Generating Strokes of Road Networks Based on Pattern Recognition

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Outline

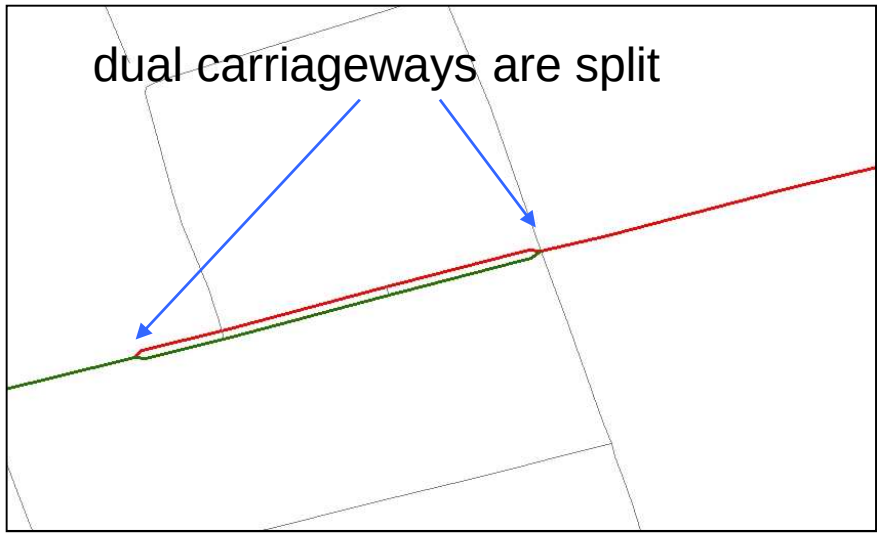
- **Motivation**
- **Generating strokes based on road pattern recognition and perceptual grouping**
- **Experiments**
- **Conclusions**

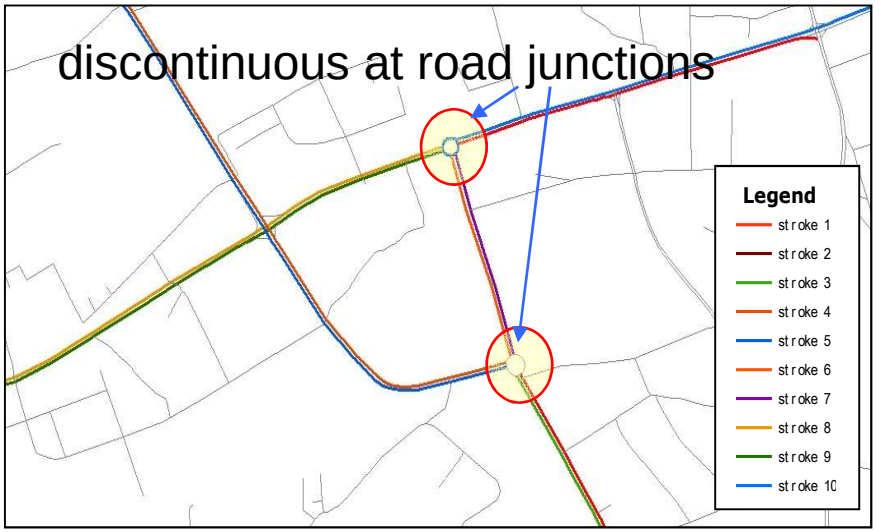
Motivation

- **What are Strokes (continuity lines)?**
  - Road segments that are continuous at intersections are prone to be regarded as naturally long lines of roads.
    - Thomson and Richardson, 1999
- **Strokes (continuity lines) are widely used in**
  - Network analysis
    - Porta et al., 2006a, 2006b; Jiang, 2007; Figueiredo and Amorim, 2007; Tomko, 2008; Jiang, 2009a, 20009b
  - Selection & Generalisation
    - Jiang and Claramunt, 2004; Jiang and Harrie, 2004; Touya, 2007

Motivation

- **Traditional methods for generating strokes**
  - Road name
  - Angle between neighboring road segments
- **Drawbacks**
  - Only appropriate to single line road networks
  - Dual carriageways are split
  - Discontinuous at road junctions





Generating strokes based on road pattern recognition and perceptual grouping

- **Three steps to generate strokes in high level of details road networks**
  - 1. Dual carriageways detection
  - 2. Complex road junctions detection
  - 3. Strokes connection across road junctions

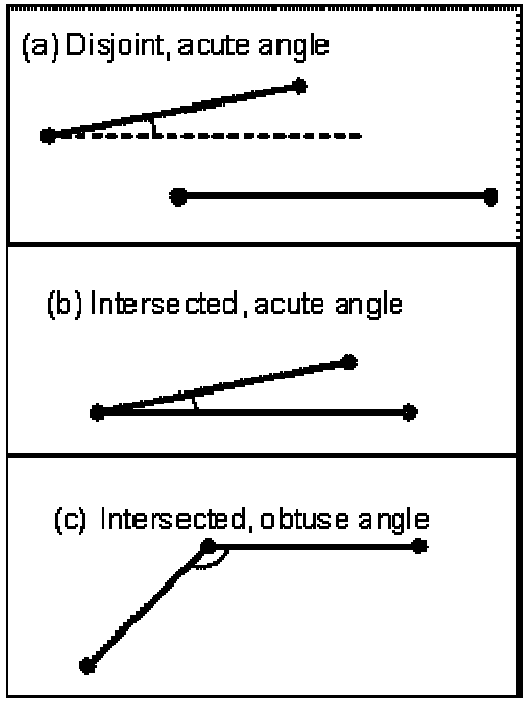
1. Dual carriageways detection

Dual carriageways detection

- **Relationship between nearby road segments**
  - Angle
  - Distance
  - Directional relation
- **Dual carriageway pair classification**
  - 1:1 pair
  - 1:n pair
- **Tracking dual carriageways**

Dual carriageways detection

- Three parameters to measure the relationship between nearby road segments.
  - **Angle**

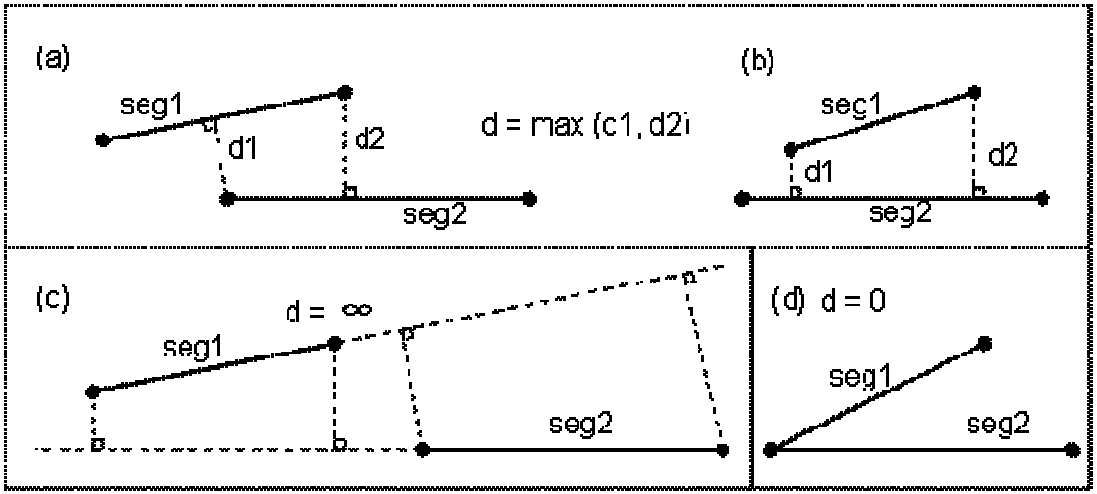


Angle between separate segment is used to detect dual carriageway pairs

Angle between intersected segment is used to track the follow-up segment of one part of the dual carriageways

