

There and Back Again: Using Fréchet-Distance Diagrams to Find Trajectory Turning Points

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Problem

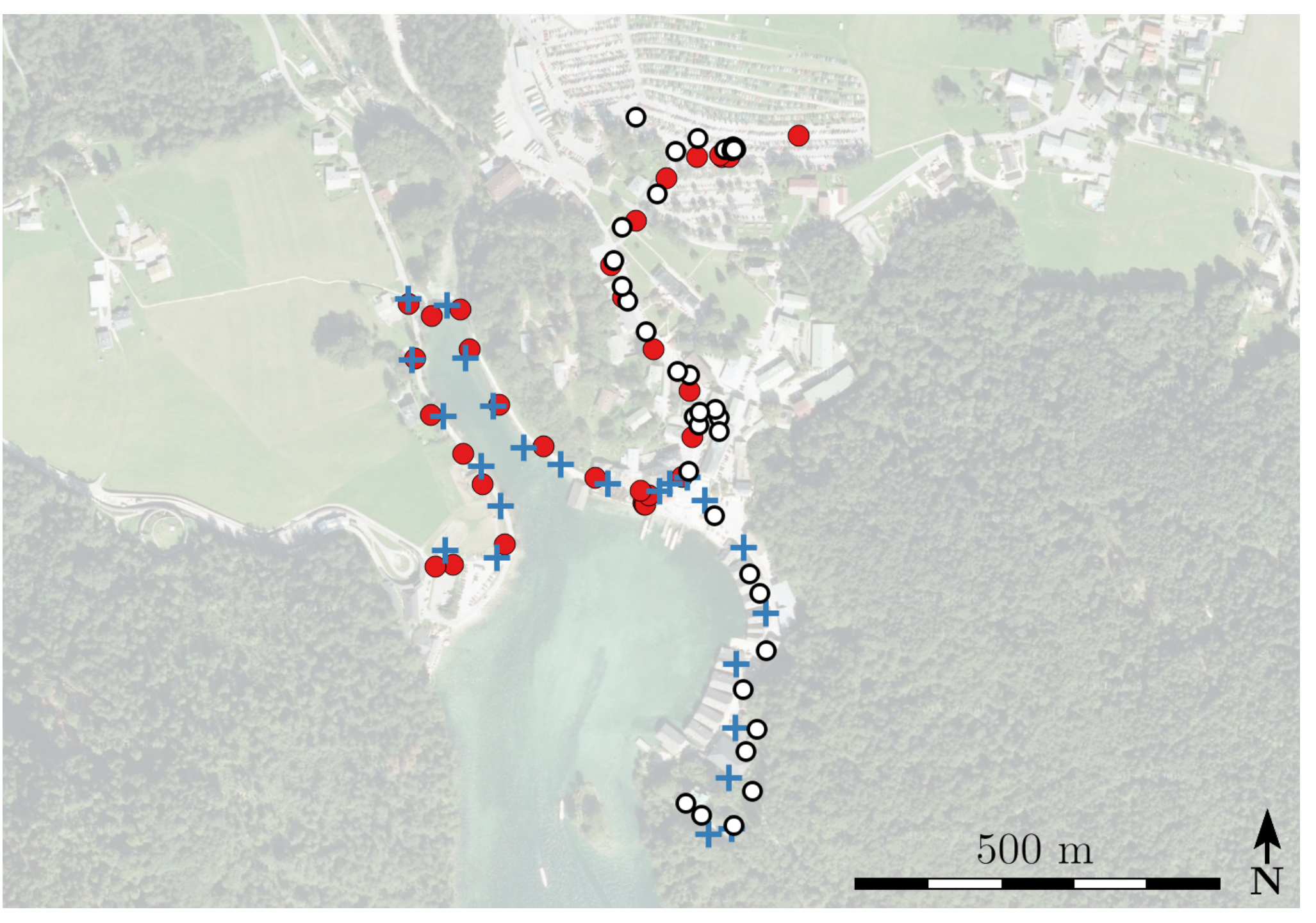
Given a GPS trajectory T , detect a set of meaningful **turning points** P .

Idea:
use Fréchet distance and free-space diagrams!

