Automatic detection of vehicle interactions in a signalized intersection,

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1. The problem

- Purpose ?
  - Comparison of traffic light control strategies and their influence on the behavior and safety of road users.
- How ?
  - Automatic detection of interactions between road users.
  - Based on video sensors.
  - A real experiment, yielding a large database:
    - → 1 intersection, with 4 traffic lights control strategies, over a period of 8 months.

2. Our approach

- Intersection: critical zone, especially the conflict zone,
  - role of the traffic lights,
  - study traffic events *occurring in the conflict zone*.
- Traffic events relevant to safety ?
  - Accidents,
  - Traffic conflicts,
  - A. Svensson's framework (A. Svensson 1998): all interactions.
- *Interactions, with or without a collision course.*

2. Our approach: the severity

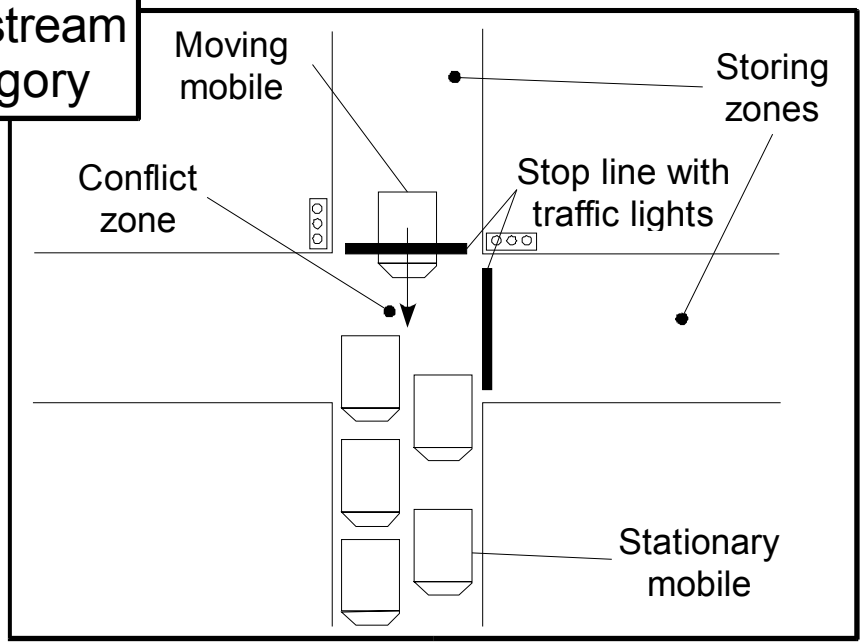
- Detect interactions and quantify their severity:
  - the distance between the interaction and the potential accident,
  - calculated in function of the features of the data,
  - interpretation: the distribution of the severity of the interactions.
- Previous work on vehicle-actuated strategies (R. van der Horst 88),
  - but no comparison with real time strategies (INRETS CRONOS).

2. A categorization of interactions

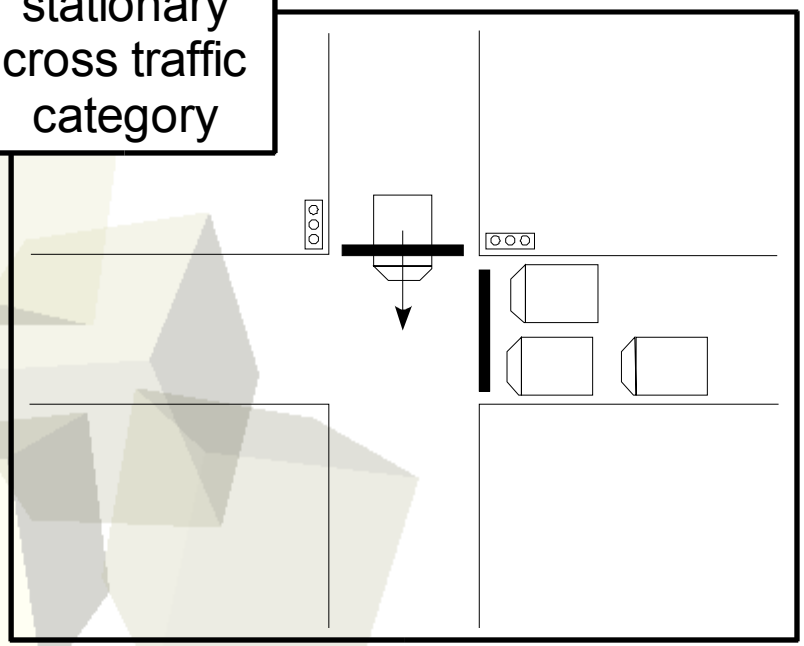
- A mobile = a road user + his vehicle.
- Categorization: *detection on the level of the zones*,
  - presence of mobiles,
  - collision course: mobiles in upstream storing zones have to cross the conflict zone,
  - not all interactions (no interactions within groups).