Dual carriageways detection

- Three parameters to measure the relationship between nearby road segments.
  - Angle
  - **Distance**

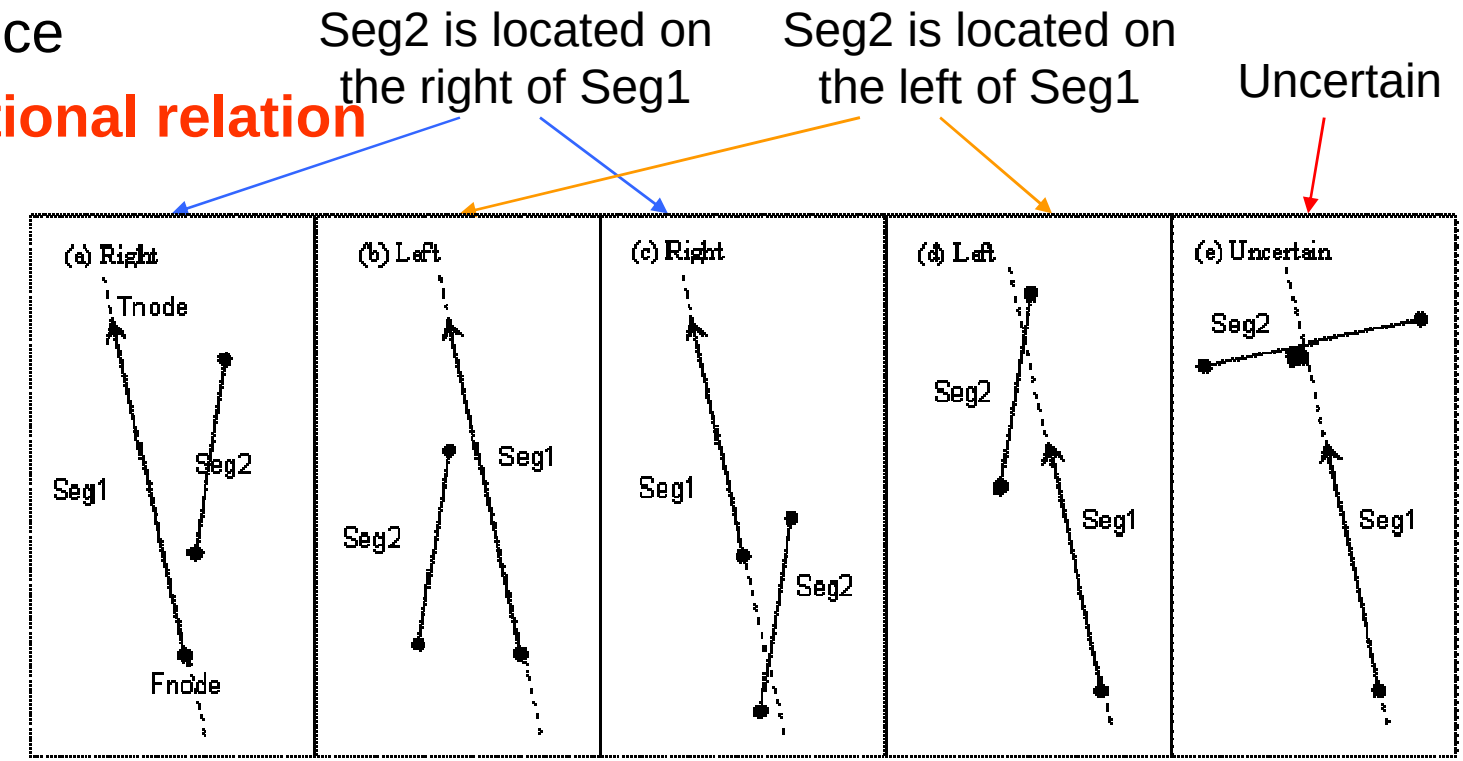


Distance of faraway segment is infinite, and it is used to indicate the end of the tracking method

Distance of intersected segment is 0, and it is used to track the follow-up segment or indicate the end of the tracking method

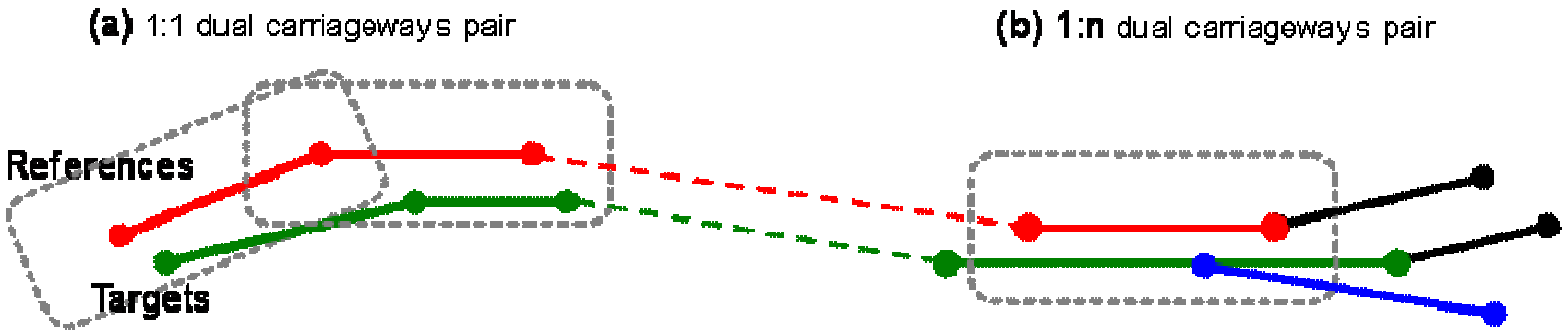
Dual carriageways detection

- Three parameters to measure the relationship between nearby road segments.
  - Angle
  - Distance
  - **Directional relation**



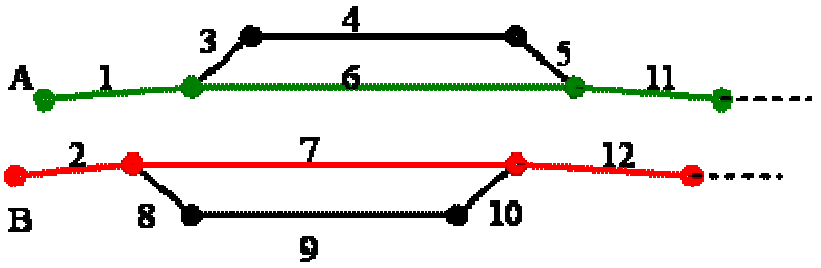
Dual carriageways detection

- **Dual carriageways pairs detection**
  - 1:1 dual carriageways pair
    - Can be regarded as the final detection result
    - Adjacent 1:1 pairs are integrated as a whole pair
  - 1:n dual carriageways pair
    - Will be tracked and refined in the following step of our method.

