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P14 Improved Road Network Reconstruction using Discrete Morse Theory

Tamal K. Dey, Jiayuan Wang, Yusu Wang
Department of Computer Science and Engineering, The Ohio State University, Columbus, Ohio 43210

Main Result

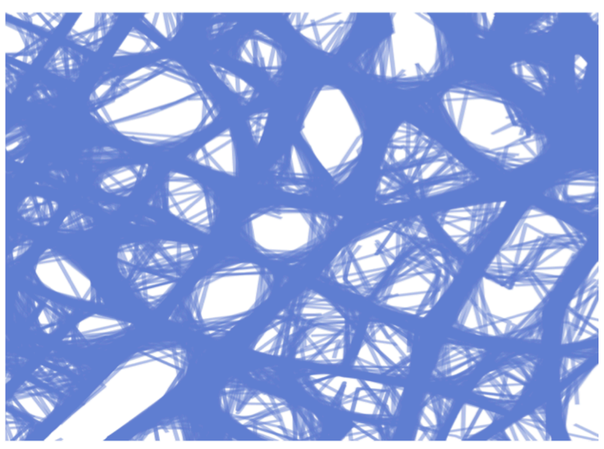
We provide two improvements of the previous algorithm [1]:

1.Two simplifications to improve the running time.

2.Editing strategies to add missing branches and loops.

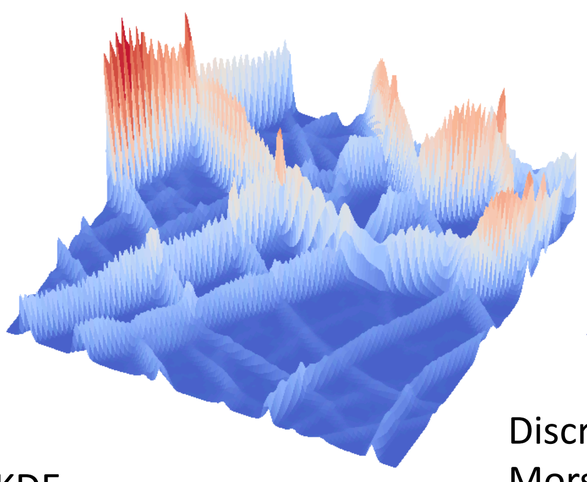
[1]:Wang, S., Wang, Y., & Li, Y. 2015. Efficient map reconstruction and augmentation via topological methods. In *Proc. 23rd SIGSPATIAL.* ACM, 25.

Pipeline of Algorithm [1]



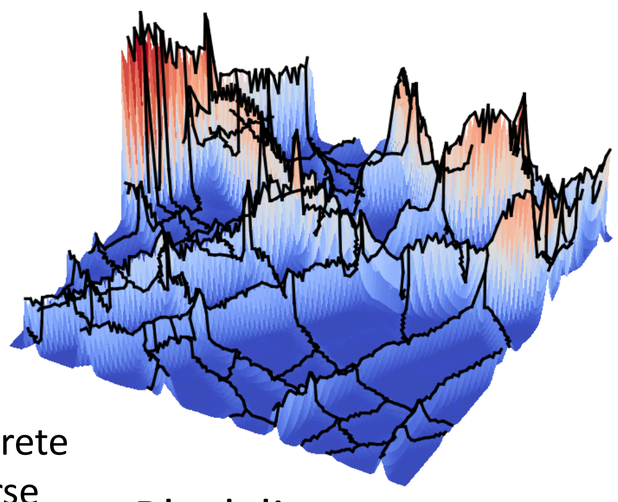
Input: GPS trajectories

KDE

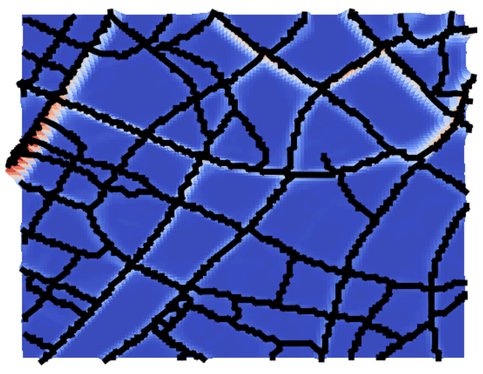


Density map

Discrete Morse theory



Black lines: output of algorithm[1]