2. The categories to be detected

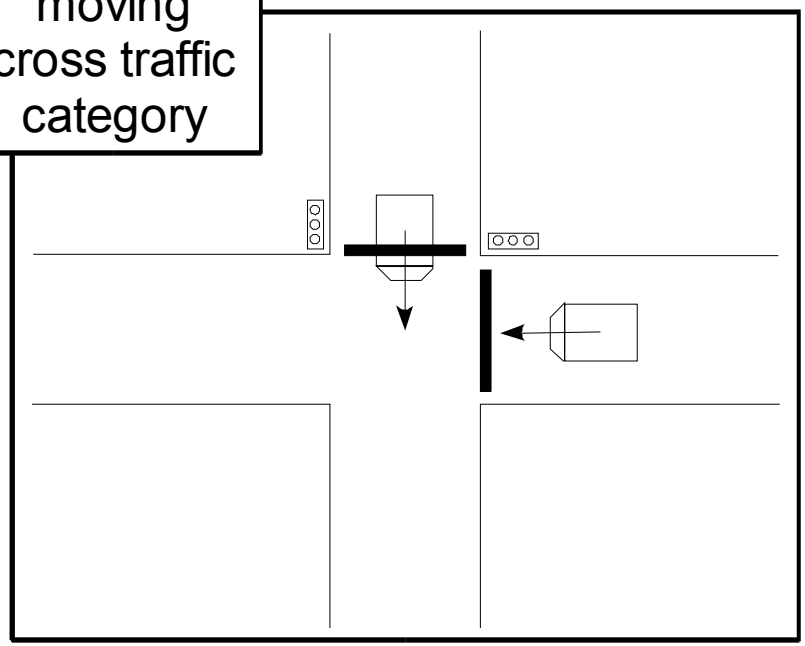
downstream category



stationary cross traffic category

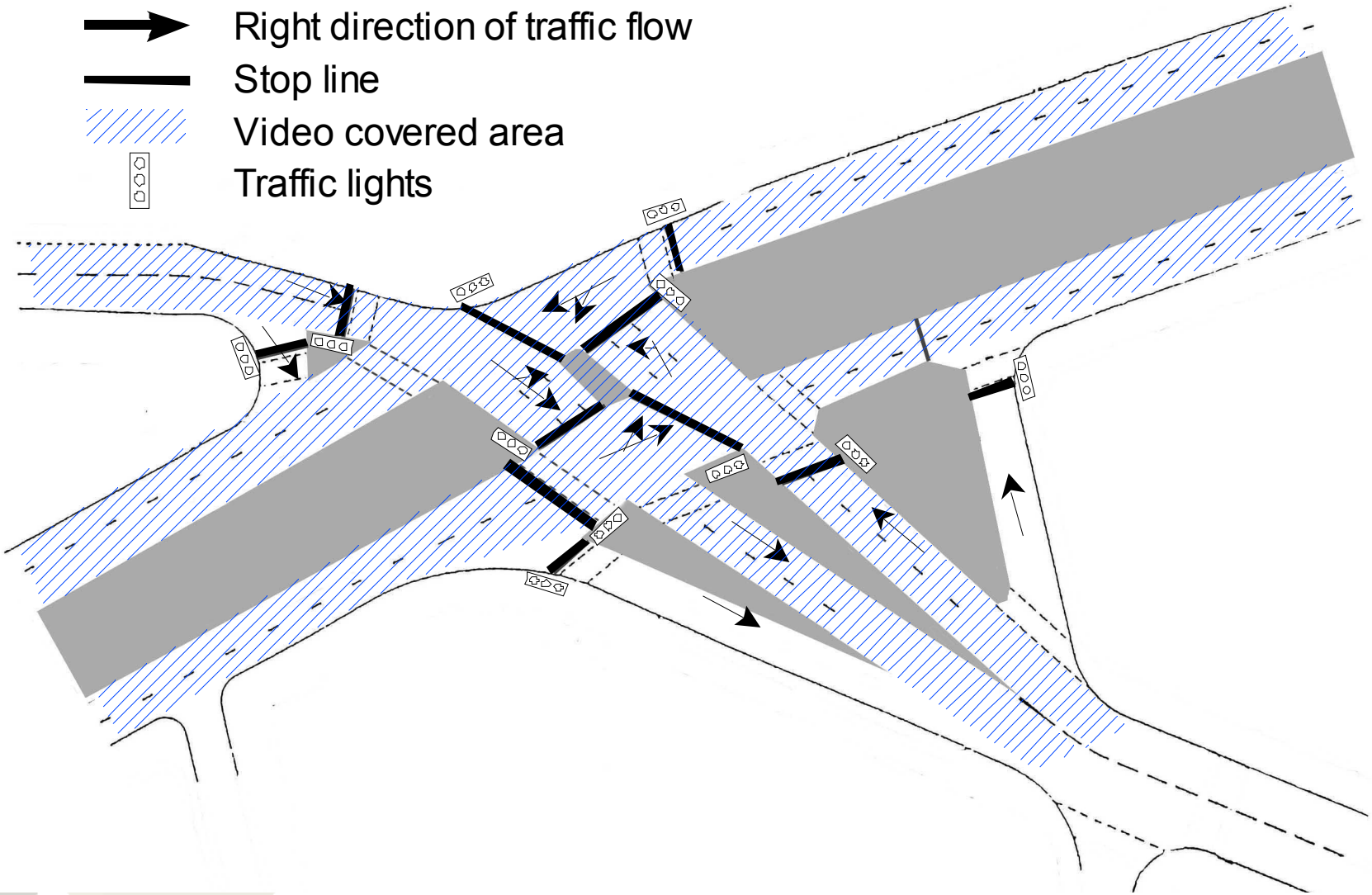


