Mapping Linear Networks Based on Cellular Phone Tracking

Ronen Rybowski
Aaron Beller
Yerach Doytsher

Mapping and Geo-Information Engineering
Technion - Israel Institute of Technology

Presentation Outline

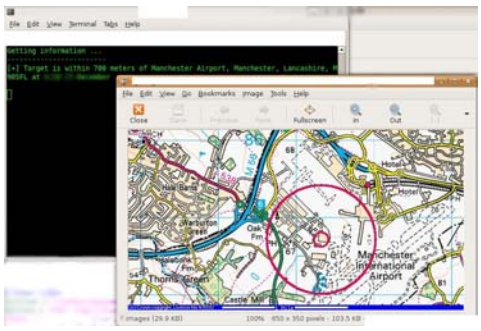
- Research Objective
- Cellular Technology
- Simulator for Cell Phones Tracking
- Practical Experiments
- Conclusion
- Future Work

Research Objective

- Common mapping methods
- Measuring location based on cell phones
- Mapping linear road networks accurately

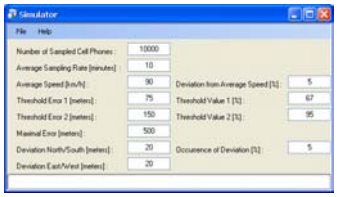
Cellular Technology

- Location based services (LBS)
- Location determination
- Privacy



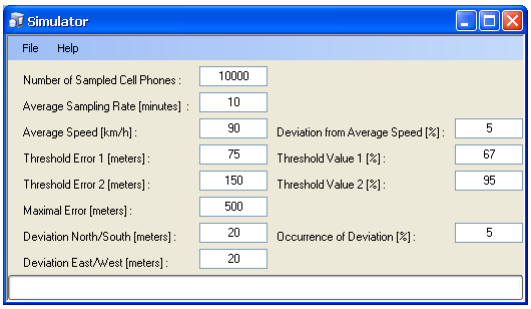
Simulator for Cell Phones Tracking

- Simulator objective
- Parameters
- Output



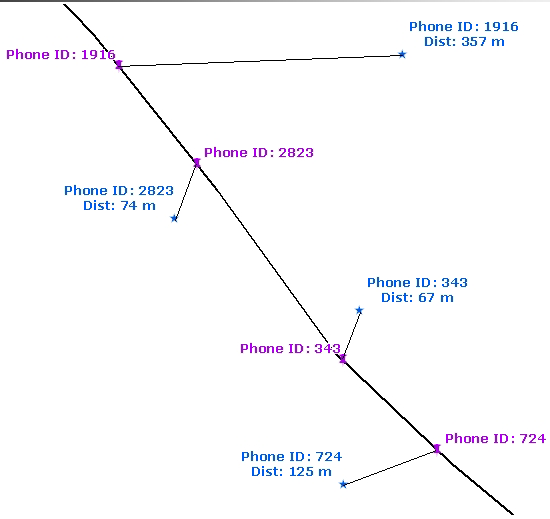
Simulator Parameters

- Number of sampled cell phones
- Average sampling rate for each phone
- Average speed along the road
- Threshold error 1 and 2
- Maximal error for the range above threshold 2
- Deviation to the north/south and deviation to the east/west

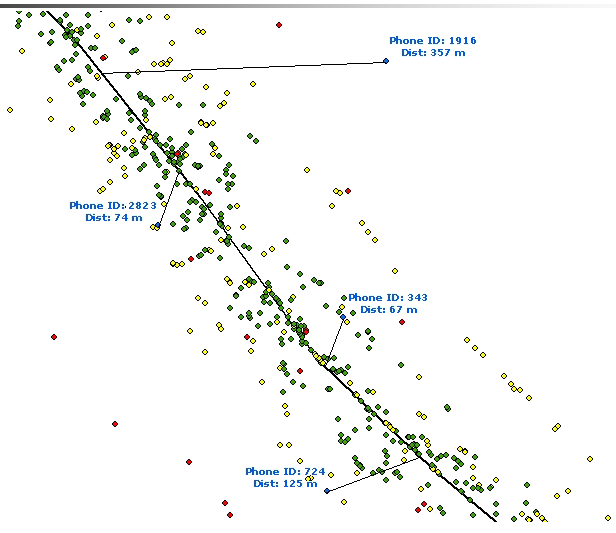


- Deviation from the average speed
- Threshold value 1 and 2
- Occurrence of deviation

Simulator Output



Simulator Output



Practical Experiments

- Locations errors
- Geometric-Statistic (GS) method
- Matching polynomials by segments method

