

# *An Object Assignment Algorithm for Tracking Performance Evaluation*

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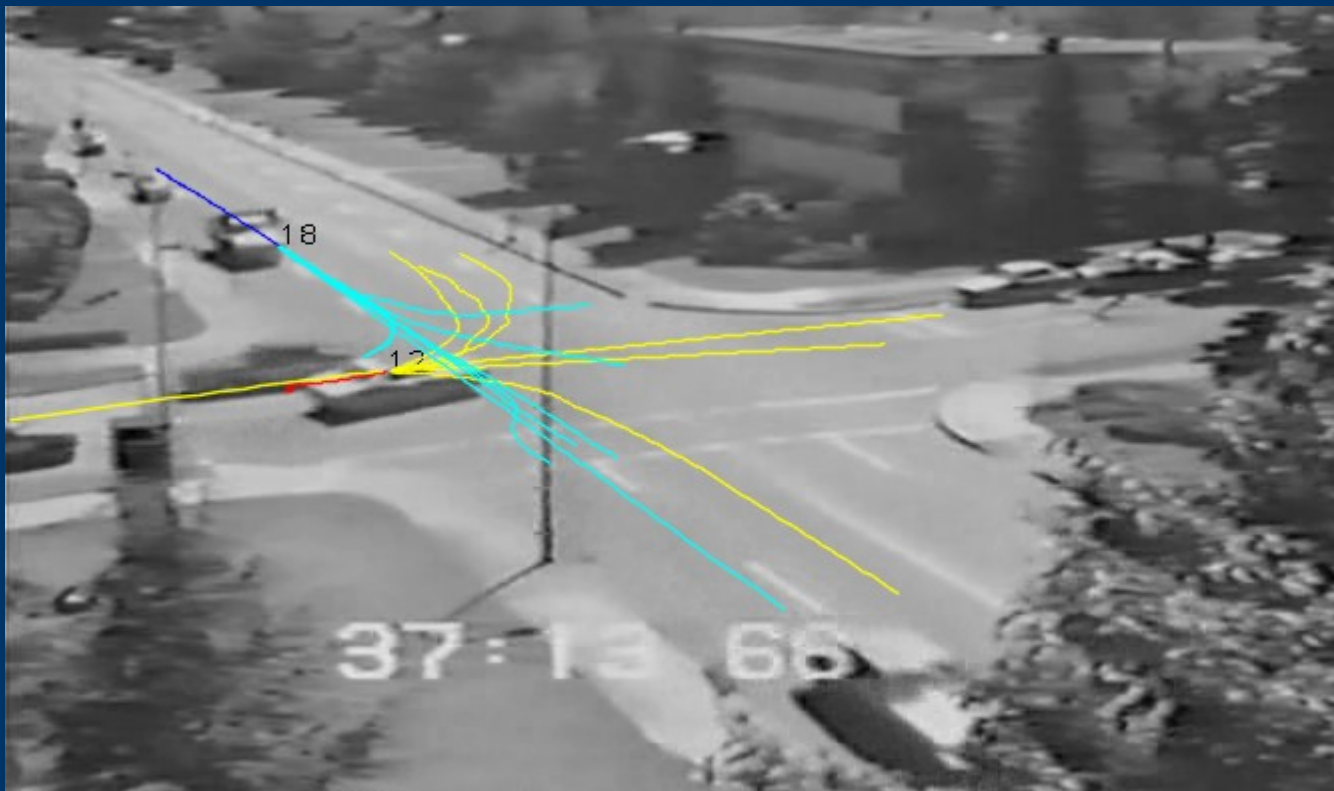
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# *Outline*

- Motivation
- The Proposed Approach
- Experimental Demonstration
- Conclusion

# Motivation

- Automated road safety analysis using video sensors.



