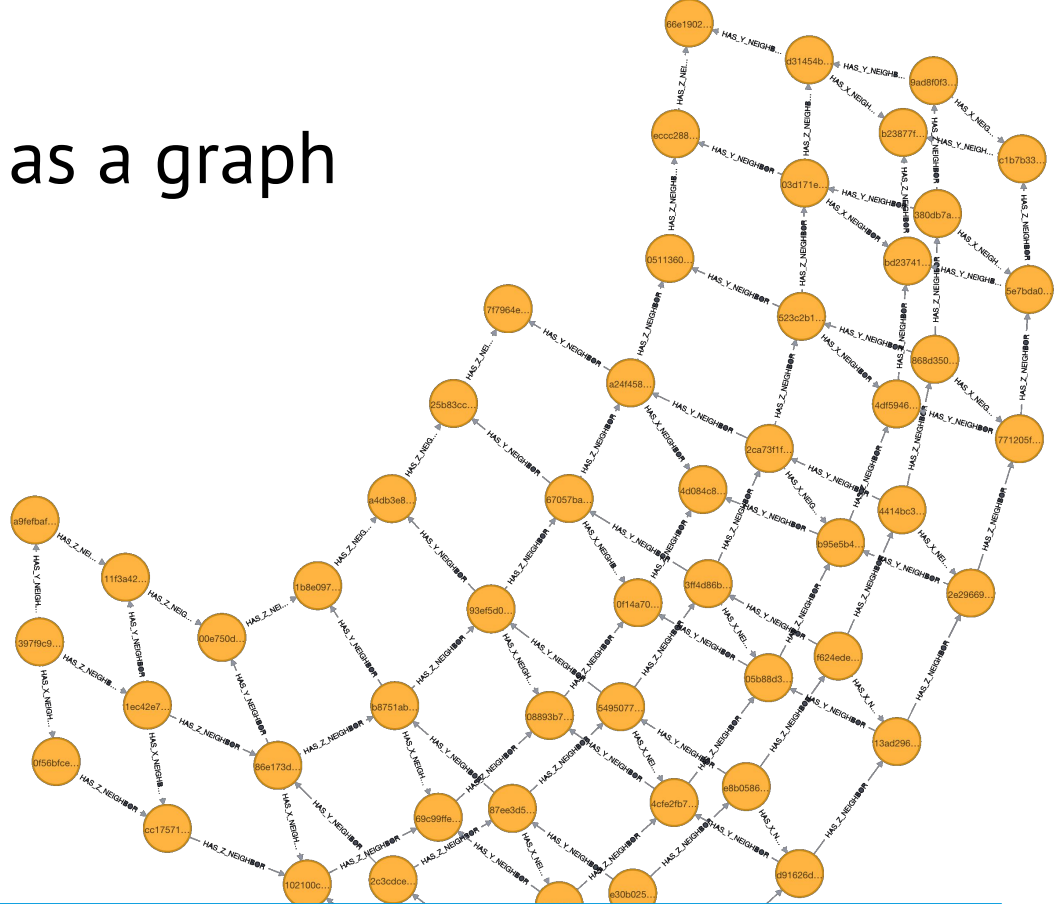
Reveal the topology and temporal nature of MS disease progression

- **increase in lesion count:**
 - A new lesion, OR
 - A lesion partially remyelinating and splitting
- **decrease in lesion count:**
 - A remyelinated lesion, OR
 - Two lesions merging together
- 3D temporal model could resolve ambiguity →



Represent imaging data as a graph

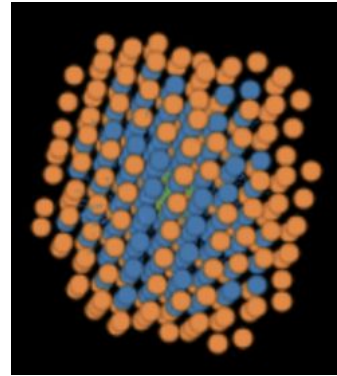
- Explicitly encode spatial and temporal relationships between voxels
- Exposes method for efficient queries of these relationships
- Leverages analytics that are uniquely enabled by graph algorithms



