Mixed Metro Maps with User-Specified Motifs

Tobias Batik[1], Soeren Nickel[1], Martin Nöllenburg[1], Yu-Shuen Wang[2], and Hsiang-Yun Wu[1]

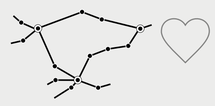
[1] TU Wien, Austria
[2] National Chiao Tung University, Taiwan

Problem

- Some metro maps follow a mixed layout style, where some parts are arranged in an iconic shape and some in an octolinear style.
- Previous approaches aim for a single style (e.g., octolinear or curvilinear layouts). [1]

Input

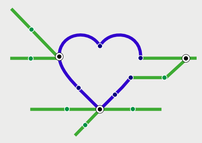
- A metro graph G = (V,E) with geographic coordinates.
- A user-defined guide shape represented as a polyline.



Left: Metro graph; Right: Guide shape

Output

- Mixed layout with octolinear and smooth edges.
- Guide shape is recognizable.
- Classical design criteria are fulfilled.
- Suitable for navigation purposes.



Blue: Smooth edges; Green: Octolinear edges

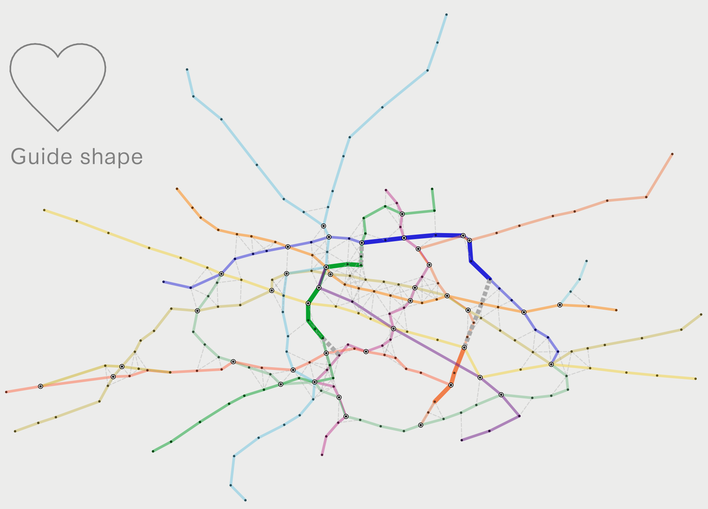
Contribution

- An approach to solve a mixed layout problem with a user-defined guide shape as input.
- A deformation process to arrange parts of a metro map in a user-defined guide shape.
- A Method to detect paths that are similar to the guide shape.

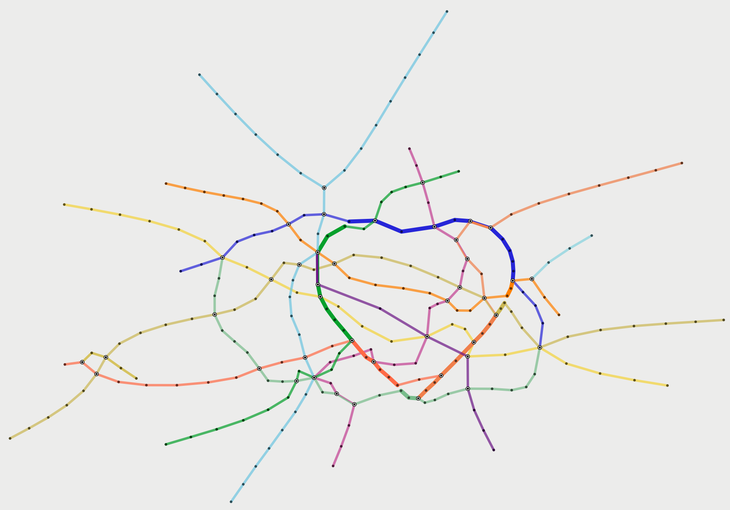
Smooth objective function
- Guide shape approximation
- Geographical accuracy
- Max. angular resolutions
- Uniform edge lengths

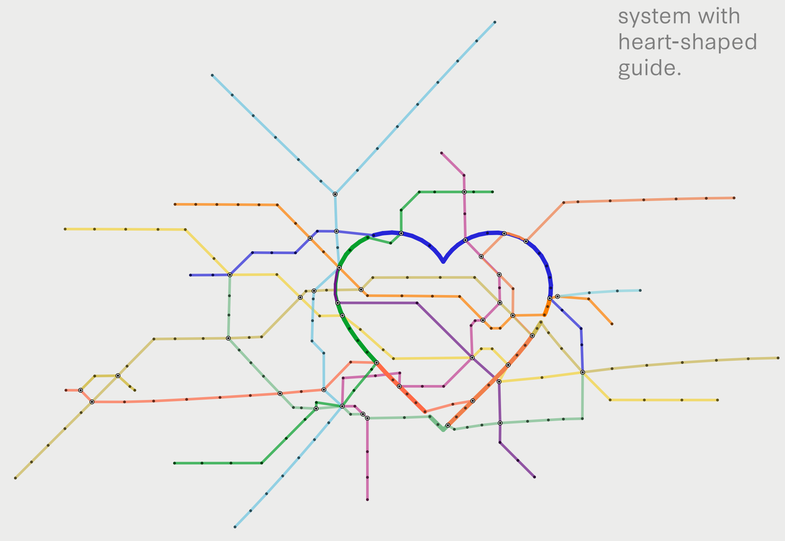
Mixed objective function
- Guide shape approximation
- Geographical accuracy
- Octolinear slopes

Three-step process



Guide shape





Paris metro system with heart-shaped guide.

1. Find a target path in the metro graph

- Djikstra-like approach with Direction-Based Fréchet Distance.
- Align the target path and the input guide shape (scaling, translating).

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2. Smooth layout

- Deform the graph by minimizing the objective function.
- Create a layout that avoids twisted metro lines and approximates the guide shape.

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3. Mixed layout

- Differentiate between smooth and octolinear edges.
- Edges are either drawn with an octolinear slope or aligned to a section of the guide shape.
- Created using least-squares optimization.

Paris metro map consisting of 236 stations and 268 edges.

Cloud-shaped guide consisting of 53 line segments.

Guide shape

[1] Wu, H.Y., Niedermann, B., Takahashi, S., Roberts, M.J., Nöllenburg, M.: A survey on transit map layout from design, machine, and human perspectives. Computer Graphics Forum (Special Issue of EuroVis 2020) 39(3) (June 2020). https://doi.org/10.1111/cgf.14030