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Effective Map-matching on the Most Simplified Road Network

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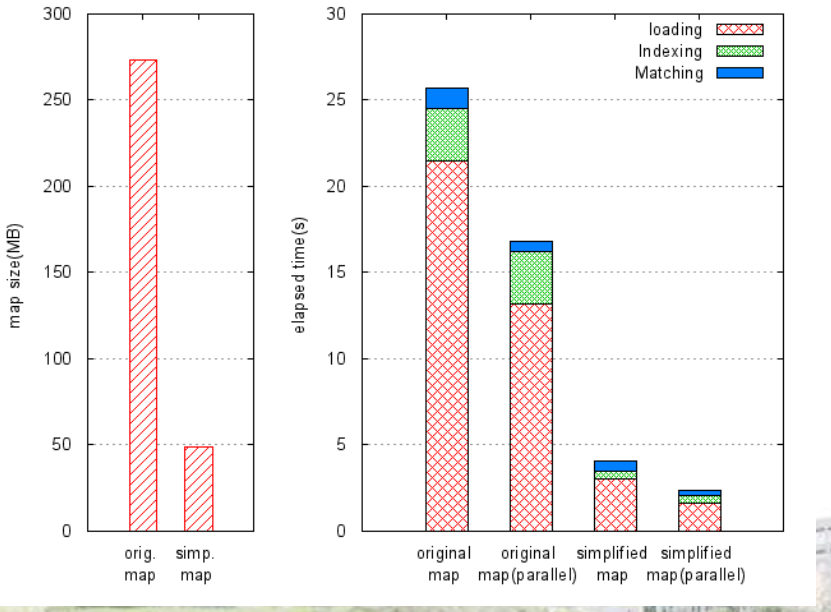
Map-matching on the Simplified Road Network: Why?

- **Motivation**
  - Some maps are simplified naturally.
  - Some terminals have limited memory.
- **Result**
  - Map size:
    - 273.5MB ➔ 48.6MB.
  - Speed up
    - Indexing: 3s➔0.48s
    - Matching: 1.2s➔0.58s
  - Accuracy
    - 1hz GPS: 95.629%

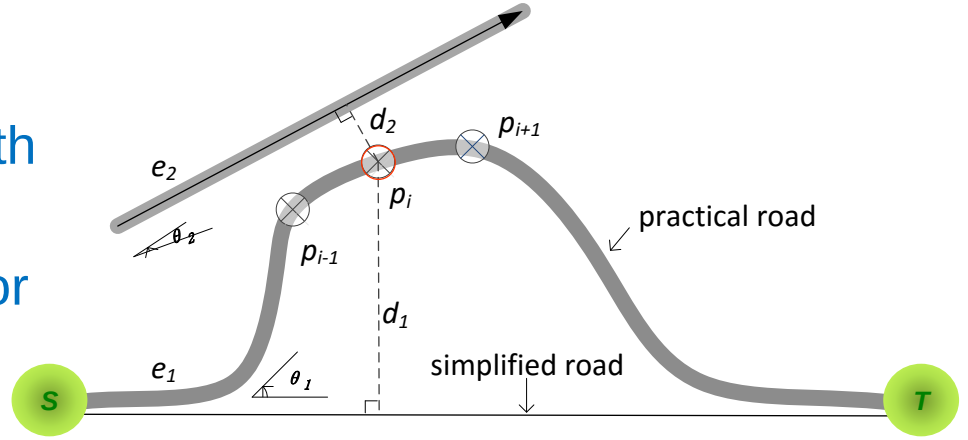
Table 1: Original road edge vs. most simplified one.

Type	Attributes
Original	$id, name, type, length, speed\ limit, width, start, p_1, p_2, ..., p_n, end, etc.$
Simplified	$id, start, end$

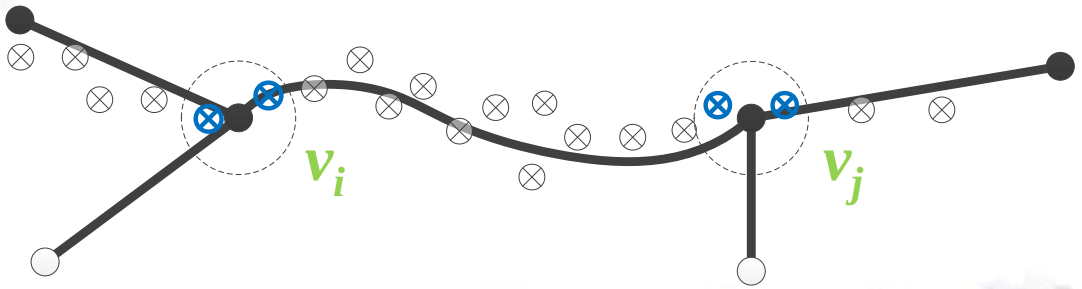


Proposed Method: *Passby* (1/2)

- **Example**
  - An object *o* moving on road e_1, with sampled positions P_{i-1}, P_i, P_{i+1},…
  - Should P_i be matched to road e_1 or road e_2?



- **Basic idea**
  - We can reduce the uncertainty of map-matching by considering both intersections which object *o* has passed and will pass by next.