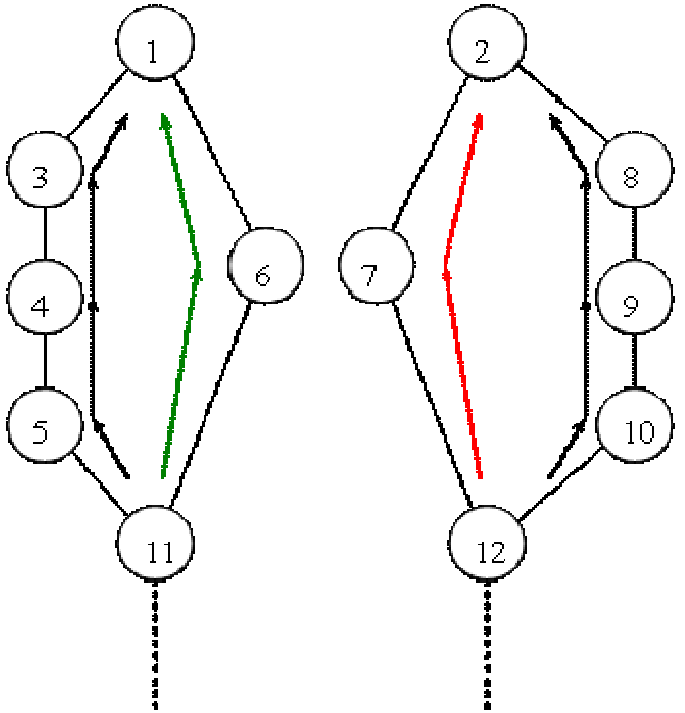


Dual carriageways detection

- **Tracking dual carriageways**

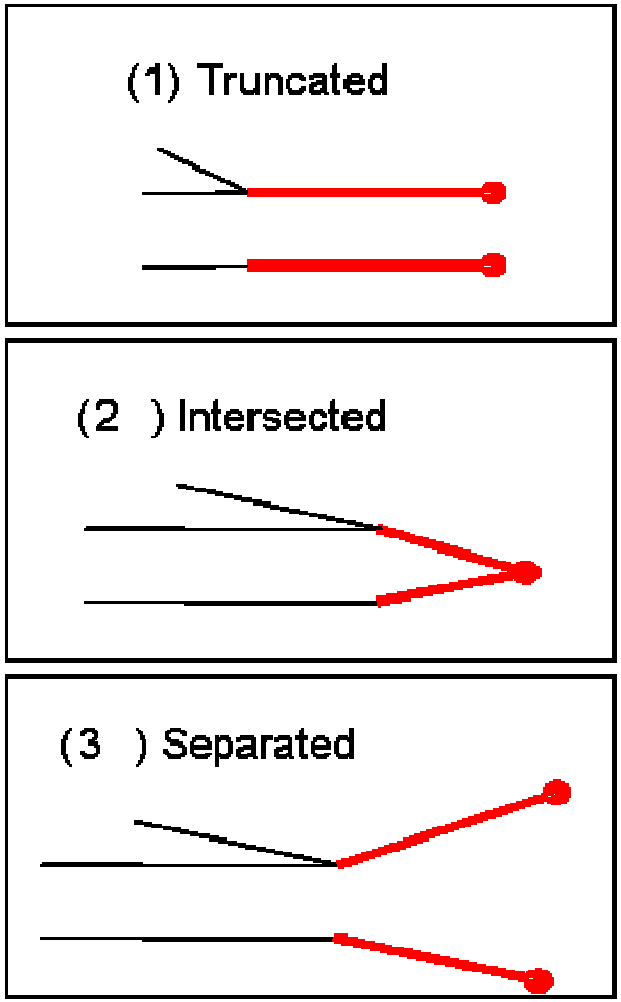


  - Each part of the dual carriageways tracking routes will be stored in tree structures.
  - The shortest route from the conflicted node to the root node will be preserved.



Dual carriageways detection

- **Ends of the tracking algorithm**



Dual carriageways are truncated

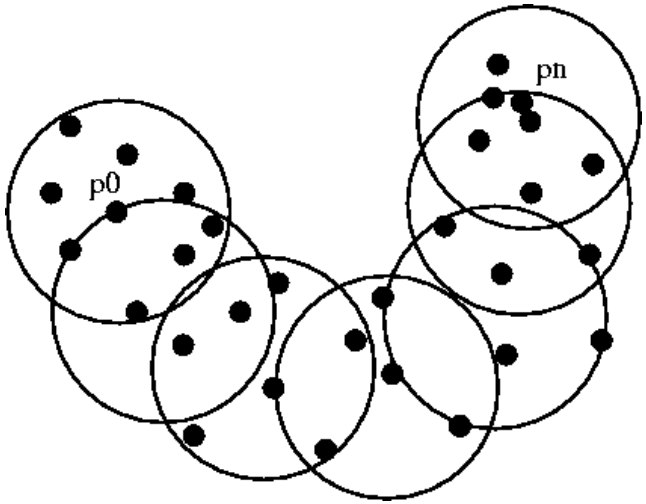
Two parts of the dual carriageways are intersected

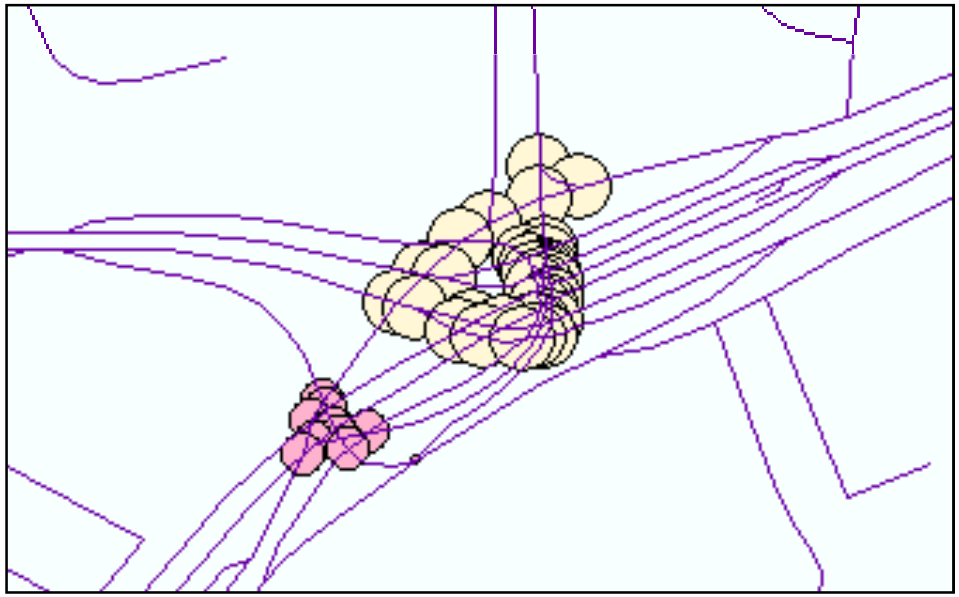
The distance or angle of two parts are larger than threshold