# Objective

- Most evaluations rely usually on aggregated or per-frame measures.
- Yet measuring the performance “**in terms of tracks rather than frames**” is a natural choice that is consistent to the expectations of the end-users”. (*Yin, Makris and Velastin 2007*)
- Application-dependent.

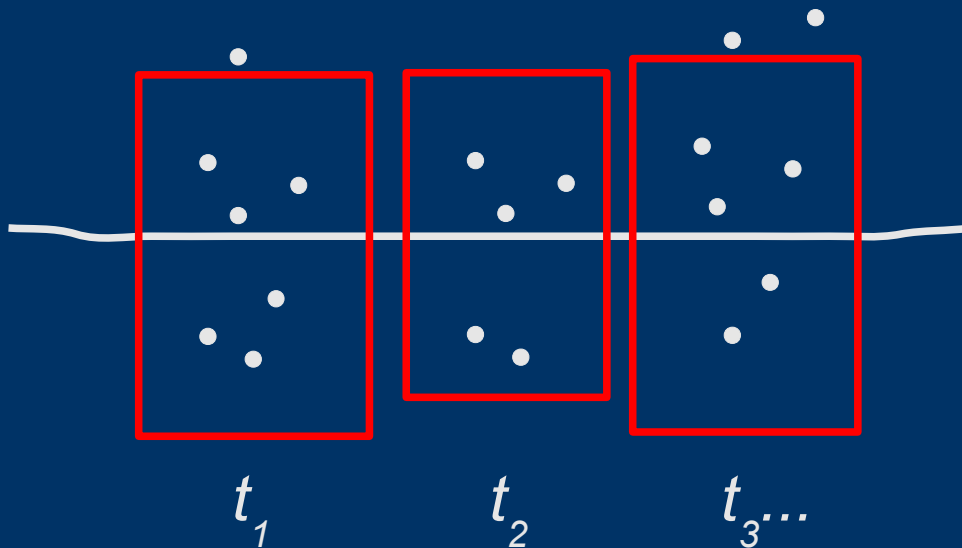
# Tracking Performance Evaluation

- Definition of **similarity** between **ground truth** and **detected** objects.
- Various assignments are possible:
  - correct assignment
  - over-segmentation
  - over-grouping
  - multiple assignment
  - missed detections
  - false detection



# Object Similarity

- Temporal matching
  - $Length(Time(GT) \cap Time(D)) > \alpha \cdot \max(Length(Time(GT)), Length(Time(D)))$
- Spatial matching