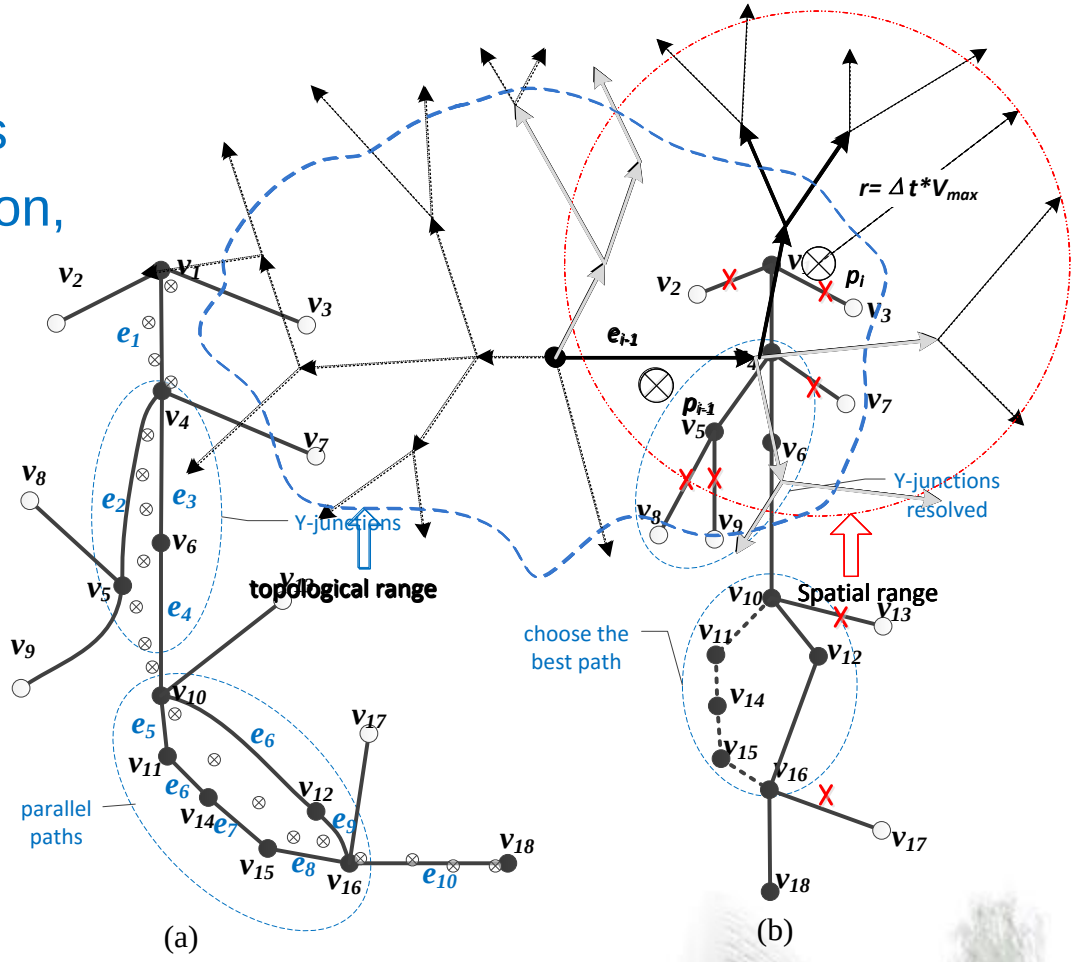


Unfortunately, it applies to high-sampling-rate trajectories only.

Proposed Method: *Passby* (2/2)

- **Challenges**
  - Low sampling rate trajectories
  - Other problems, e.g., Y-junction, Parallel pathways, tunnel

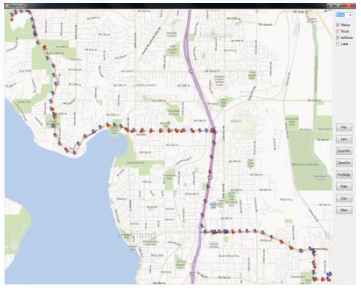
- **Improved approach**
  - Search Space
    - 1. Topological constrains
    - 2. Spatial constrains
    - 3. Temporal constrains
  - Ranking with weighted sum strategies



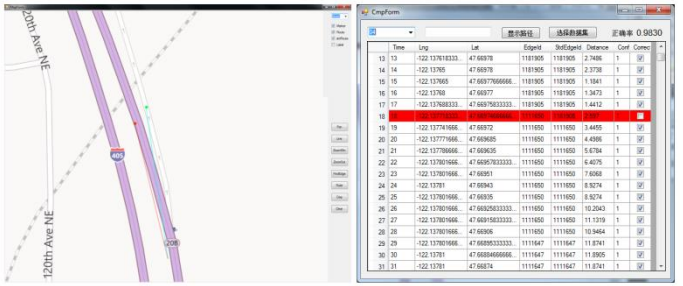
***Passby* shoots more than 60% (15s). Now, much better!**