- **2. Complex road junctions detection**

Complex road junctions detection

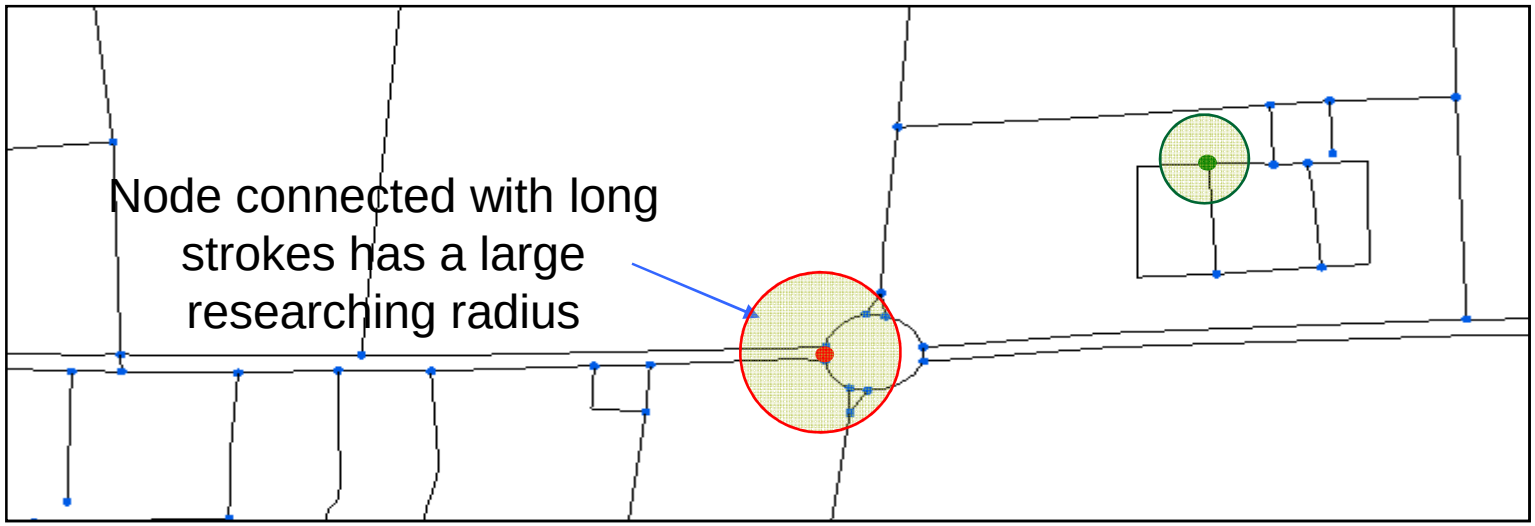
- Similarities to DBSCAN algorithm (Ester et al., 1996)
  - Not required to know the number of clusters in the data a priori
  - Can find arbitrarily shaped clusters
  - Has a notion of noise





Complex road junctions detection

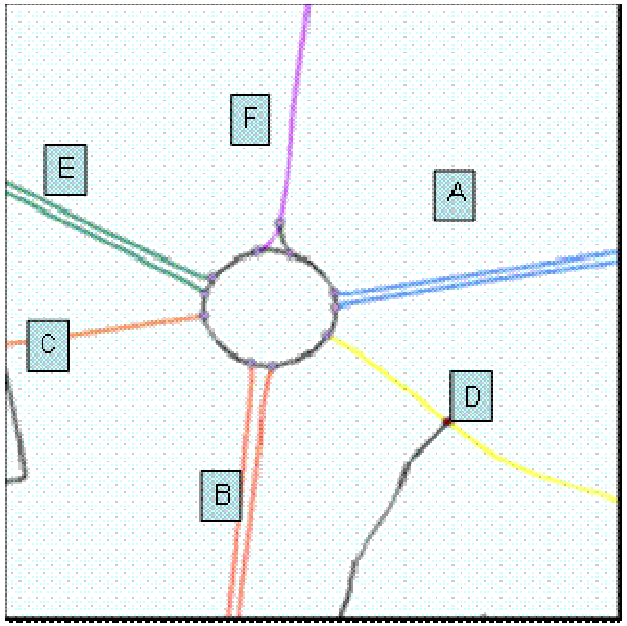
- Differences to DBSCAN algorithm
  - Network distance instead of Euclidean distance
  - Searching radius of each intersection is related to the length of strokes connecting to it. The longer the strokes are, the more likely the clusters are road junctions.



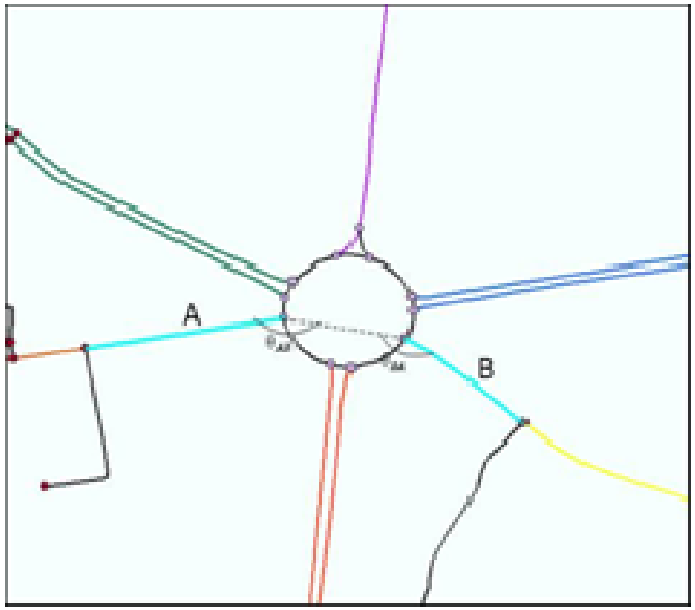
- **3. Strokes connection across road junctions**

Connect strokes across road junctions

- To judge the smooth property of road segments connecting to the junction, the angles between each two segments is calculated.