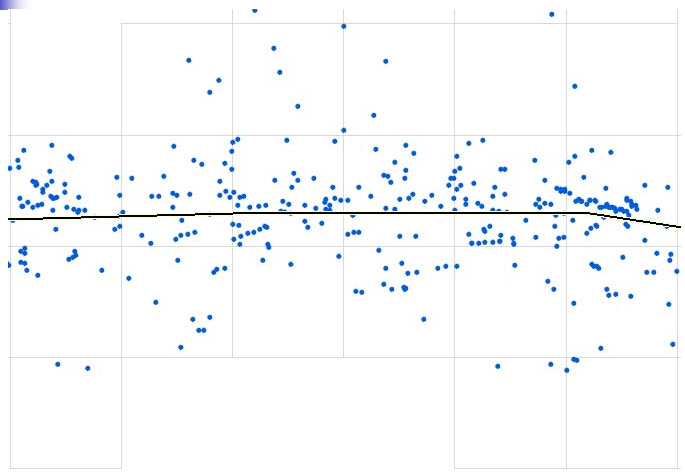
Geometric-Statistic (GS) Method

- Method's steps
- Approximate road extrication
- Operating the method

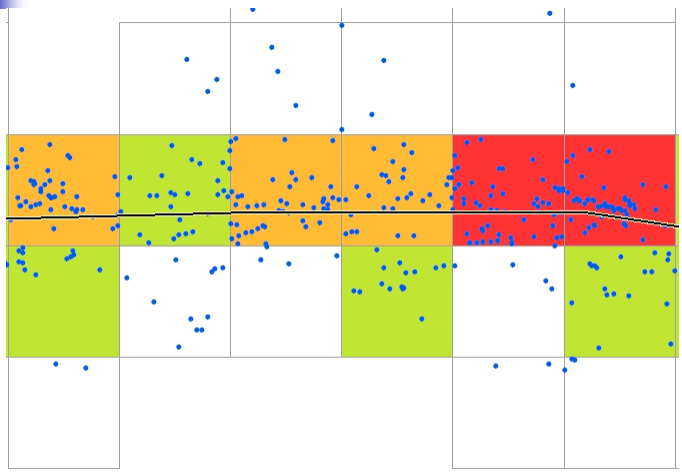
GS - Method Steps

- Spreading geometric cells' network
- Attribute locations to cells' network
- Classifying the cells' network
- Determining a "representation point"
- Extrication of the approximate road

GS - Approximate Road Extrication



GS - Approximate Road Extrication



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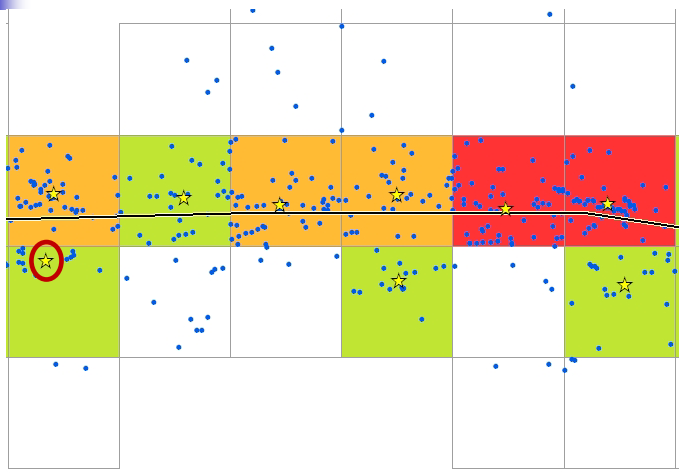
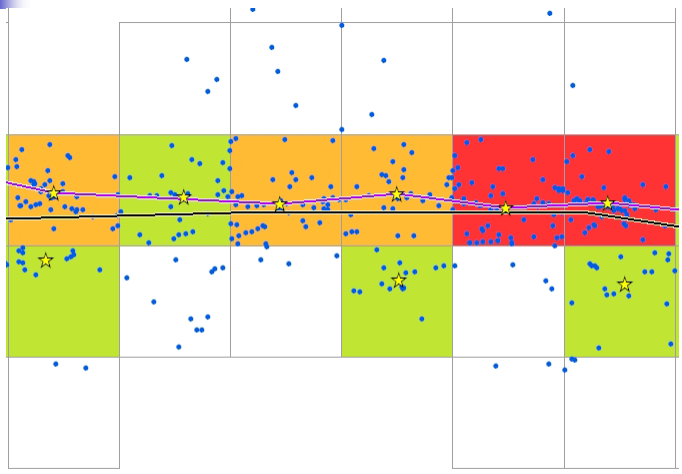
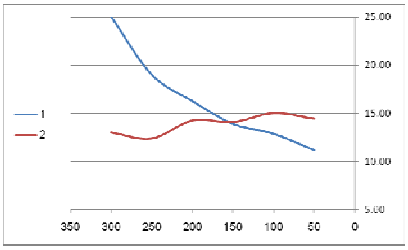