Some supplementary mechanisms & tools

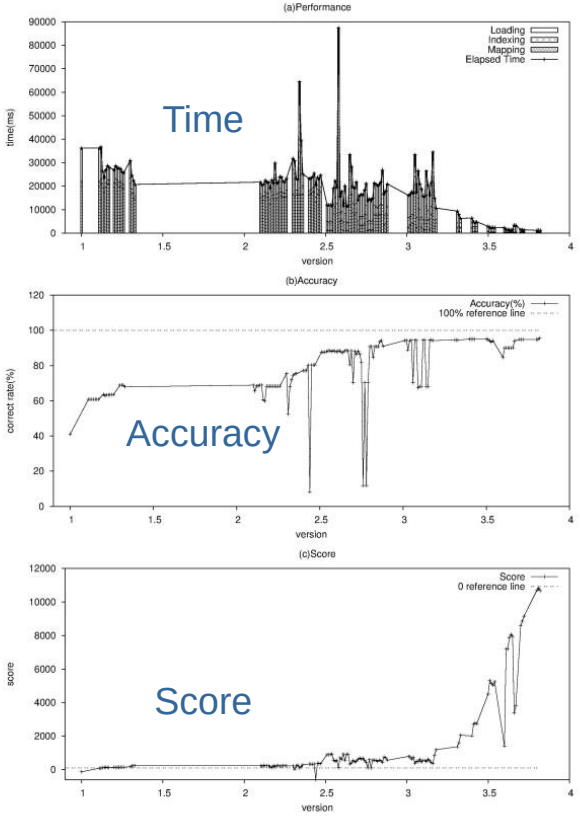
- **Fast Angle Calculation**
  - Hash tables: *arctan*, *cosine* and *sine*
- **Parallelized Matching Process**
  - Matching(1hz) with OpenMP: 0.58s➔0.3s
- **Outlier Identification**
  - Topology connectivity and path reversibility
- **Visualization Tools**



(a) Matching result



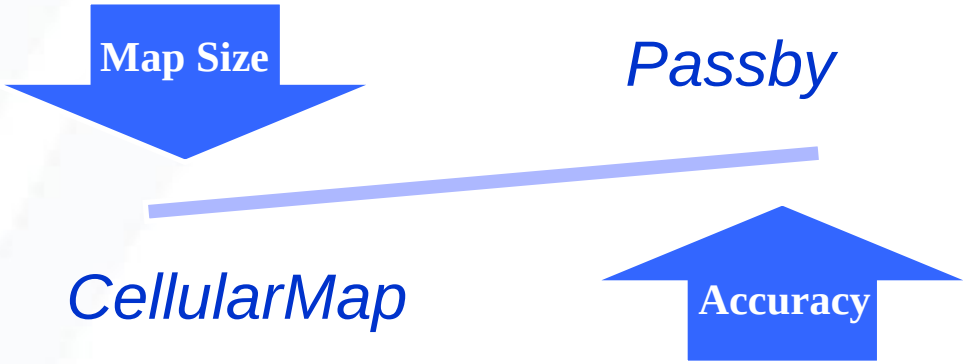
(b) Error debugging



(c) Log analyzers (1hz)

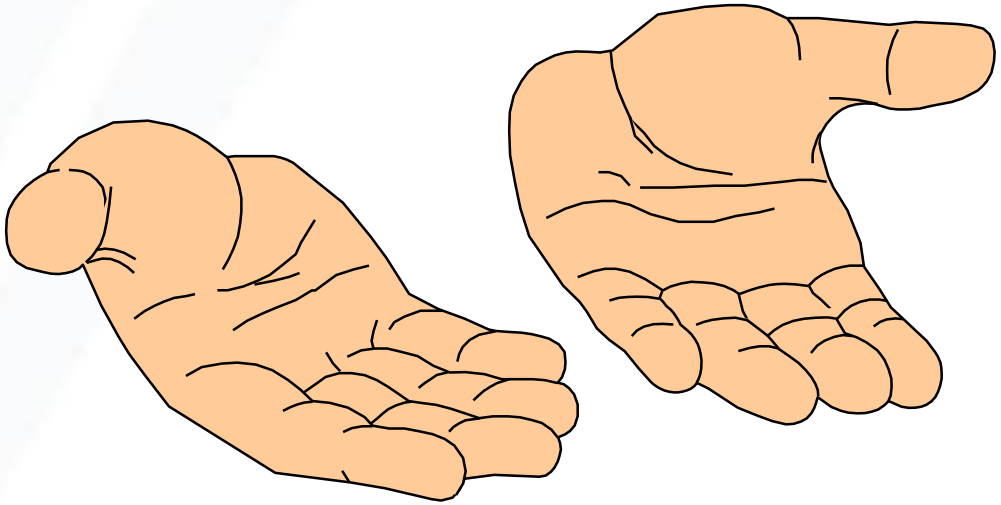
On-going works

- ***Passby*** **under extending**
  - given a simplified map, how to improve the matching accuracy as much as possible.



- ***CellularMap*** **under construction**
  - given an acceptable tolerance, how to compress/simplify the underlying road network as much as possible.

Your Comments are Welcome!



The picture is borrowed from Prof. T.H. Tse's slides