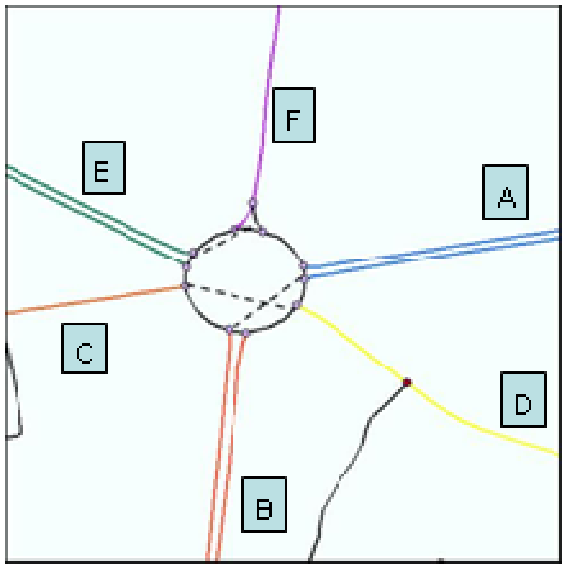
The original connection of strokes



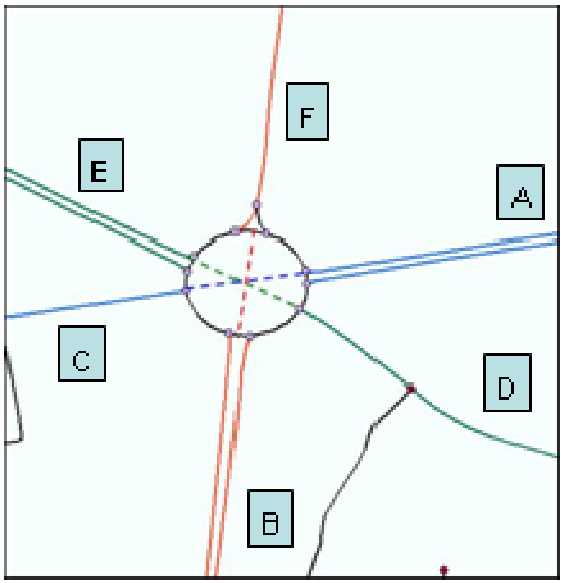
The angles between strokes A and B

Connect strokes across road junctions

- Series of combinations of stroke connection.
- The combination with the max value of the sum of angles is preserved as the final connection result.



The sum of angle of one combination is 868.961



The max value of the sum of angle is 1003.273

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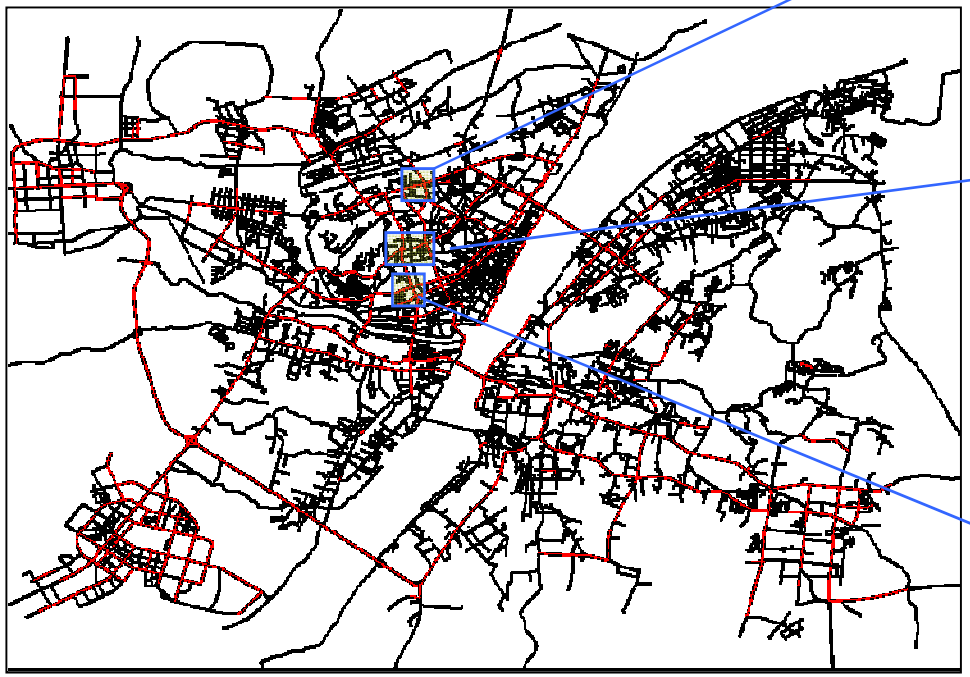
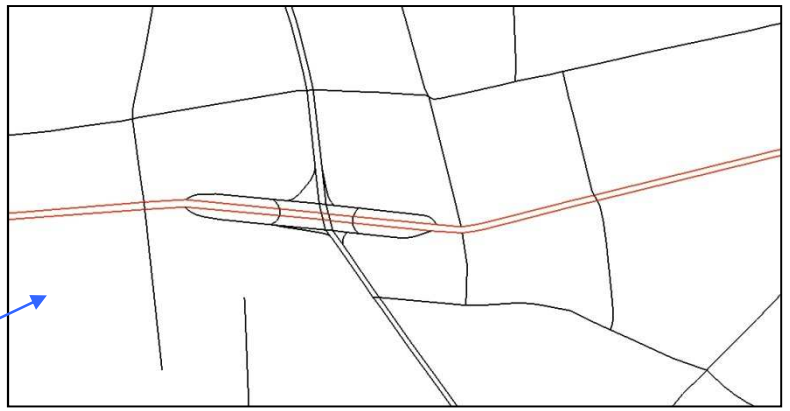
Experiments

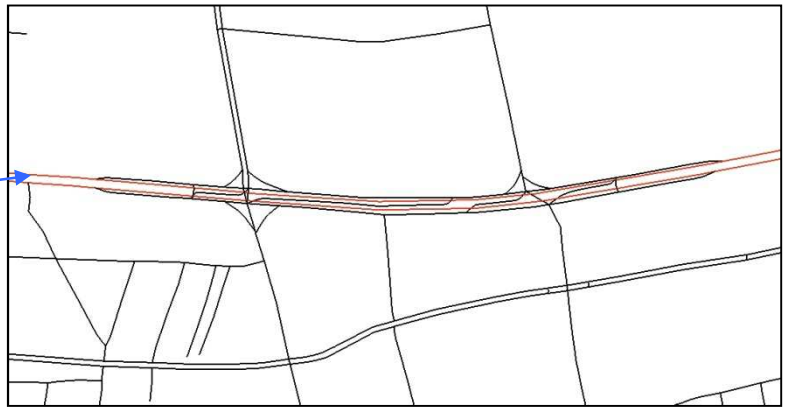
- **Data**
  - Wuhan (China) and Zurich navigation map datasets
  - 11,598 road sections in the Whuan dataset and 11,396 in Zurich dataset
  - Some roads are represented as dual carriageways and some road junctions are complicated.