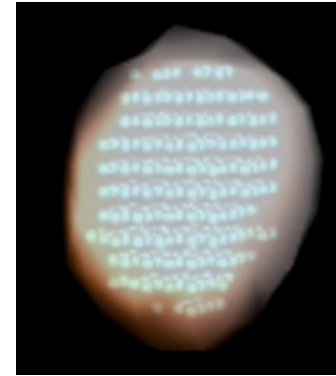
Internal graph representation of an MRI: voxel at $x,y,z=1,1,1$ is a neighbor of voxel 1,1,2

Graph modeling and analysis on the cloud

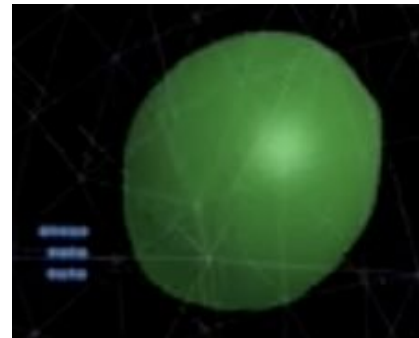
- Graph modeling strategy:
 - X,Y,Z and time relationships encoded on a per-voxel basis
 - Extract spatial and temporal lesion communities
 - Graph queries to identify lesion surface nodes and **connect lesions over time**
- Benefits of the cloud:
 - Analyze data at scale
 - Access visualization on the browser from any device
 - Can support multiple users at once