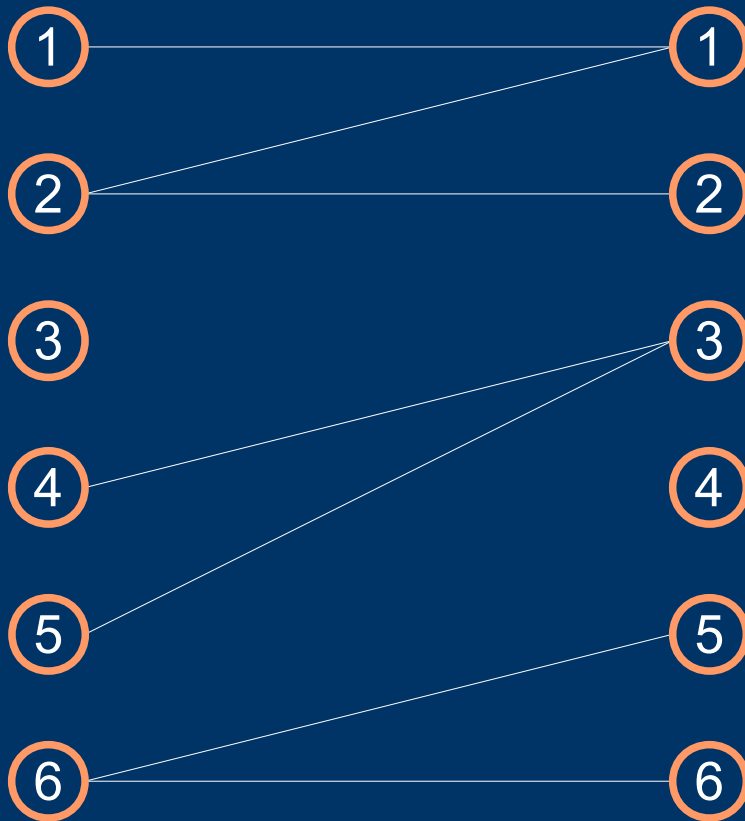
## Spatial Condition 2

Number of features during the condition is satisfied superior to a proportion  $\beta$  of  $Length(Time(GT) \cap Time(D))$ .

# Algorithm for Object Assignment

GT

Detected



The neighborhood  $N(O)$  is set of objects adjacent to  $O$ .

*Isolated(O)* is the subset of  $N(O)$  of the objects adjacent only to  $O$ .

# Assignment Algorithm

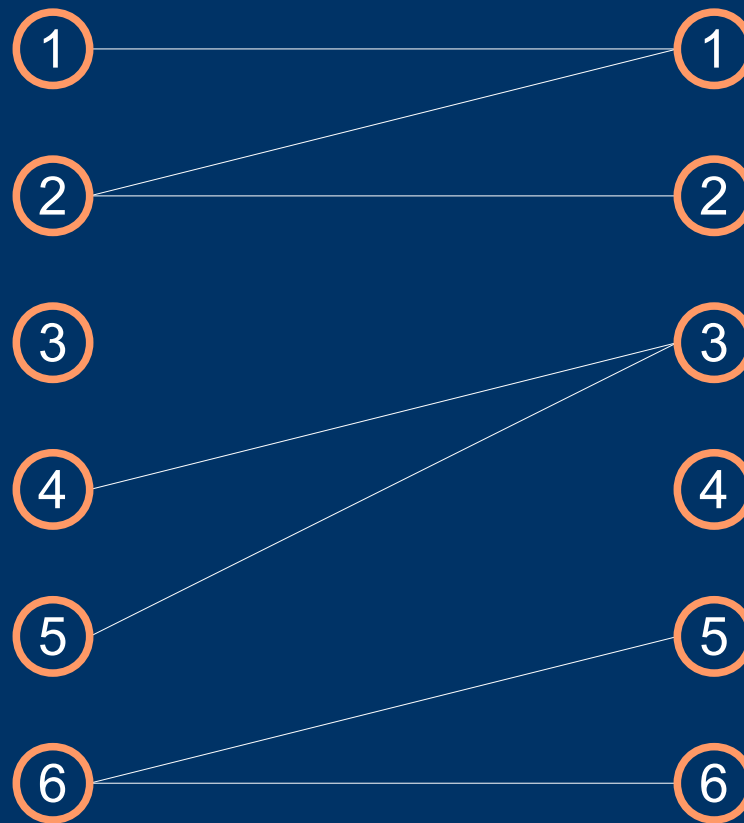
- For any object  $O$ 
  - if  $N(O)$  is empty, it is a missed/false detection
  - else
    - if  $Isolated(O)$  is empty
      - if there is an object  $O'$  in  $N(O)$  such that  $Isolated(O')$  is empty,  $O$  is assigned to  $O'$  (correct assignment).
    - else if  $Isolated(O) = \{O\}$ ,  $O$  is assigned to  $O'$  (correct assignment).
    - else  $O$  is assigned to  $Isolated(O)$  (over-segmentation or over-grouping).