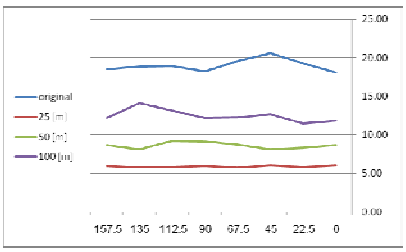
GS - Approximate Road Extrication



GS - Operating the Method

- Size of network cells
- Road angle in relation to the network





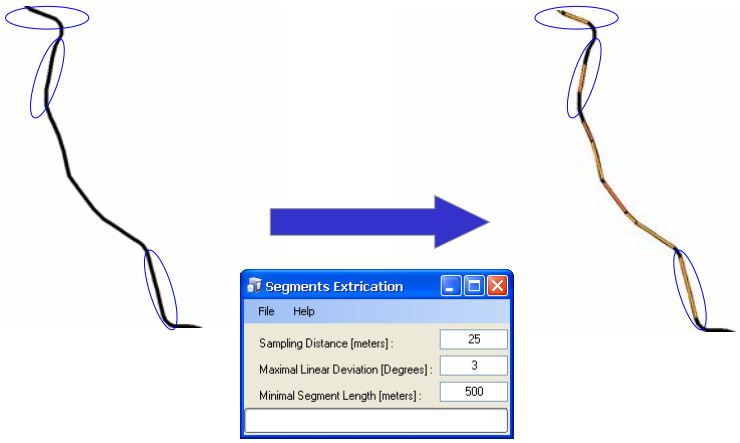
Matching Polynomials by Segments Method

- Method's steps
- Linear segments extrication
- Operating the method

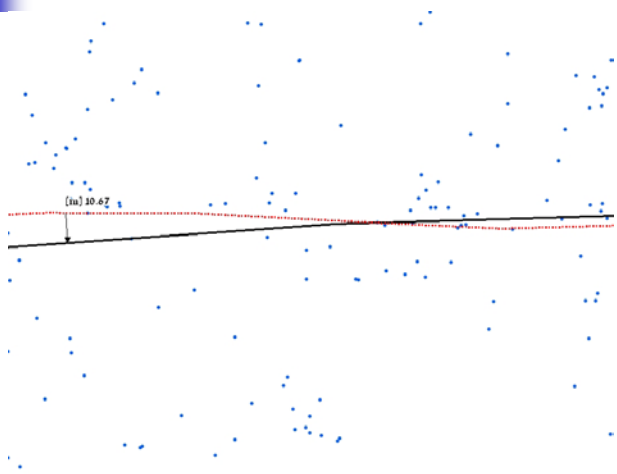
Matching Polynomials - Method Steps

- Divide the approximate road into segments
- Match the polynomials to each segment by its type
- Extrication of the accurate road

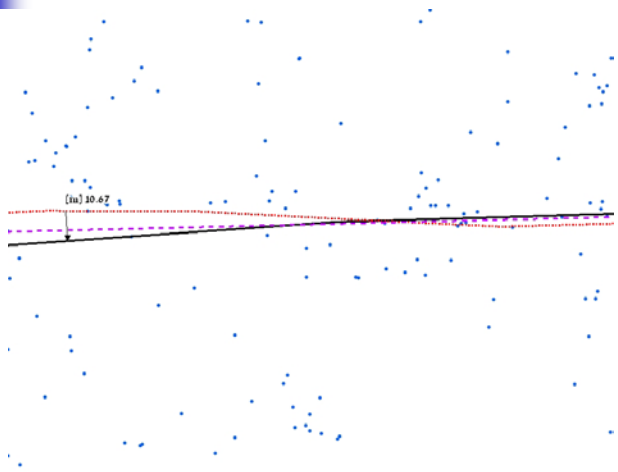
Matching Polynomials - Linear Segments Extrication



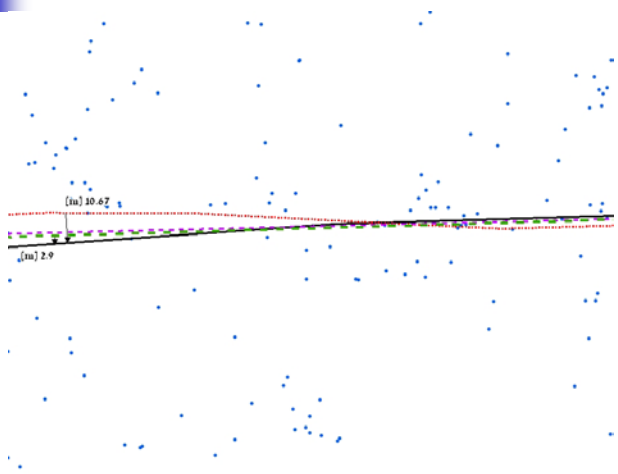
Matching Polynomials - Operating the Method

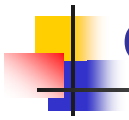


Matching Polynomials – Operating the Method



Matching Polynomials – Operating the Method





Conclusion

- GS approximate road extrication
  - Maximal improvement of 70%
  - ±10 meters accuracy
  - Minimal value of cell phones needed
- Polynomials algorithm
  - ±3 meters accuracy

Future Work

- Non-Linear segments extrication
- Detecting and defining the nodes of linear road networks
- Full road networks mapping process
- Collecting real cellular location
- Operating the algorithm on the real location data


Thank You!