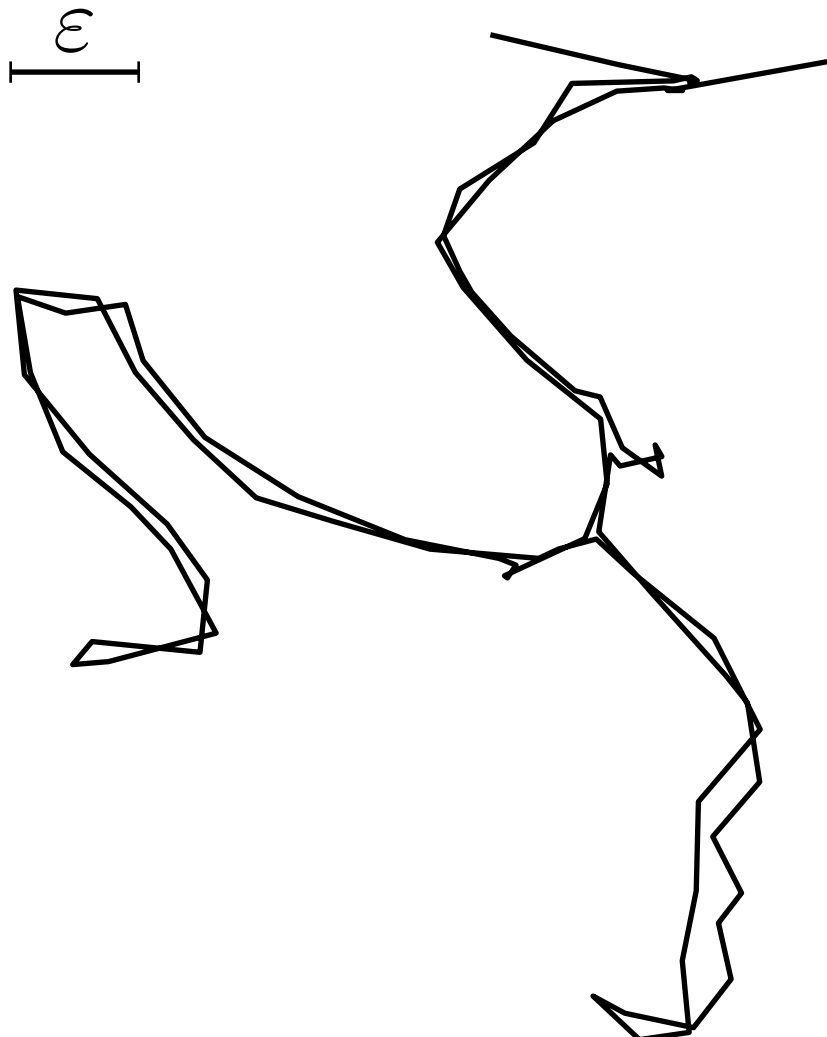
Applications:

