OD Morphing: Balancing Simplicity with Faithfulness for OD Bundling

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Origin – Destination (OD) Bundling

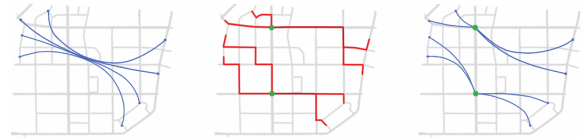
- Simplify origin to destination patterns using *edge bundling.*
- Addresses *hairball* problem associated with networks.

Bundling Trade-Off

Bundling sacrifices faithfulness, suggests unrealistic movement

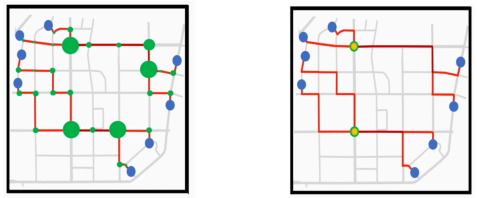
Balancing trade-offs with OD Morphing

- Iteratively identifies critical waypoints
- Add smooth transitions for interactivity



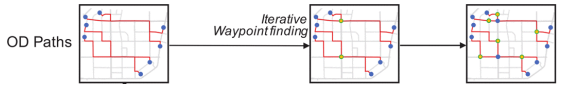
Waypoint Finding

- Maximize importance of waypoints, but minimize the number of them
- Variant of min cut network flow problem



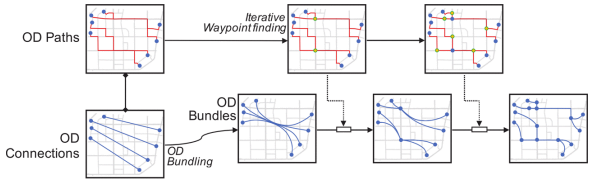
Iterating Waypoints

- Divide paths into subpaths at waypoints and search again
- Iteration ends when no subpaths contain intermediate vertices



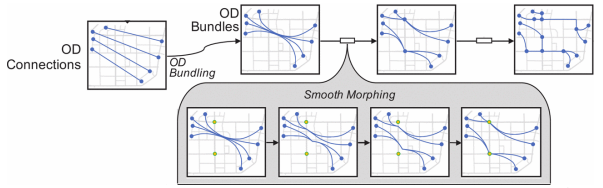
Apply Bundling

- At each waypoint frame, calculate OD Bundles



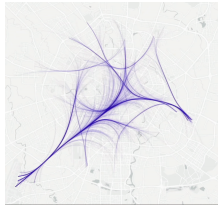
Smooth Morphing

- Add smooth animation from one waypoint frame to the next, eyes beat memory!
- Visualization allows users to scrub through animation



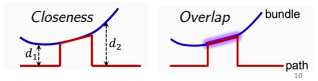
Final Visualization

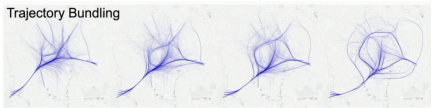
- Visualization allows users to see simple OD structures, but also more geographically faithful paths
- Users can observe where critical waypoints exist as vis becomes more faithful



Evaluation

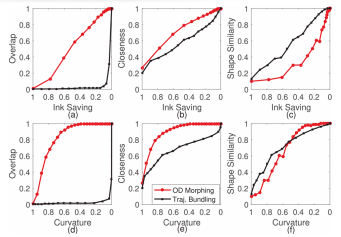
- Faithfulness
  - Overlap
  - Closeness
  - Shape (Fréchet Distance)
- Simplicity
  - Ink Used
  - Curvature
- Baseline
  - Trajectory Bundling





Results

- Based on Simplicity and Faithfulness metrics, provides better tradeoffs than trajectory bundling
- Domain experts (3) gave positive review
  - "It's very cool."
  - Gave constructive critiques (color and interactivity)



Critique

- Color
  - Waypoints can be difficult to see, displayed as light green on blue/purple bundles.
  - Figures are significantly more difficult to decipher printed out on black and white.
  - Bundles could be identified by color (experts' recommendation)
- Evaluation
  - Faithfulness / Simplicity metrics helped to convince, but semi-structured expert interviews left more to be desired.
  - Only two datasets used. how difficult it is to make data usable with this tool? One dataset is filtered based on length and time, possibly to highlight OD patterns.
- How useful to domain users in real-world settings without prepared data?

Thank you, Questions?