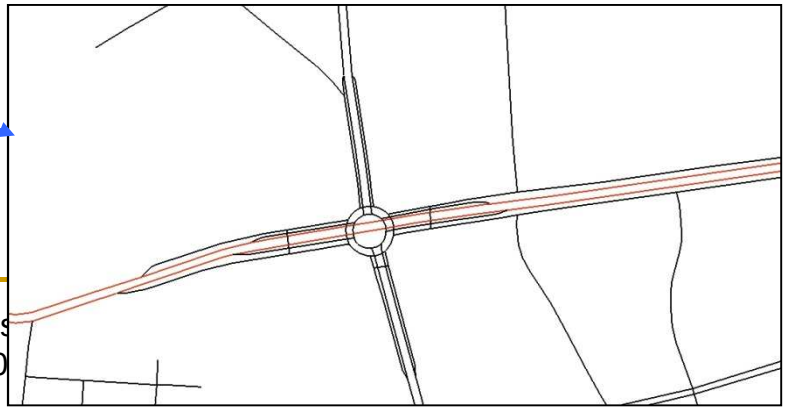
Dual carriageways detection

- Dual carriageways detecting results (Wuhan)



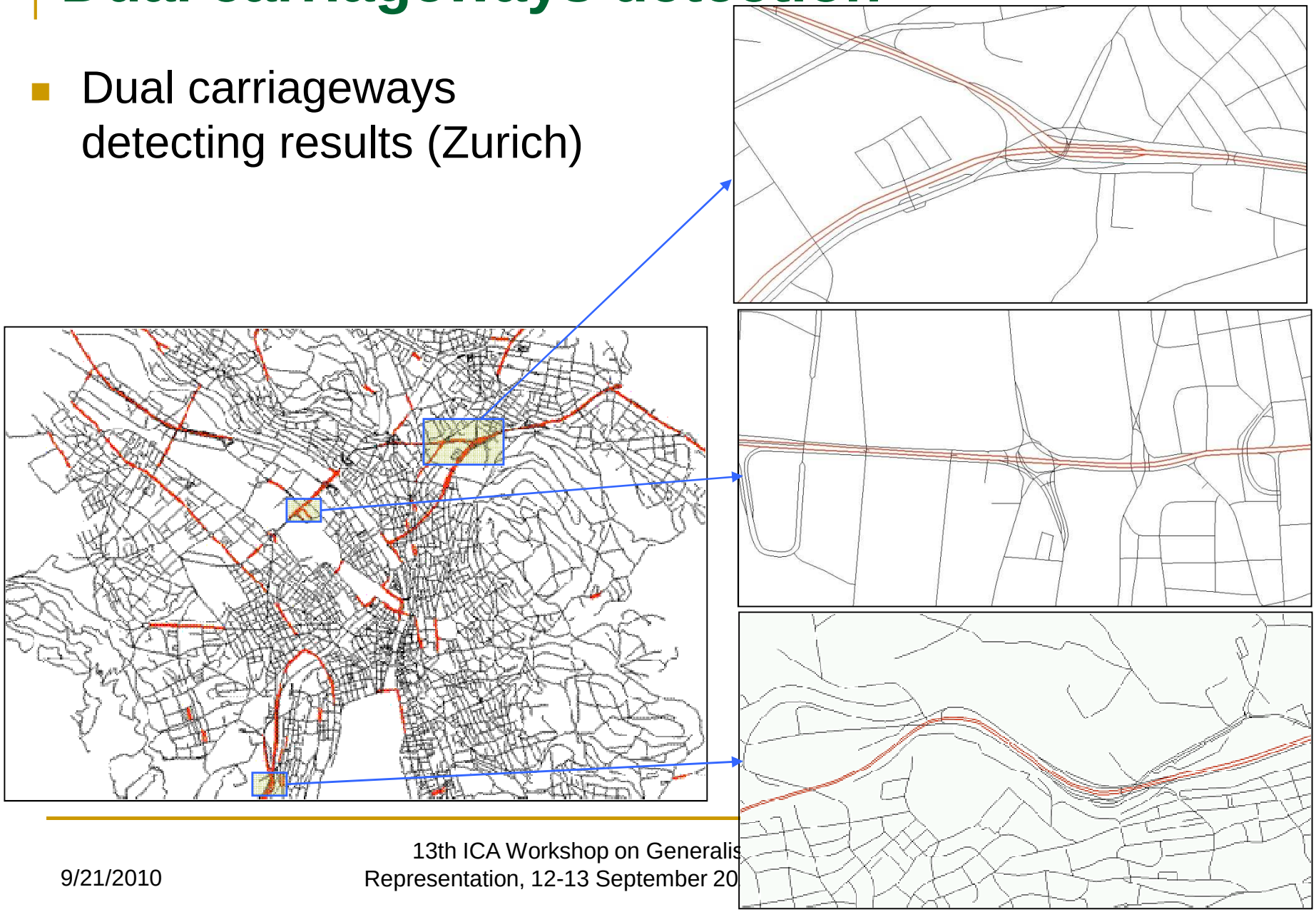






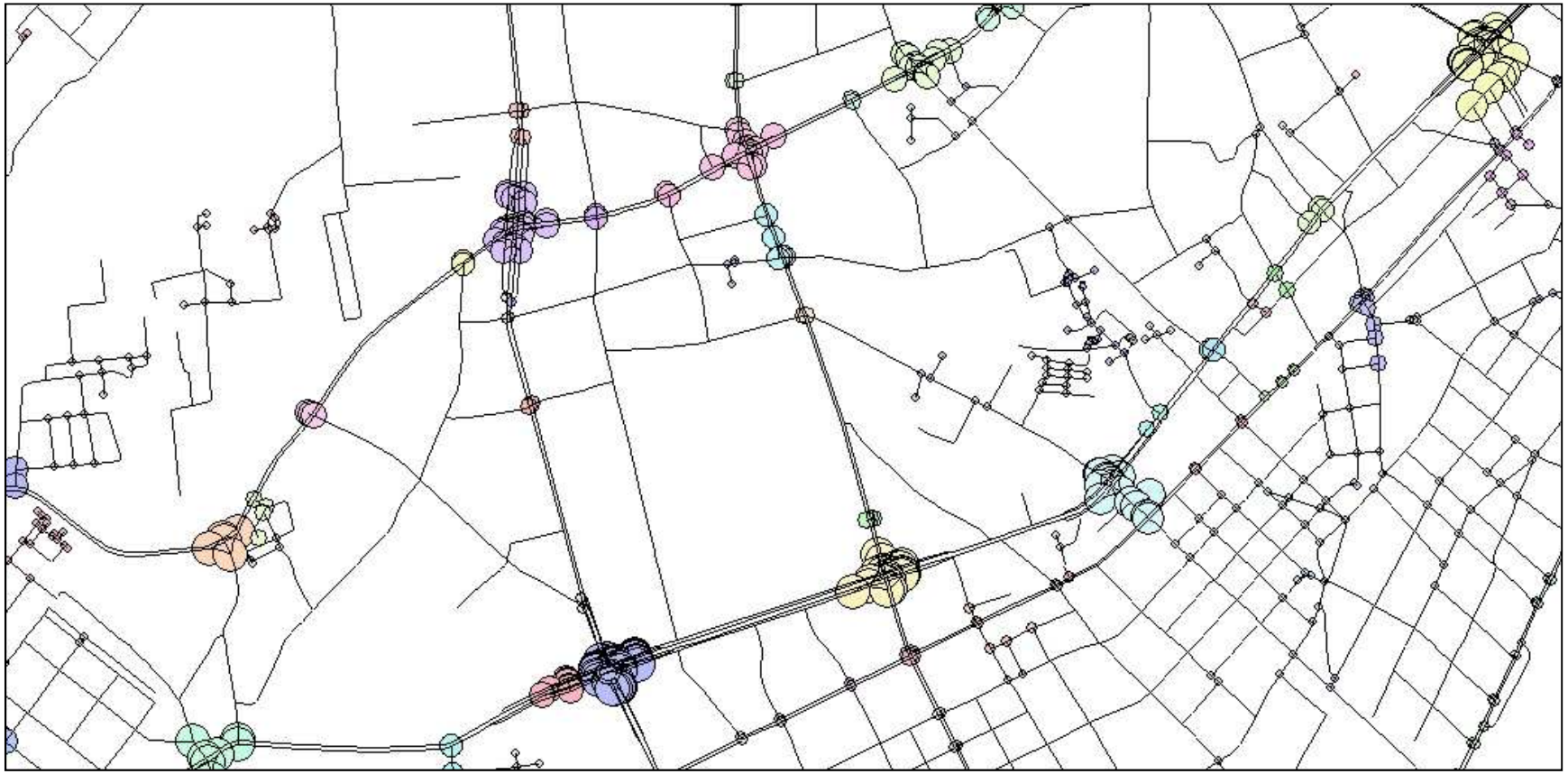
Dual carriageways detection

- Dual carriageways detecting results (Zurich)