moving cross traffic category



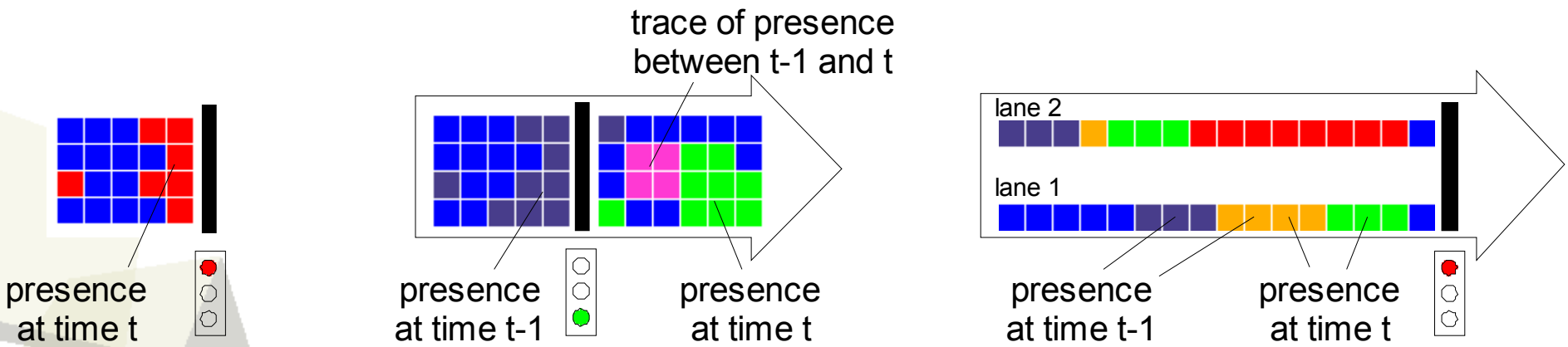
3. The intersection

- An urban intersection, near Paris.