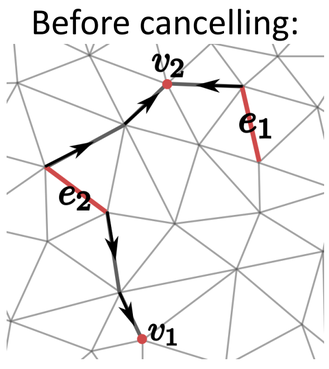


Top view of the output

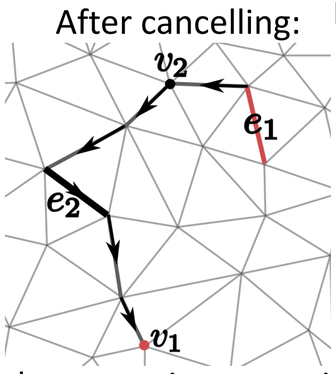
Simplifications

Vertex-edge pair, cancellation of $<v_2, e_2>$:

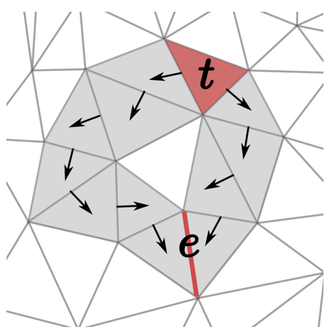
Before cancelling:



After cancelling:

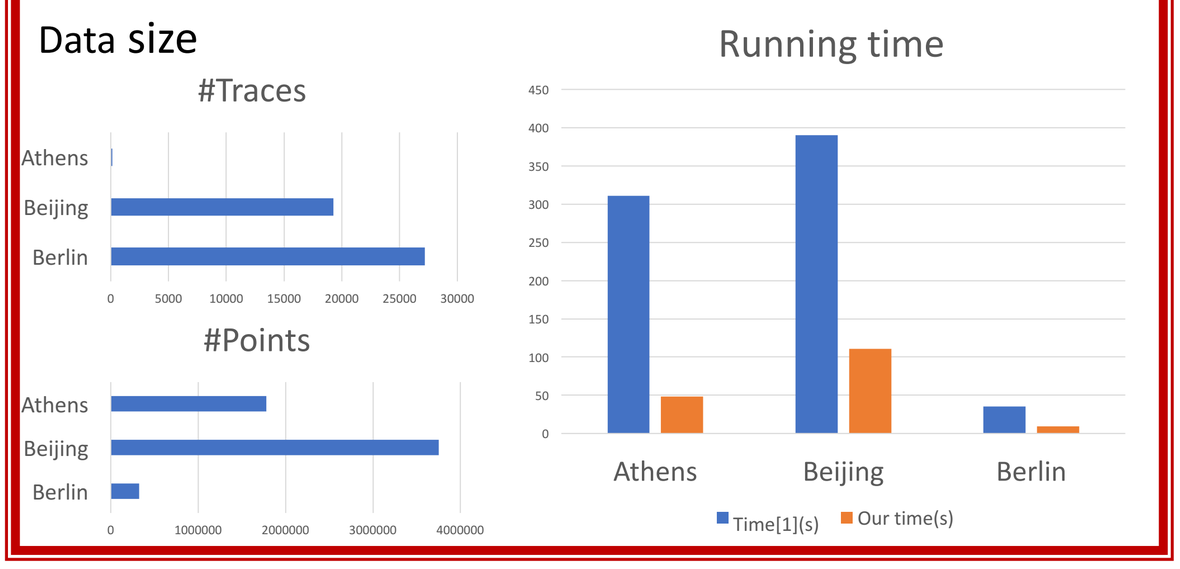


Edge-triangle pair,
Example: Not cancellable



1. No need to check whether a persistence pair is cancellable.
2. No need to cancel edge-triangle pairs .

Running Time Improvement



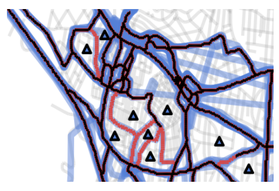
Editing Strategies

Athens

Add branches: Click at the end of missing branches.

Add loops: Click triangles at regions with missing roads that form loops.

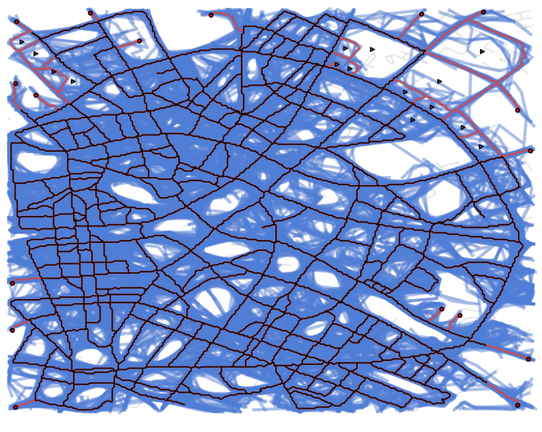
The idea is to modify the value of the density map at the chosen vertices.



Adding extra triangles will capture more loops. One loop needs one triangle .

Blue curves:
Input GPS trajectories
Black curves:
Original reconstruction
Red curves:
Newly added branches

Berlin



Acknowledgment

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