Complex road junctions detection

- Road junctions detection (Wuhan)



Complex road junctions detection

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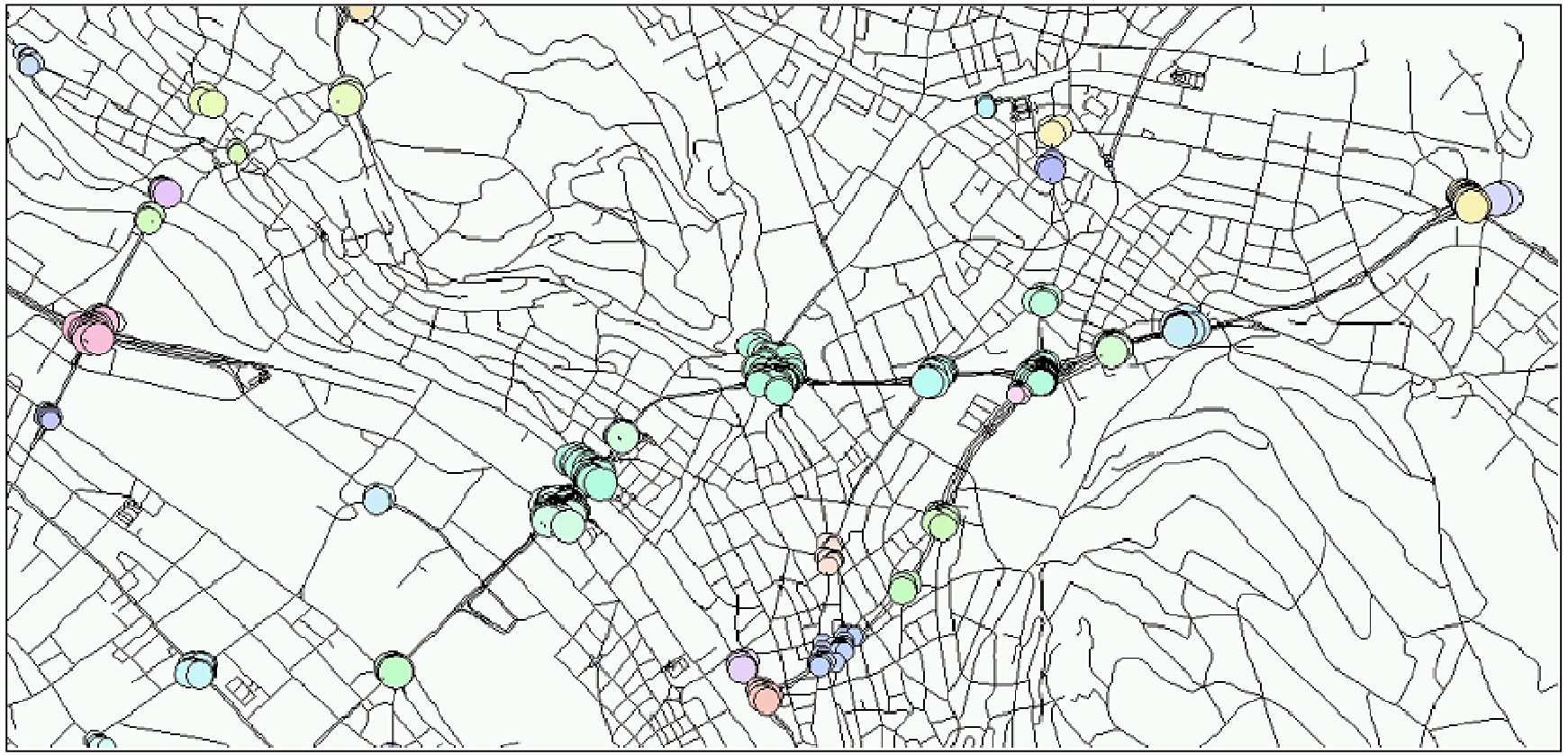
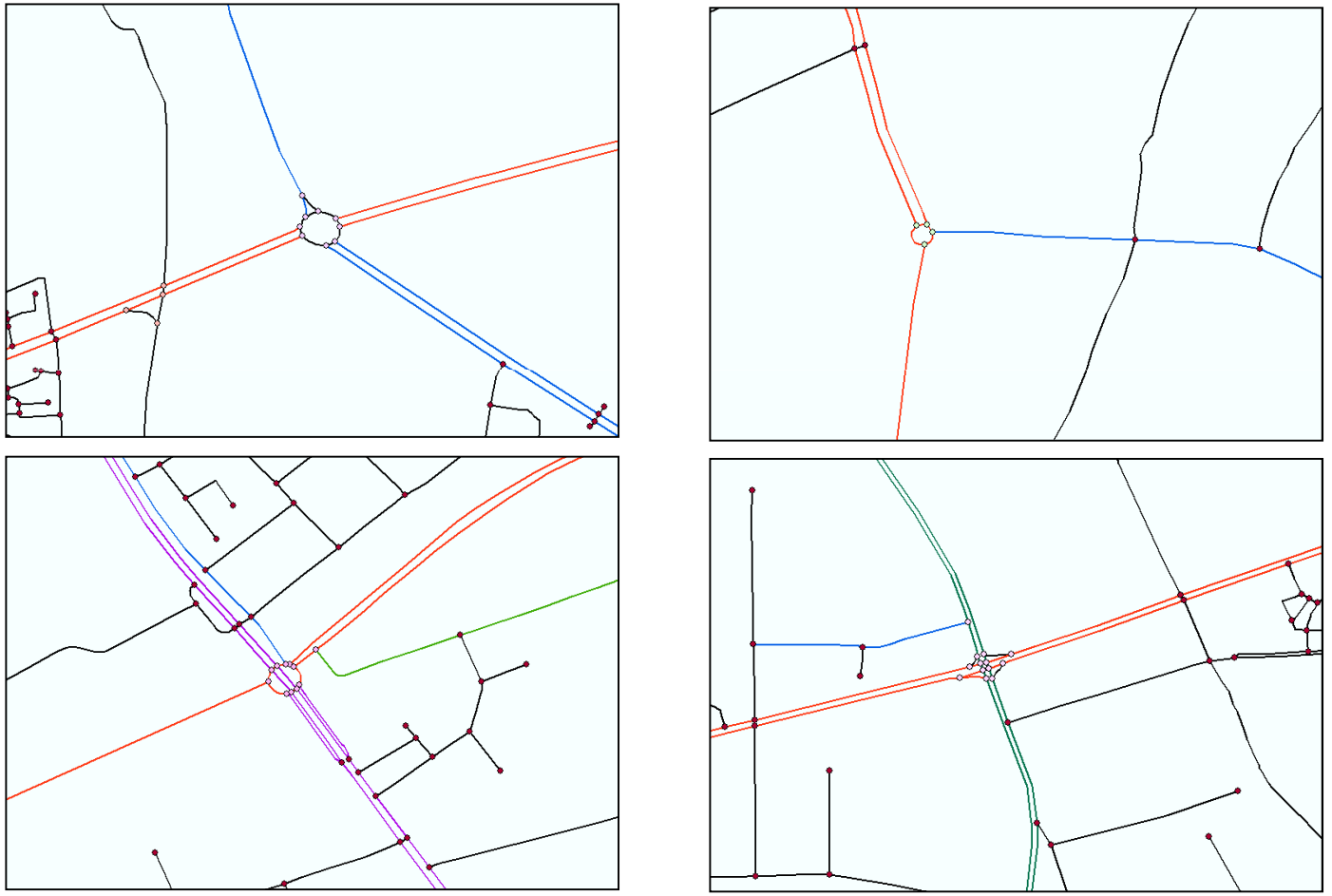