- tourism studies
- flocking behaviour
- traffic modelling

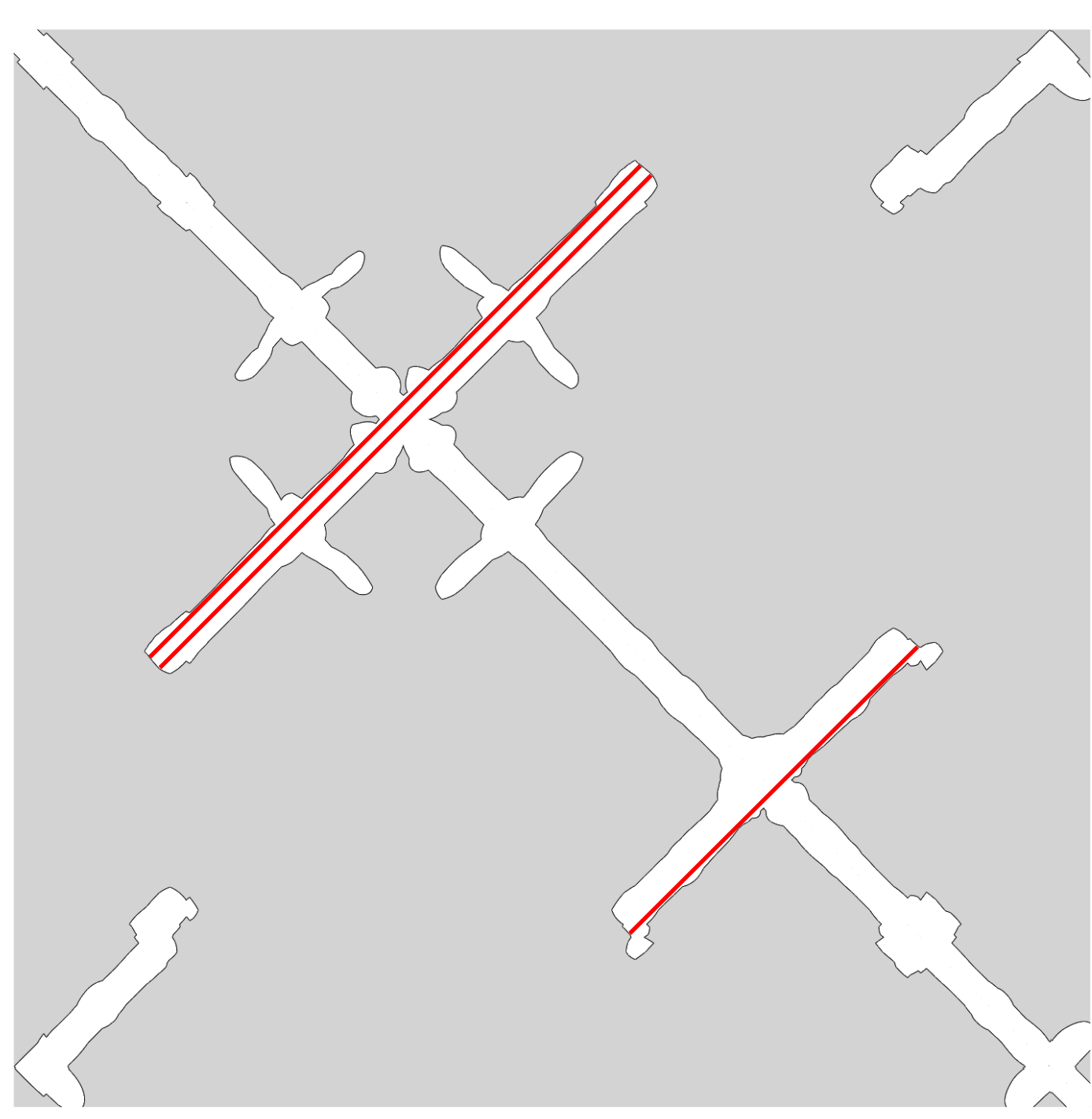
GPS trajectory



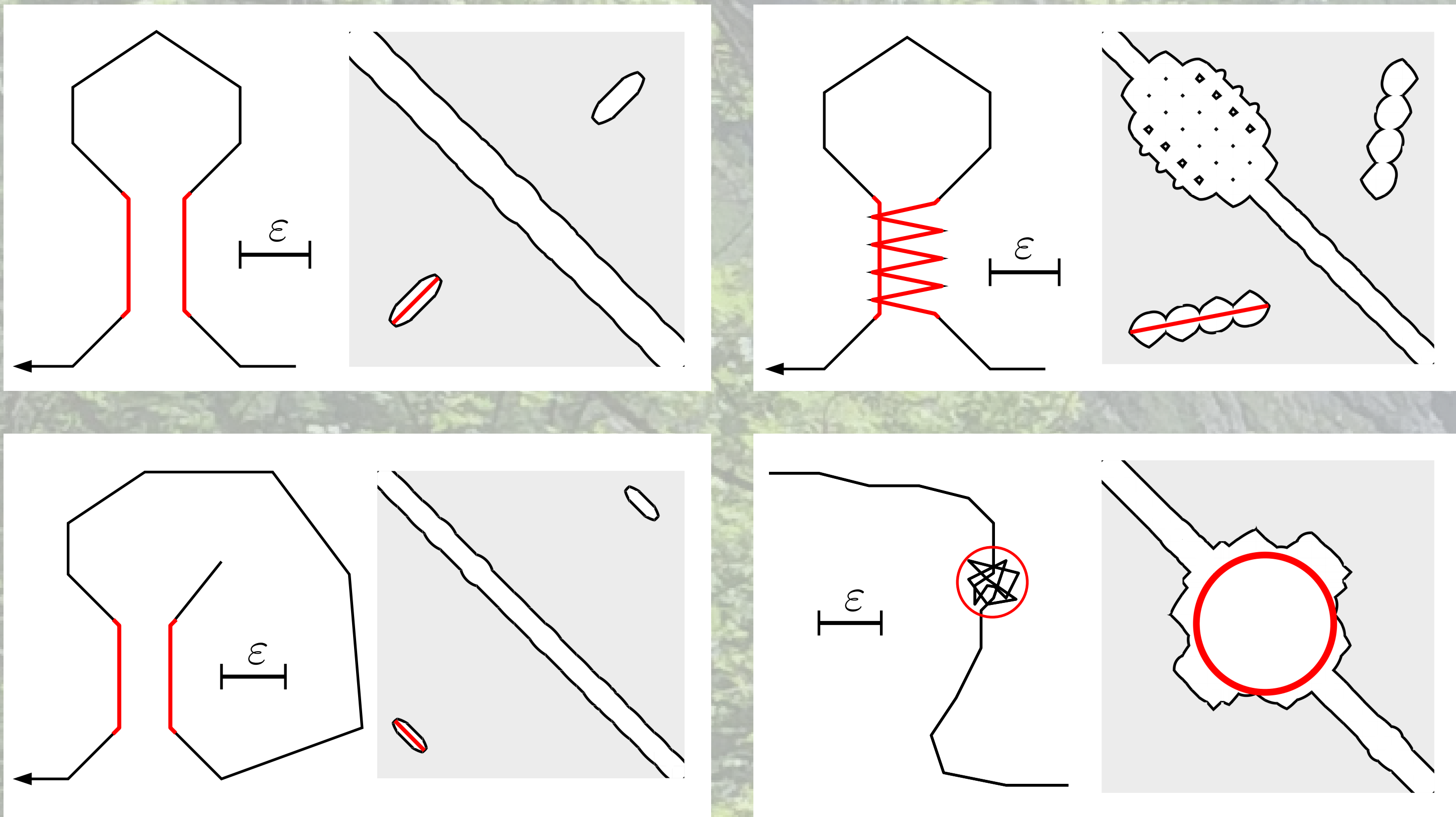
Polyline and ε



Fréchet diagram



Holes in Fréchet diagrams



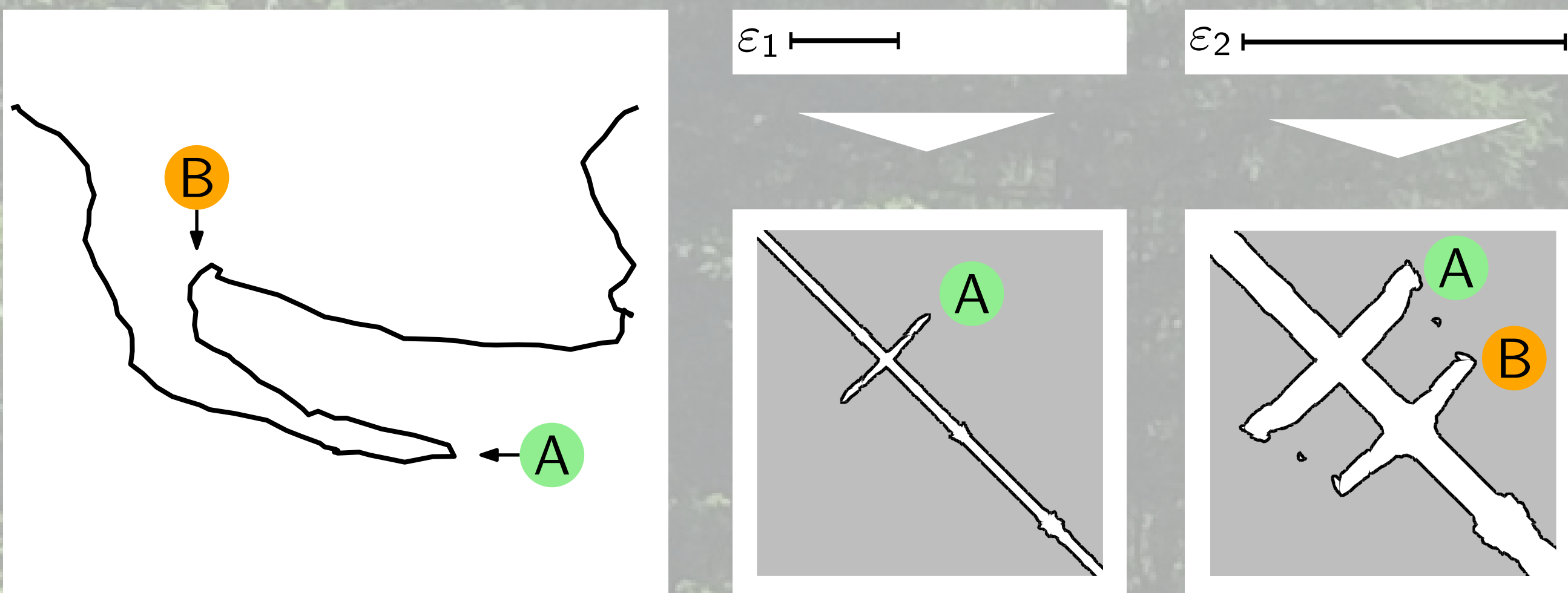
Algorithmic approach

- find maximal line segments of fixed slope
- swepline algorithm, runtime $O(n^2)$
- classify detected turning intervals by length threshold τ

Case Study

- tourism study in Berchtesgaden National Park
- 637 GPS trajectories
- outdoor activities (hiking, skiing, ...)
- manual ground truth available

Influence of Scale



Results

τ	Recall	Precision	F_1 Score	Distance (med.)
1.13	0.94	0.73	0.82	50.2 m
1.55	0.78	0.85	0.82	55.0 m
4.12	0.50	0.99	0.66	63.2 m

- successful data reduction step
- high geographic accuracy
- implementation has practical runtimes

Contributions

- formal definition of turning points using Fréchet distance
- global approach that works on different scales
- useful concept of turning intervals

Future Work

- derive other meaningful properties of trajectories from Fréchet diagrams
- detect shapes other than fixed-slope line segments
- take points of interest into account