Lesion community



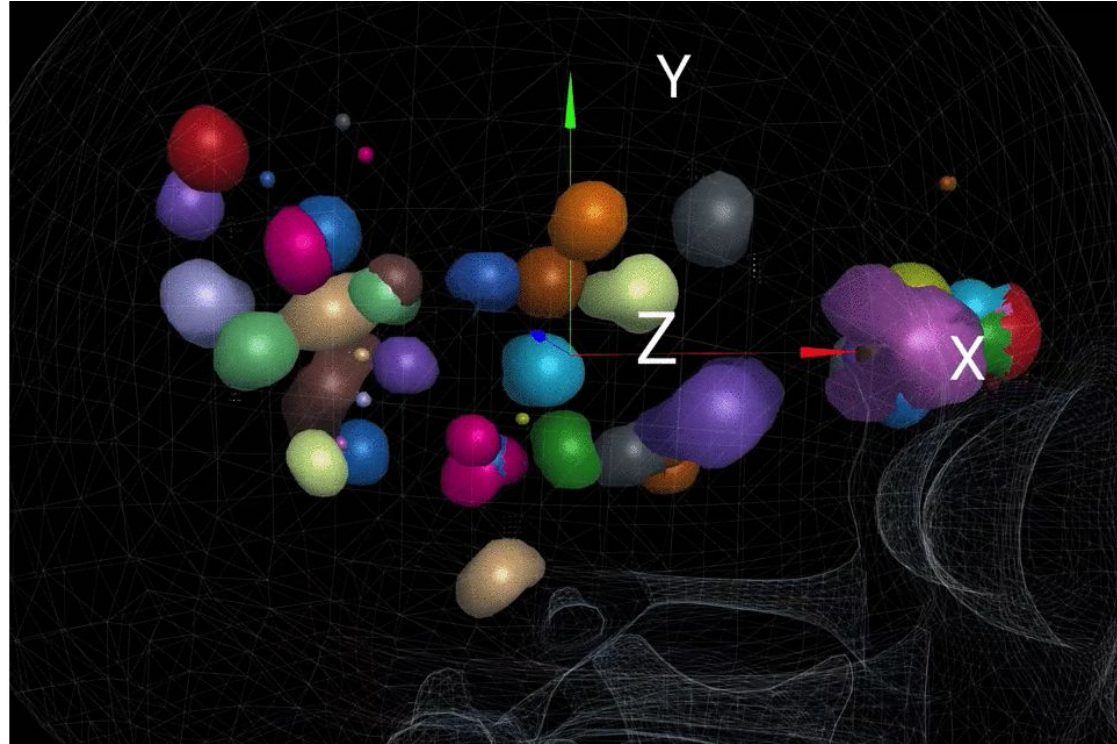
Lesion surface



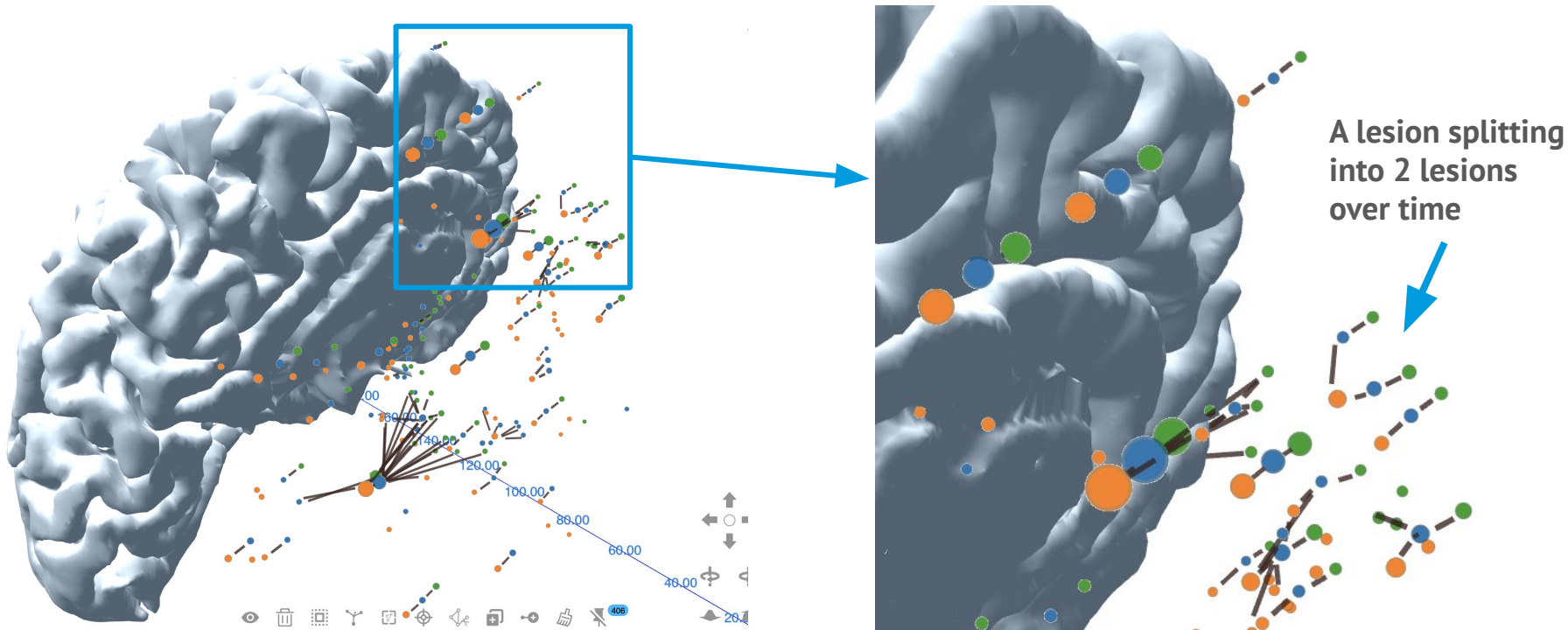
Lesion shell

Lesion evolution over time

- Enables user to view and interact with lesion changes over time
- See how lesions change relative to one another and relative to brain anatomy