# Algorithm for Object Assignment

GT

Detected



*Isolated*( $GT_1$ ) is empty,  $N(GT_1) = \{D_1\}$  and  $Isolated(D_1) = \{GT_1\}$

# Performance Measures

- Generic cost function
  - $Cost = N_{OS}C_{OS} + N_{MD}C_{MD} + N_{OG}C_{OG} + N_{FD}C_{FD}$
  - Normalized cost
- Simplified cost (total numbers of missed and false detections)
  - $Cost' = N_{TMD}C_{TMD} + N_{TFD}C_{TFD}$

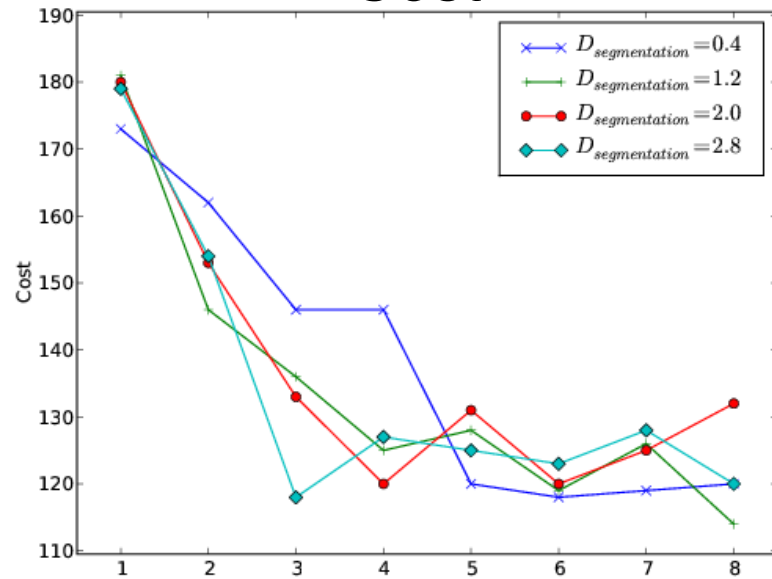