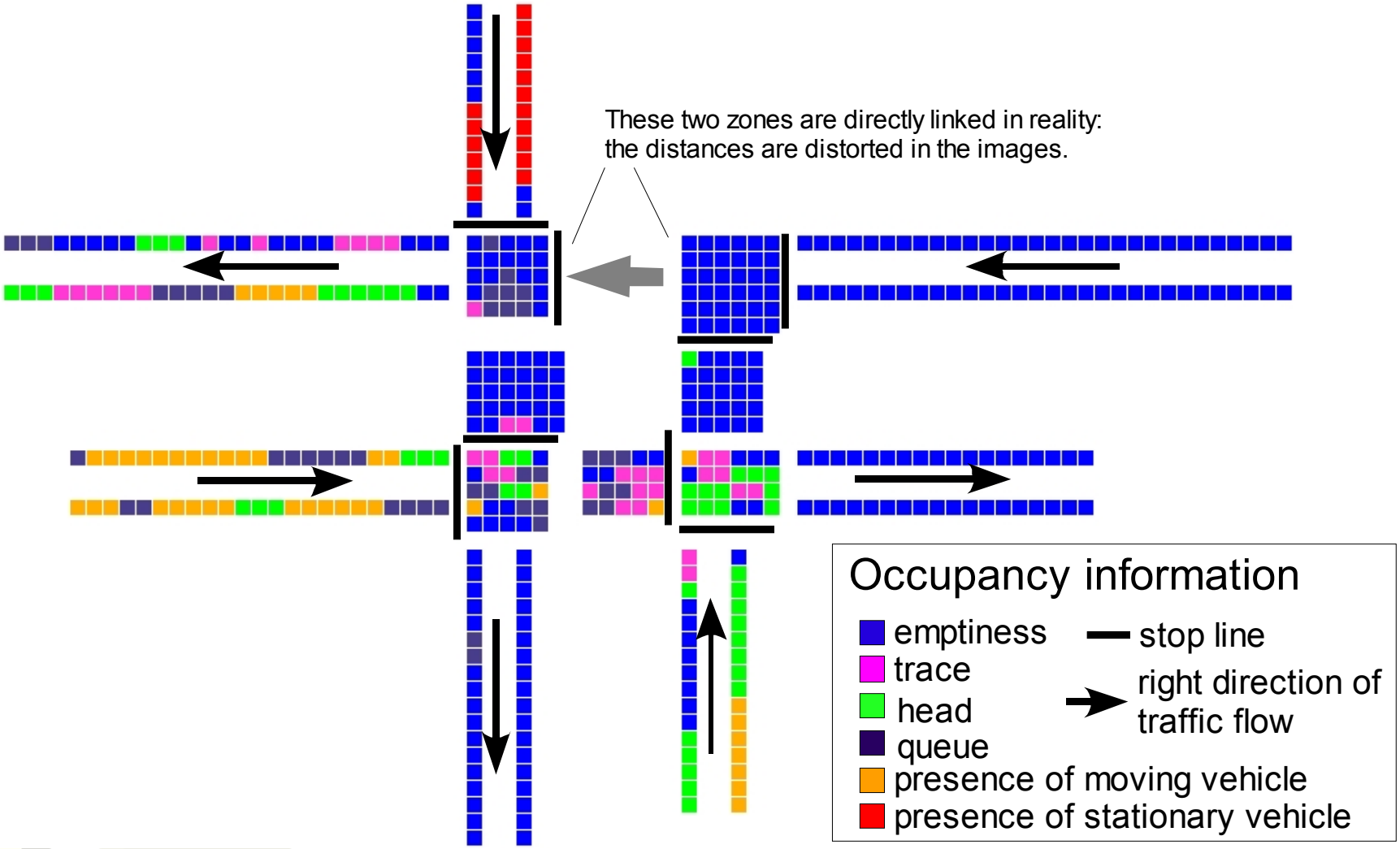
3. The data

- Surface data from video sensors: robust image processing tool.
- Basic discrete occupancy information: emptiness, presence of moving mobiles, and presence of stationary mobiles (no type of vehicle).



