Network Flow: Visualizing Neurological Connectivity

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dub design use build university of washington

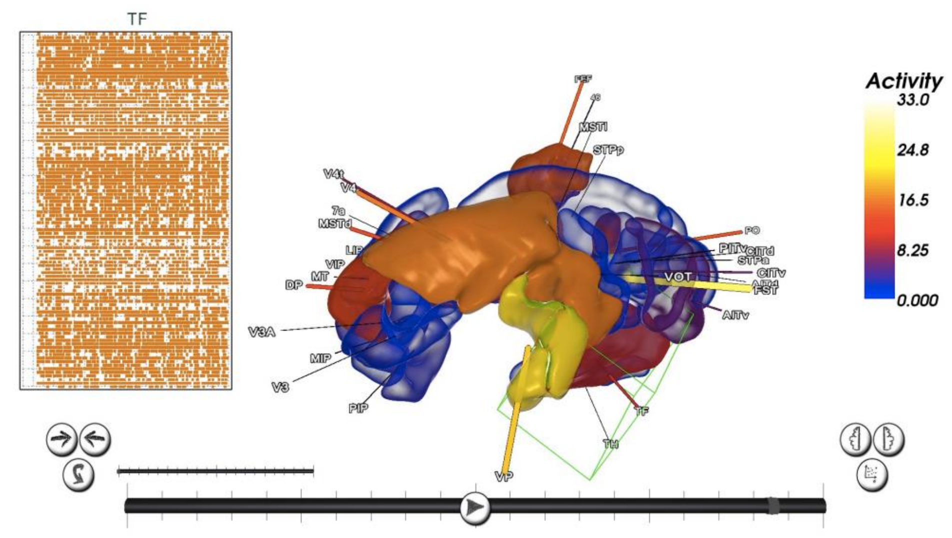
Problem

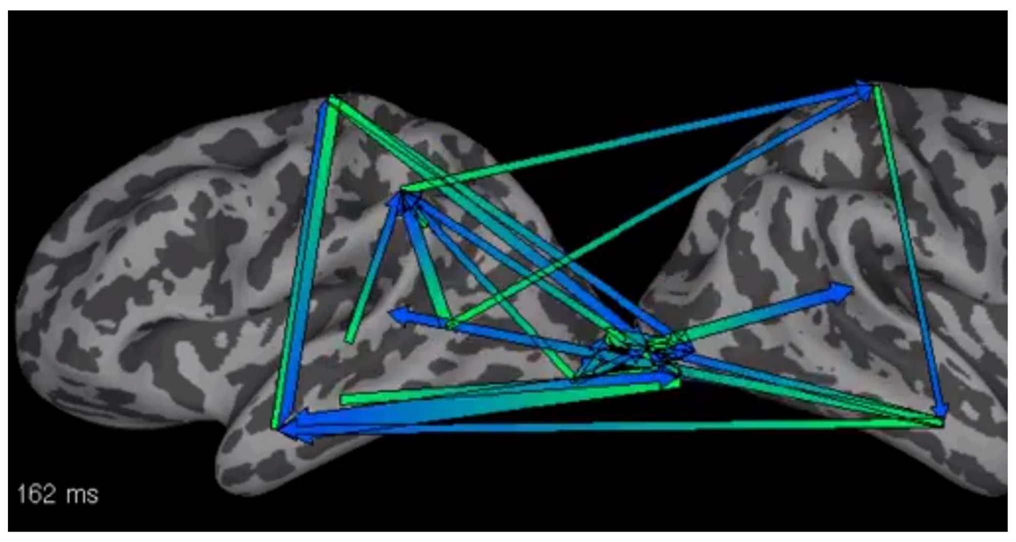
Dense, time-varying network flows present visualization challenges, including:

- High number of edges
- Competitive visual information
- Difficult to interpret

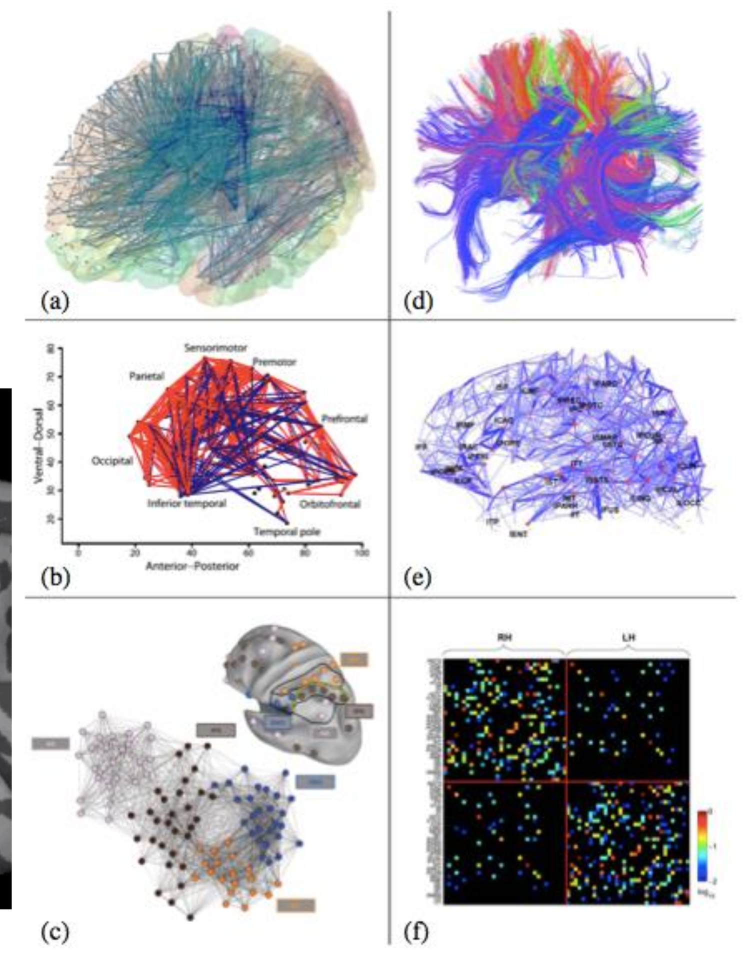
We consider neurological connectivity data, derived from EEG & MEG, to address:

- Ease of use for non-experts
- Dense, highly connected networks
- Selection bias to show only supporting data





Prior Work focuses on:



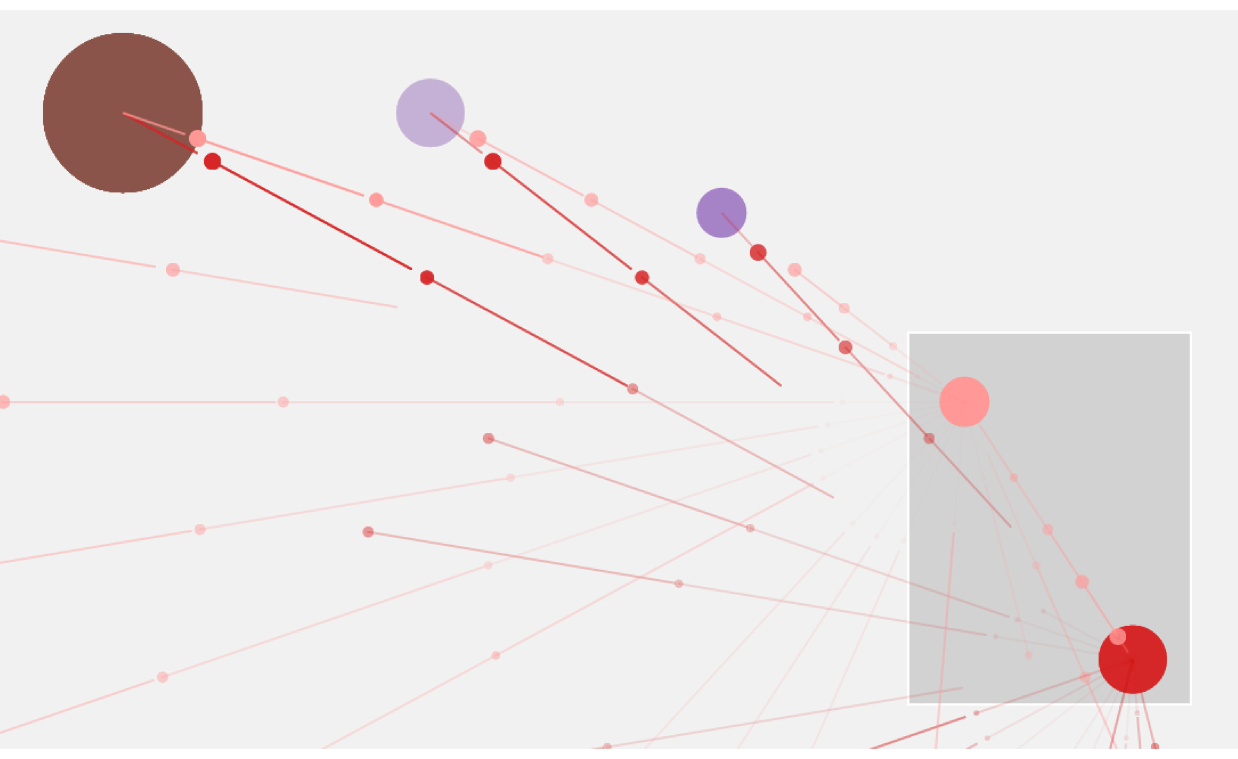
Physical brain layout to give domain context (ie known functional areas)