# Demonstration

- Interactive display of the results

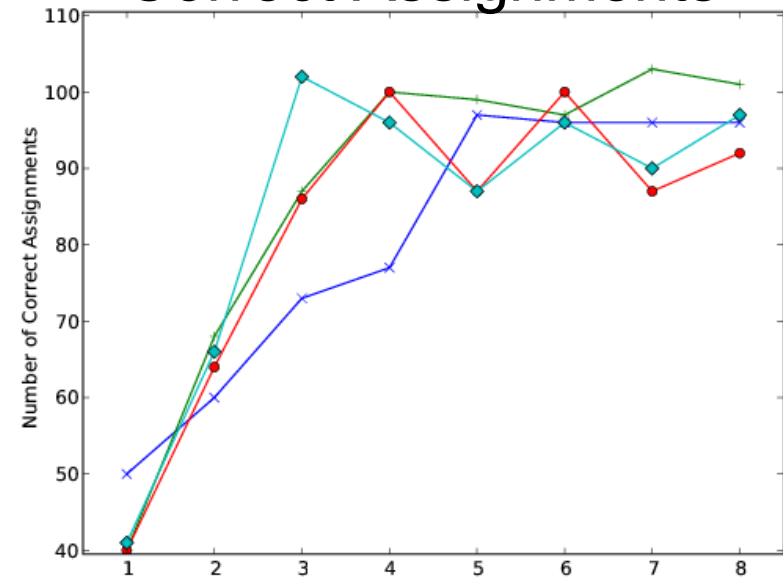


# Tracking Parameters Optimization

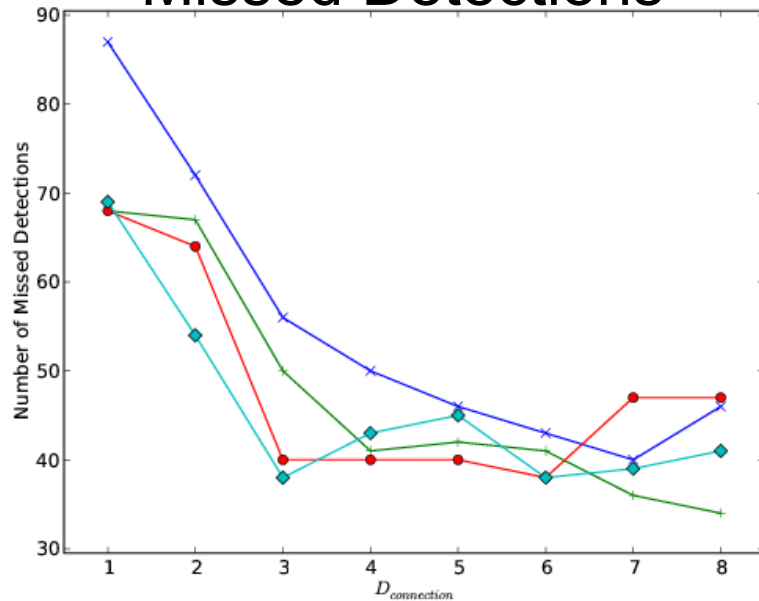
## Cost



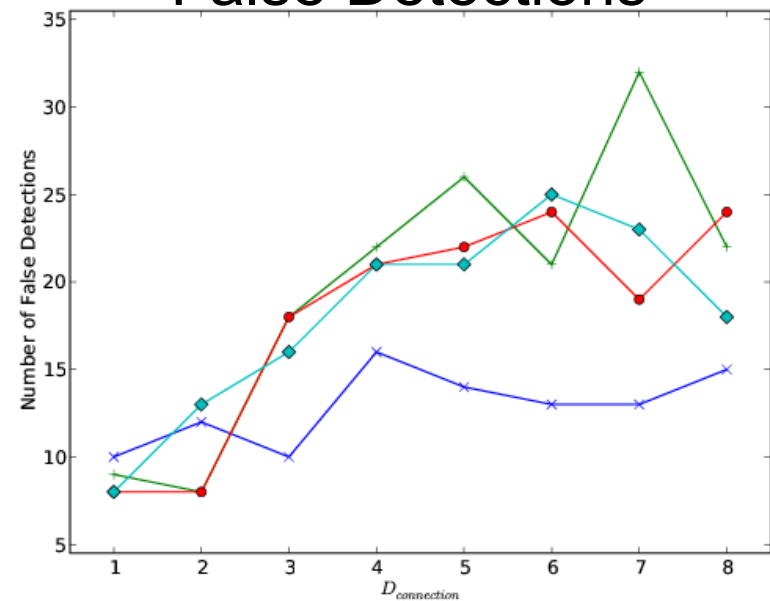
## Correct Assignments



## Missed Detections



## False Detections

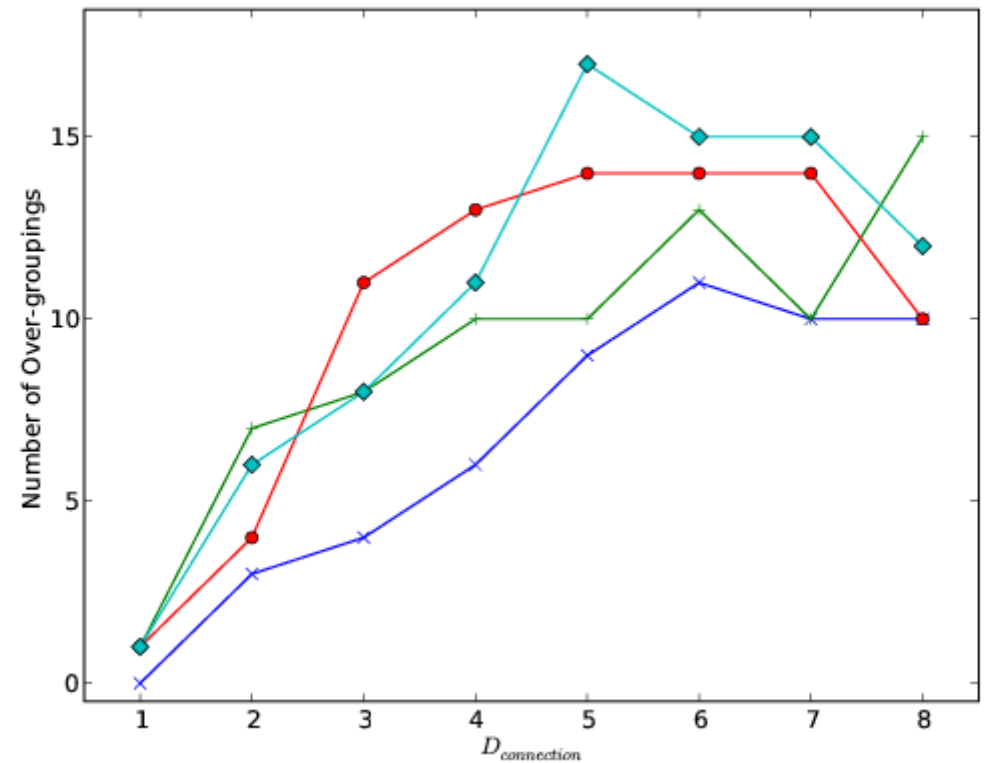
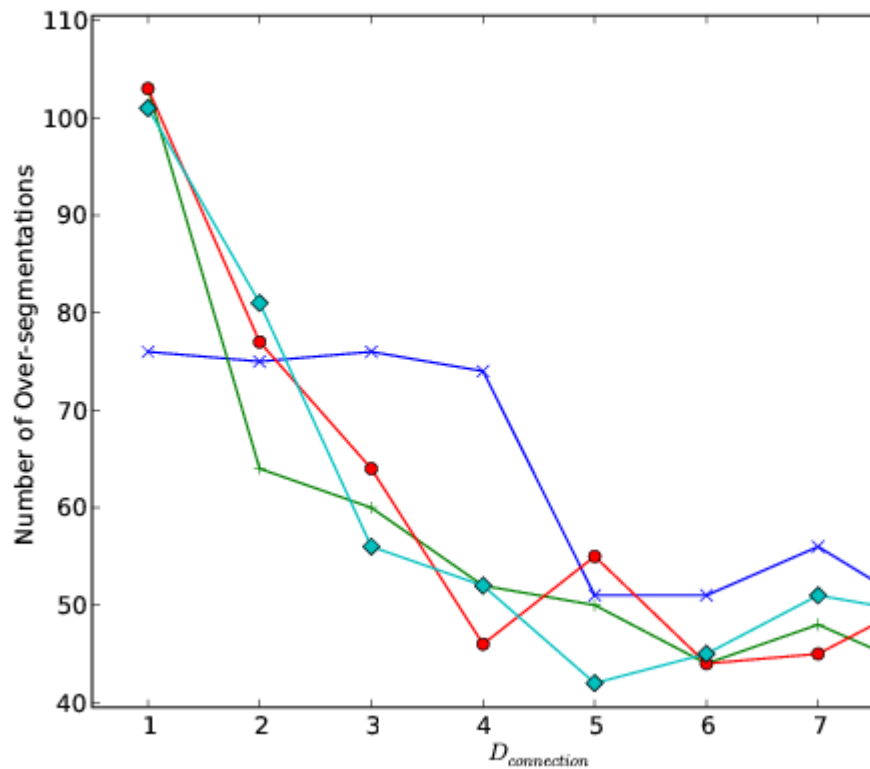


# Conclusion

- Track assignment is necessary for track-based performance evaluation.
- Other quantitative performance measures:
  - Over-segmentation and over-grouping ratios,
  - Average distance, track latency,
  - Fragmentation measure.
- Optimize performance and tracking parameters (*Lazarevic-McManus et al. 08*).

***Thank you for your attention***

# Tracking Parameters Optimization



# Tracking Parameters Optimization