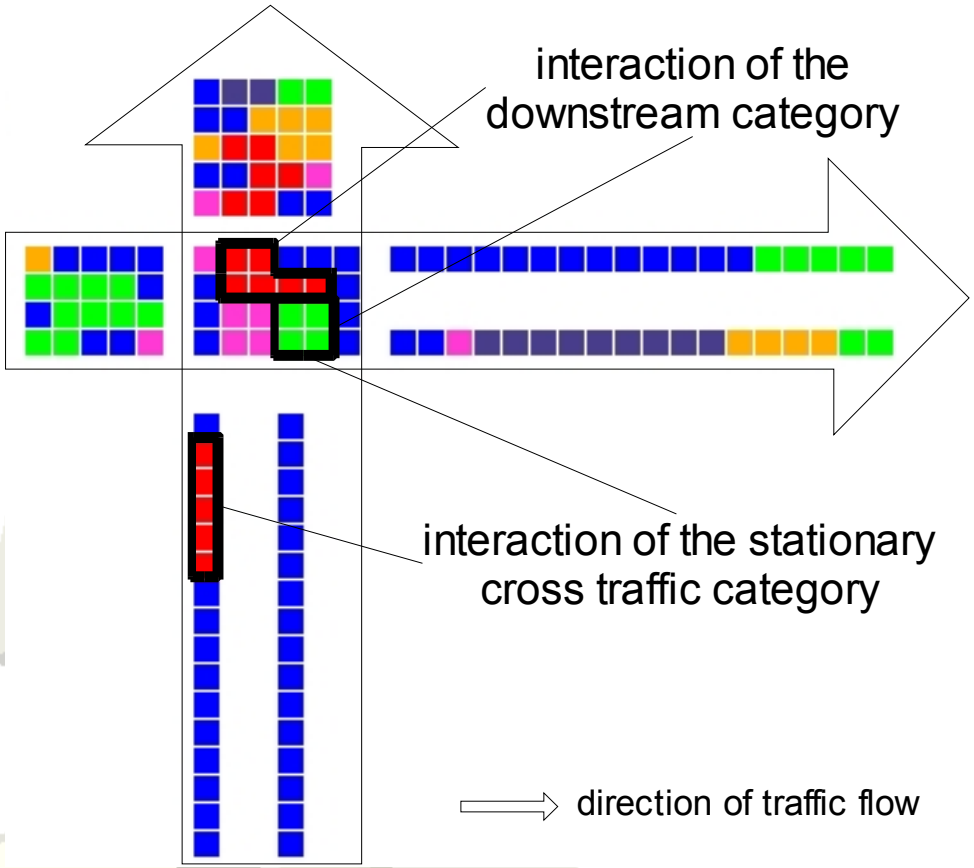
3. The image of the intersection

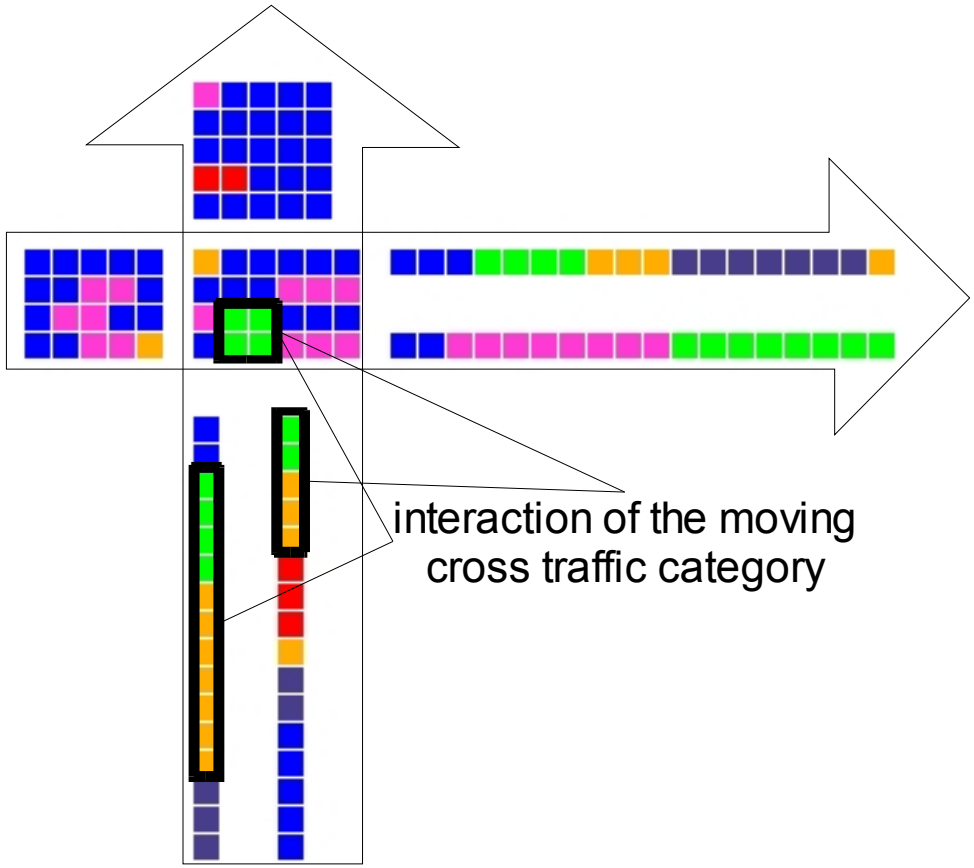
- Processed several times a second, combined every second in an image of the occupancy of the intersection.



3. Interactions in the data

- Configurations of connected sets of units of presence, called blobs.