Showing dense connectivity graphs over longer time intervals

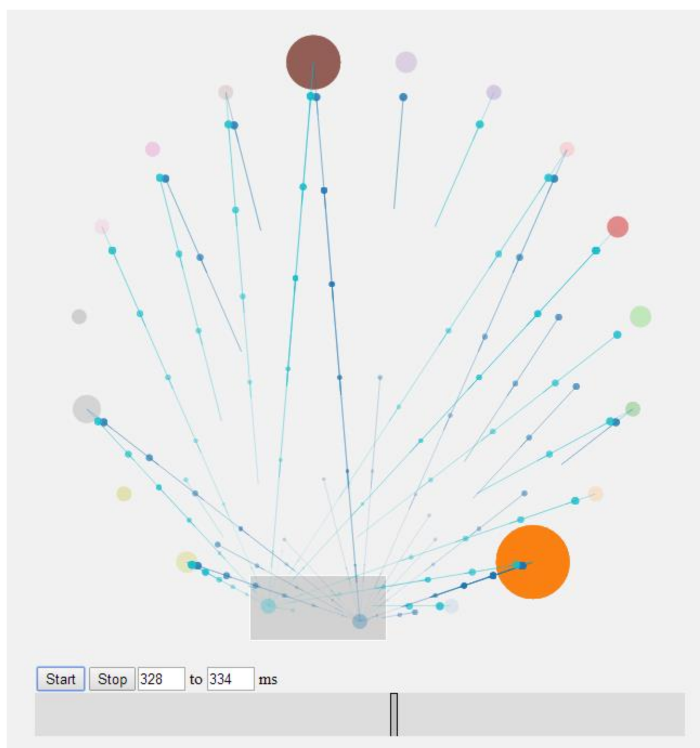
Lacks uncertainty measures or visual hypothesis testing