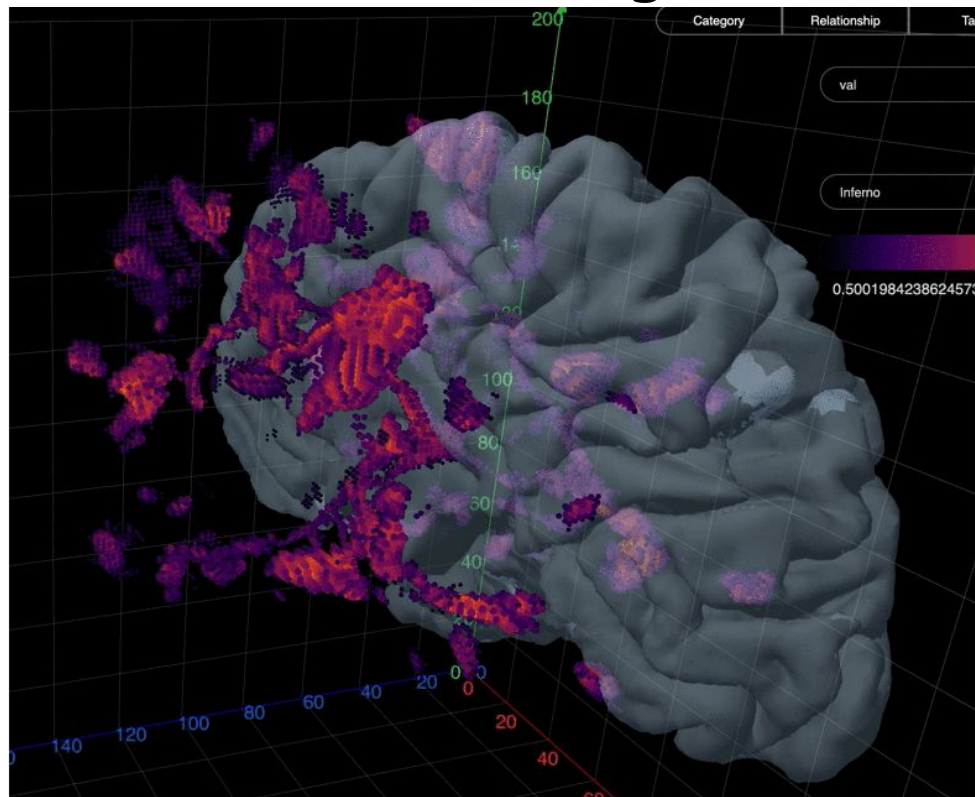


Lesion evolution over time: alternate view



Graph visualization resolves lesion count ambiguities

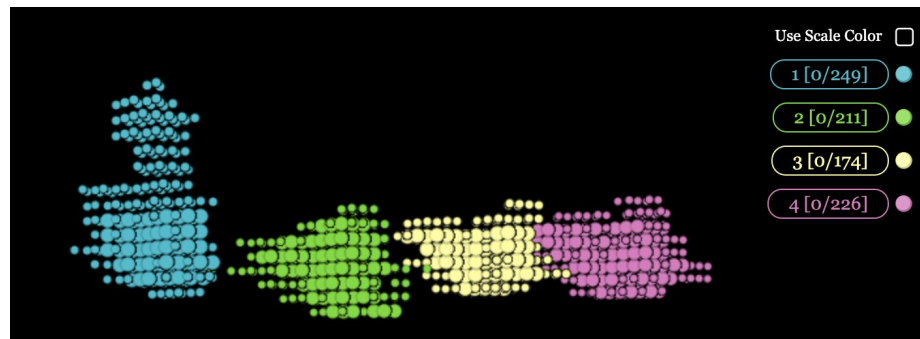
- Can *quickly* resolve temporal lesion count ambiguities visually
- Can also compute metrics:
 - Volumetrics per lesion
 - Shape Analysis per lesion
 - Texture Analysis per lesion



reveal internal lesion texture

Visualizing quantitative lesion metrics in the clinic

- Educational tool for patients
- Improve understanding of quantitative metrics in MRI reports (see poster **P0590**) with an accompanying visualization for neurologists



lesion evolution over four time points show consolidation

Questions?

Contact us: dhughes@octavebio.com, akeshavan@octavebio.com

Visit additional posters with Octave Bioscience

P0055

P0063

P0082

P0091

P0583

P0590