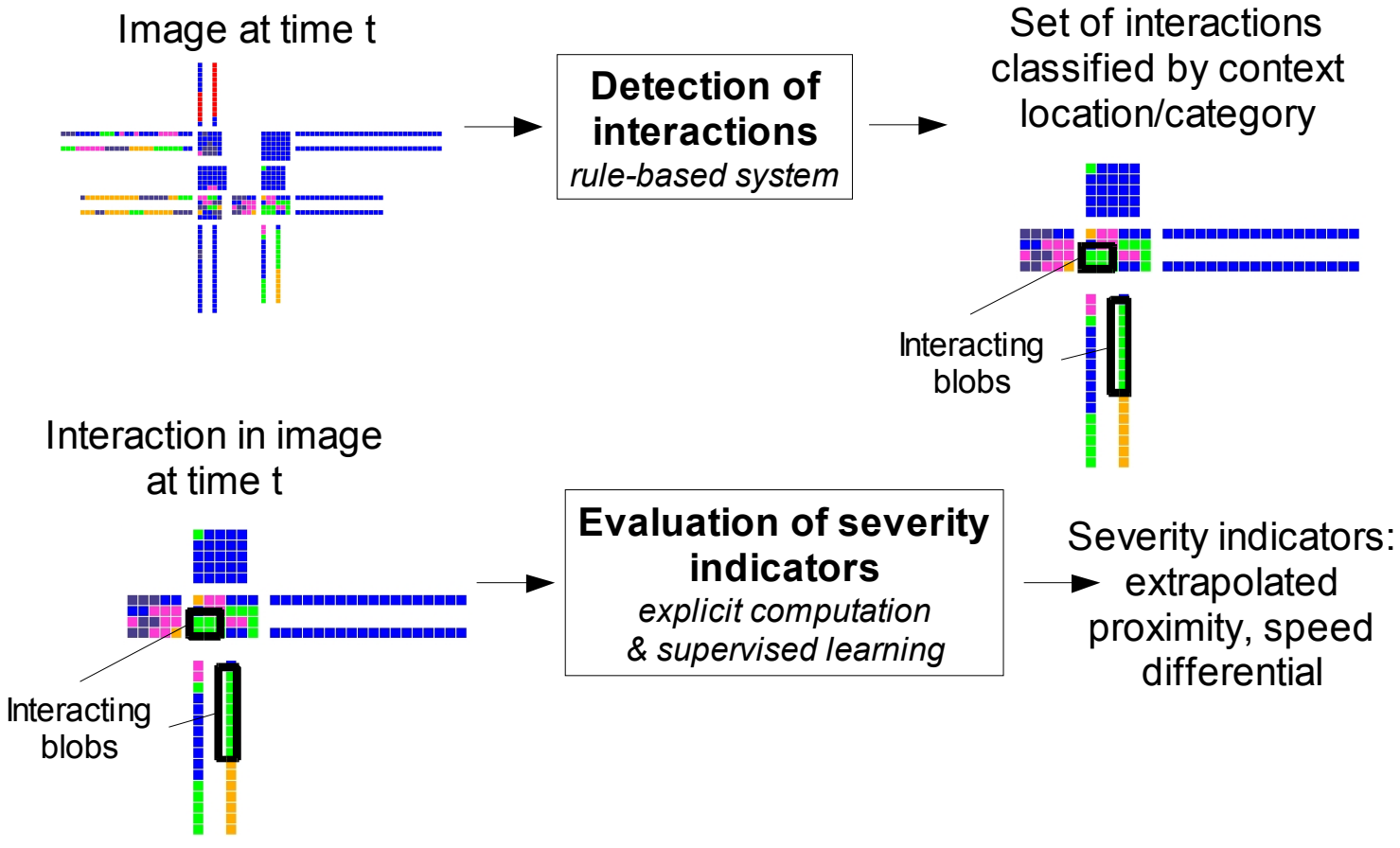


3. Severity indicators

- Information in the data: *speed and distance*.
- No complex indicator, no evasive actions.
- 2 indicators:
  - extrapolated proximity: minimal extrapolated distance between the protagonists,
  - speed differential: norm of the difference of the speed-vectors of the protagonists.
- Severity: the closer the protagonists, the higher the speed differential, the more severe the interaction.