Time Animation and Filtering

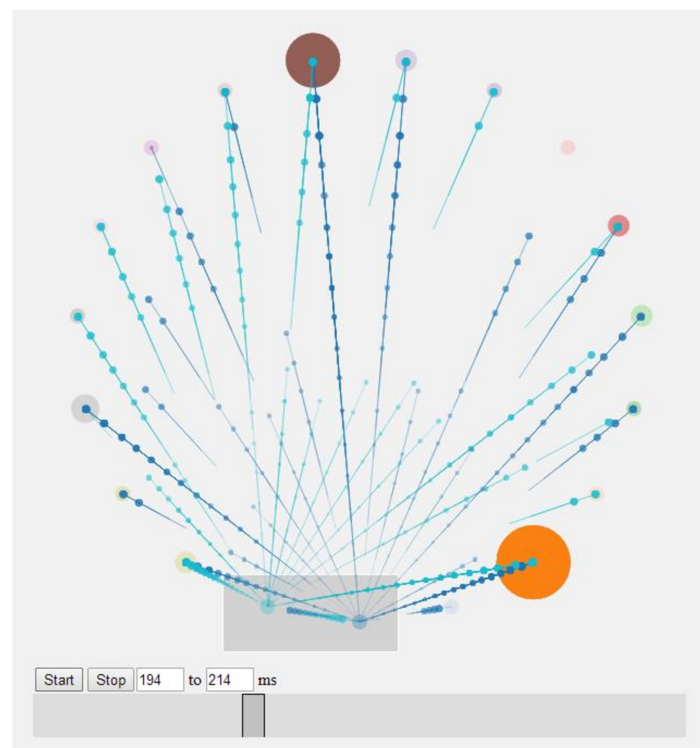
Show packets moving over time

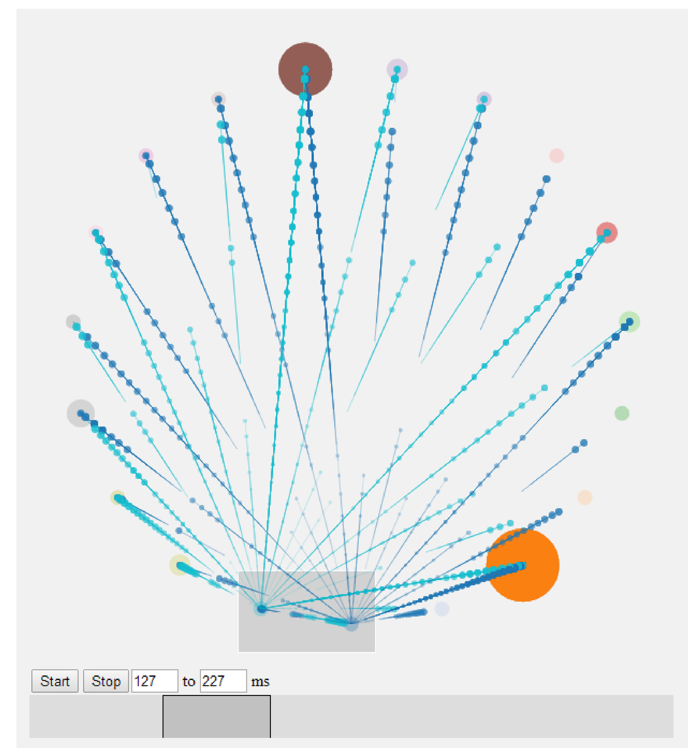


Time - start, stop, and loop



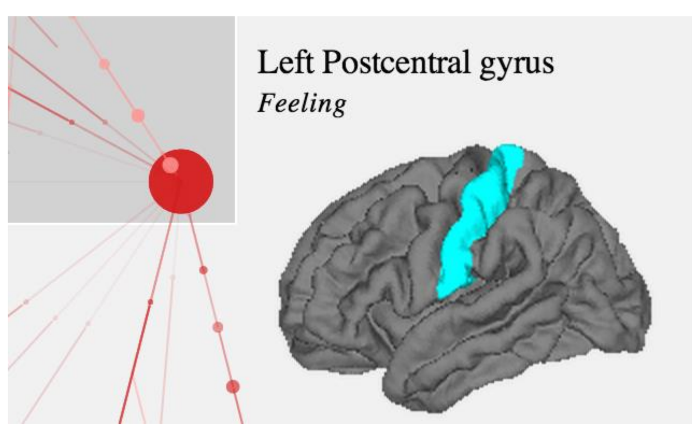
Brush to change fraction of graph shown





Filtering and Comparison

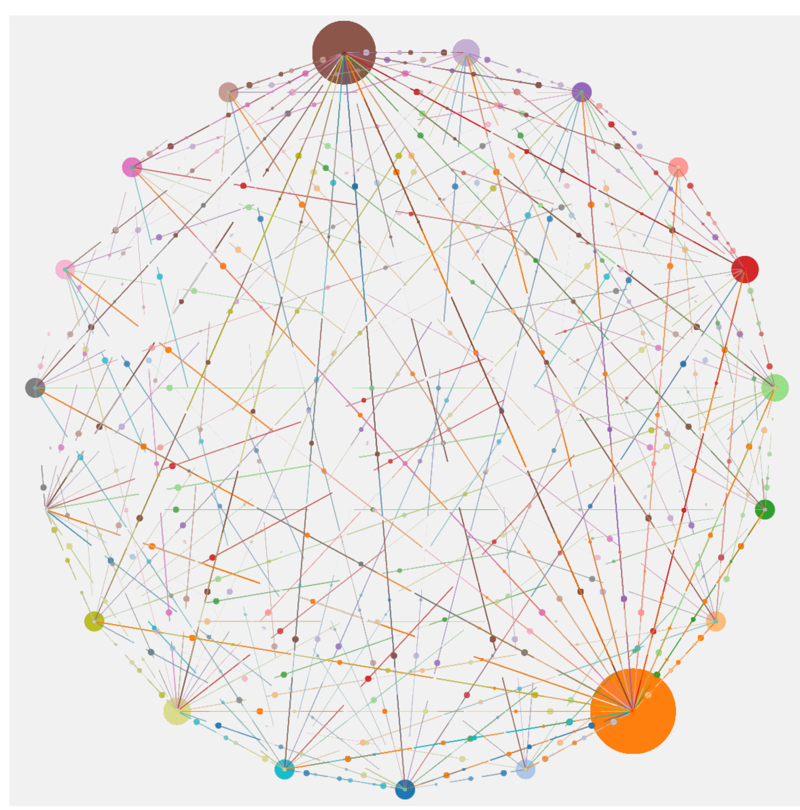
Grouping Areas to Reduce Nodes

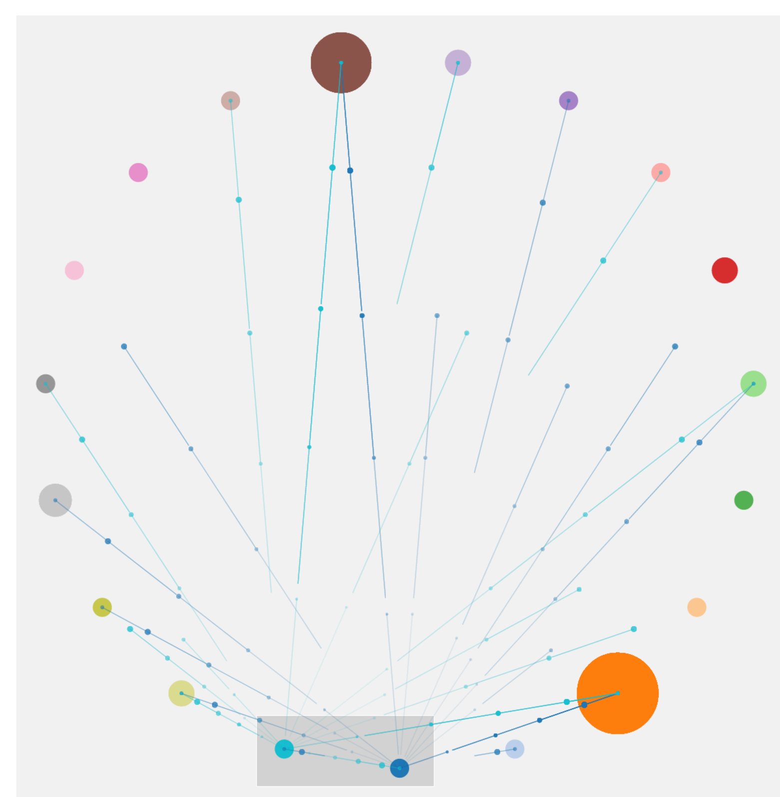


Tooltips with Domain Knowledge

Brushing

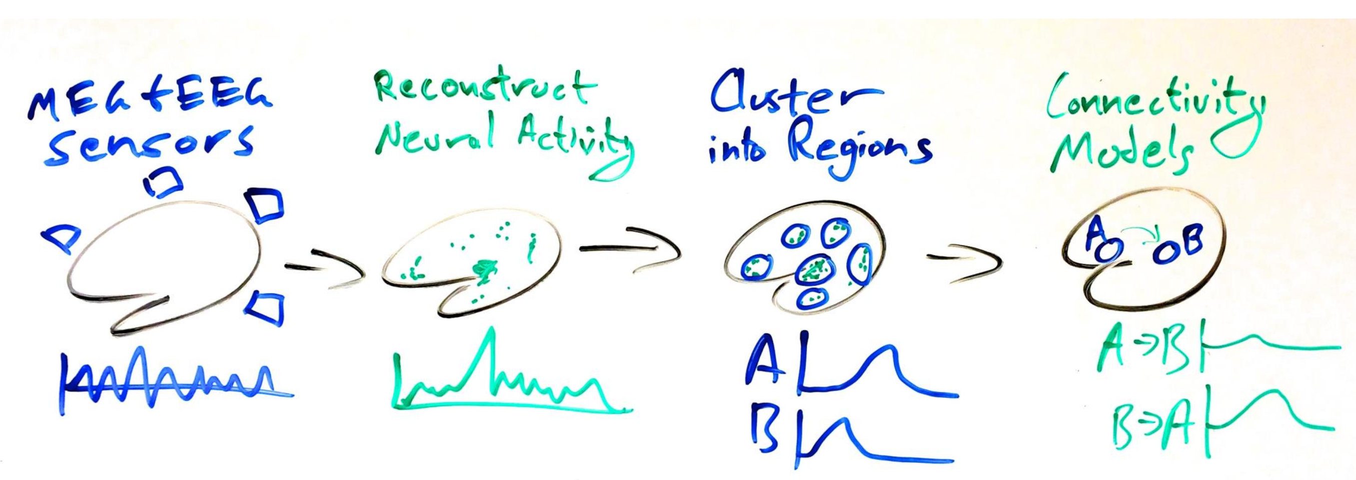