Connect strokes across road junctions

- Grouping results (Wuhan)



Connect strokes across road junctions

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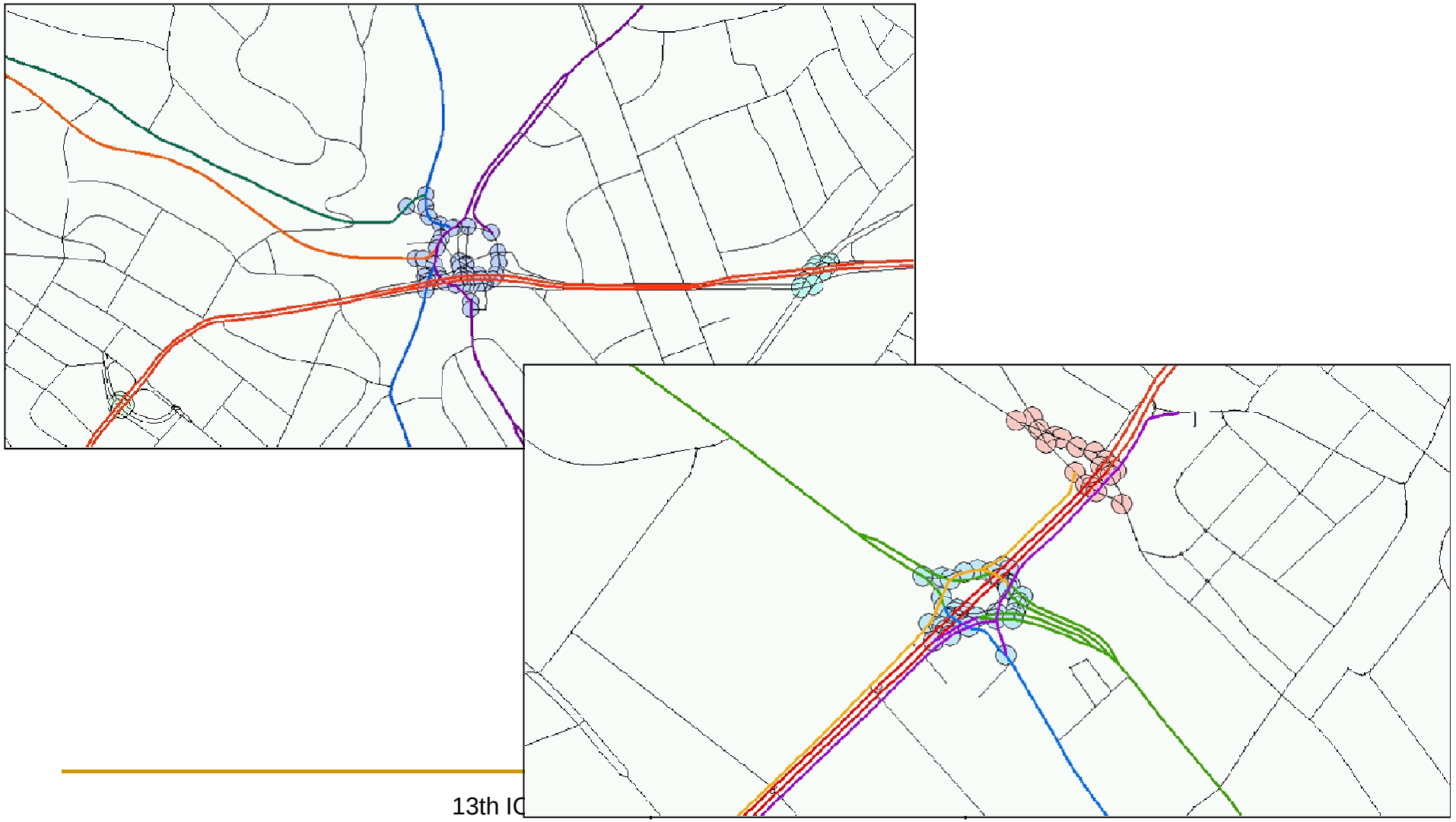

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Conclusions

- Contribution
  - An automated method for generating strokes from road networks
  - Be able to deal with the road networks with dual carriageways and complex junctions and to keep the continuity of strokes
- Future work
  - Road network analysis and hierarchical selection
  - Dual carriageways and road junctions simplification
  - Road network generalisation

Thank you!

Questions?