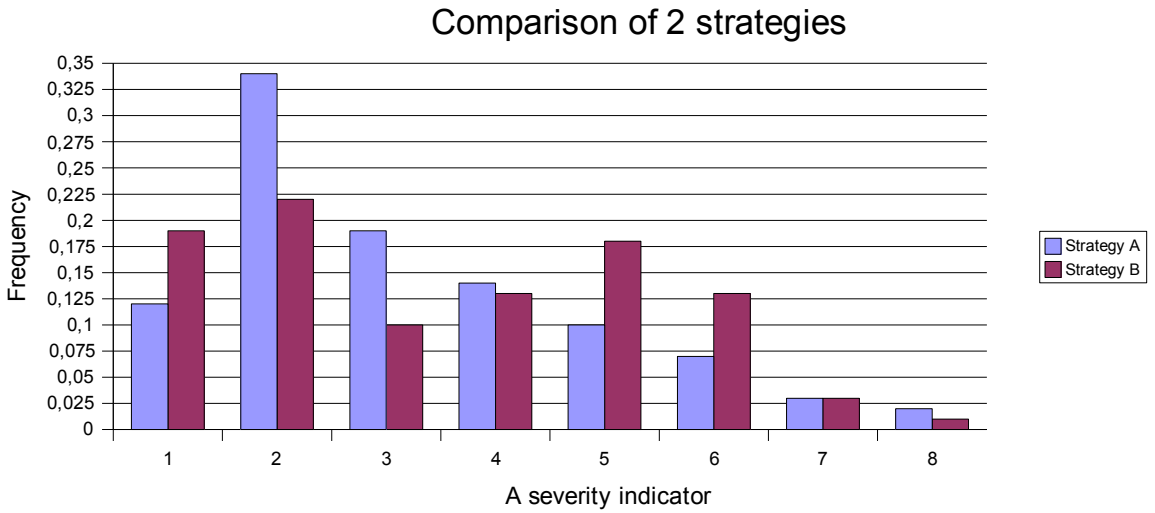
4. Development

- Rough data, but automatic detection for the treatment of large databases.
- No kinematics: work on images separately with pattern recognition methods.



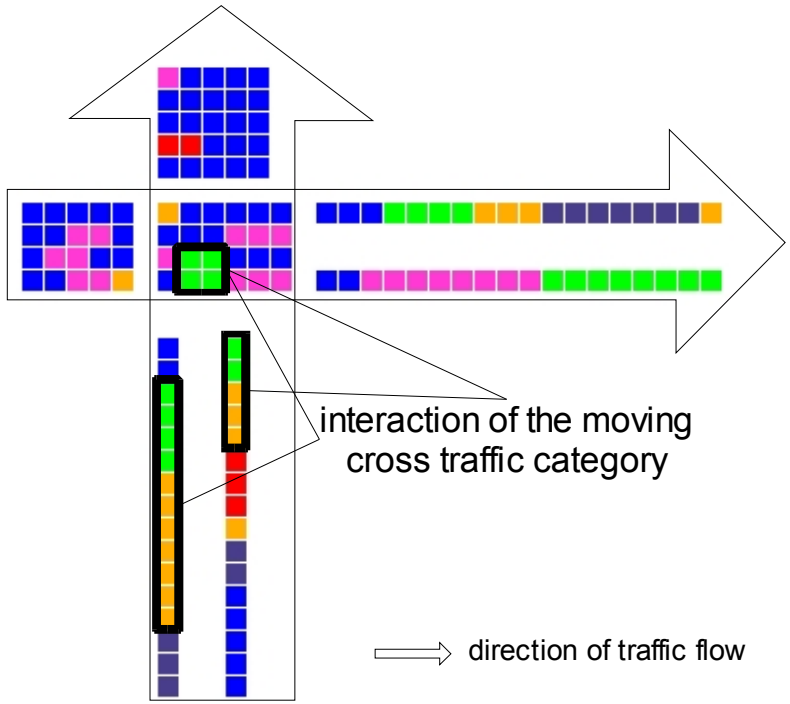
4. Evaluating the severity indicators

- Multi-sensor data, disagregation of the analysis:
  - compare interactions per location and category (context).
- Severity indicators: different difficulty in the tasks
  - extrapolated proximity: computed explicitly,
  - speed differential: supervised learning, which is more robust as the information is spread over the image.
- Goal: compare distributions (per context).



4. Focus on interactions

- More than one interaction can be detected in the same image and context:
  - ambiguity in the output.
- The *focusing* problem: how to weigh the relative usefulness of the parts of the input ?
  - different techniques.



5. Current results and validation

- Validation of the detection of interactions with respect to the reality (video) (10 minutes):
  - about 90 % of correct detections.
- Learning of the speed differential with a focusing technique and an artificial neural network:
  - 88% in generalization.

6. Conclusion

- No implementation of a Traffic Conflict Technique.
- Treat large databases automatically.
- Compare traffic light control strategies.
- General purpose video data (control, AID, safety diagnosis...).
- New safety diagnosis tool for traffic management at intersections.
- Work in progress.