Allowing users to select subsets of nodes



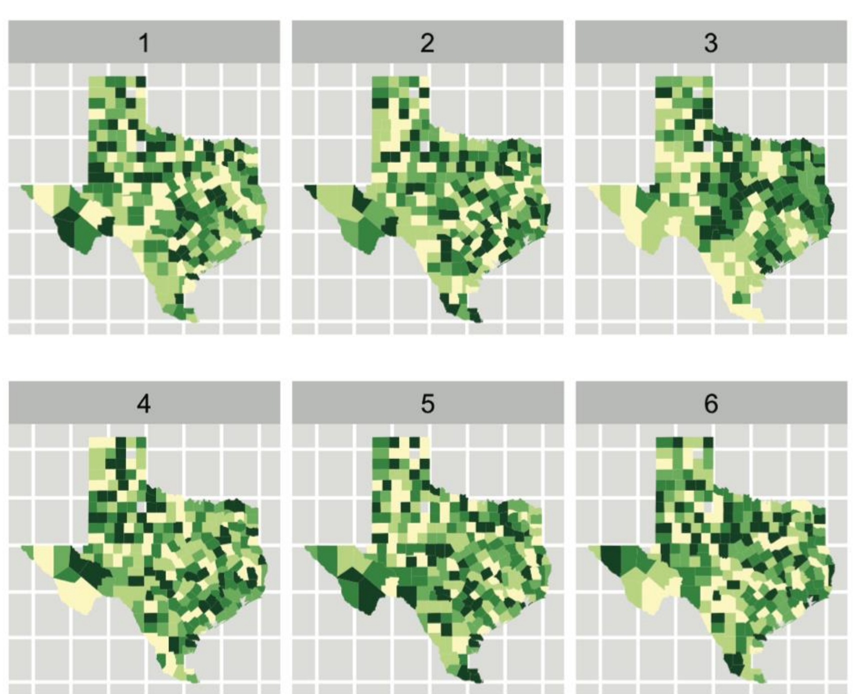


Visual Hypothesis Testing

Functional connectivity is derived from raw data fed through three layers of complex mathematical models.



Visual hypothesis testing [3] can show random data passed through the same process – are the patterns found in actual data also seen in random data?



We propose comparing to data from different functional tasks (distinguishing between real words and nonsense words), already present from neurology experiments. From our computer science background, we also propose generating directed graphs with the same in and out degree distributions by node or marginally for the entire graph.

References

[1] VisNEST - Interactive Analysis of Neural Activity Data, Nowke et al.

[2] Rules from Words: A Dynamic Neural Basis for a Lawful Linguistic Process, David W. Gow et al.

[3] Graphical Inference for Infovis. Hadley Wickham, et al.