Some studies on automated vehicle detection in Israel
by
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Ran Naor Foundation for Road Safety Research

Expert meeting automated video analysis of road traffic scenes

TNO Soesterberg 15-16 november 2010

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1. Automated obstacle detection at road – railway crossings
2. Automated detection of vehicle- pedestrian interaction at zebra crossing
3. Automated conflict analysis at intersections
4. Trajectory detection on freeways
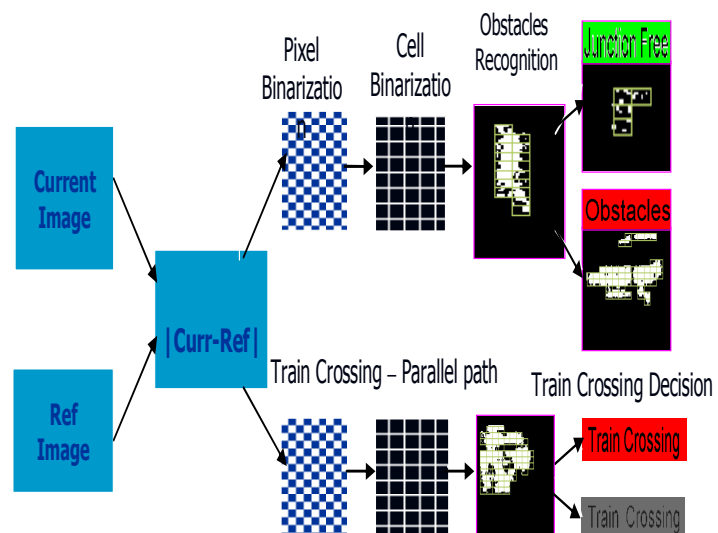
5. Research applications of Mobileye

Technion
Electrical Engineering Department
Vision and Image Sciences Laboratory

1. Automated obstacle detection at road – railway crossings
by Prof. Yehshua Zeevi et al., Technion Electrical Engineering

Main challenges of the developed algorithms where: Identification of region of interest. This was usually done manually by the user through initialization process.
Detection of objects which may be direct obstacles for an approaching train.
Different scenes, such as vehicles vs. walking peoples, should be distinguished accordingly, so that appropriate warning signal will be launched.
Approaching train should be distinguished from obstacles.

Main findings:
Indication of region of interest handedly during initialization is beneficial.
Developed algorithms give fast and accurate indication of presence of obstacles.
The obtained warning signal, classify the nature of obstacles. Vehicles/walking persons/other.
Approaching trains are identified as such.

All the above applies also for night vision photography, as well as for photography from different view angles and different locations. This indicates the robustness of the algorithms developed during the research.
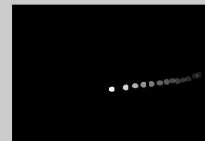
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A SMART CROSSWALK

Stav Yoffe & Noa Mauber
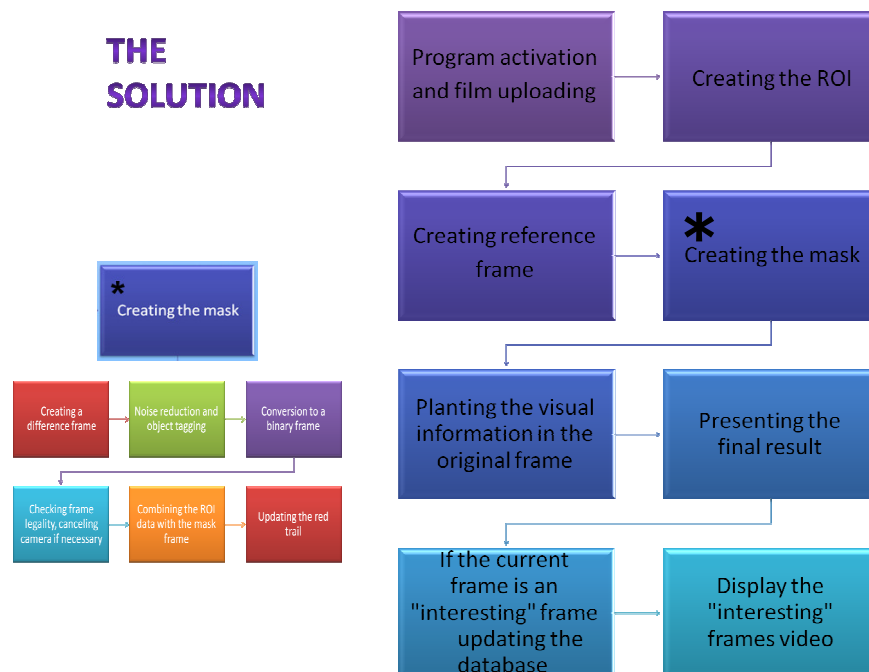**Guidance: Johanan erez**
October 2009

OBJECTIVES

- Planning and implementing a system for analyzing videos of crosswalks.

- Identify "interesting" situations such as danger to pedestrian and traffic violations. Saving the results in a database for offline analysis.

CLIENT REQUIREMENTS / THE PROBLEM

- Developing a new method for analyzing videos. (Previous Projects)

- Creating a red trail after "Objects". Provides information on speed and direction of movement.
- Definition of an "Object".
- Coping with changing conditions such as:
  - Lightning   -- blockage of FOV
  - Distance from the object   --Camera's angle
  - Background   --Low Resolution
  - neutralizing of a camera
- Definition of an "interesting" frame.

- the ability to redefine an "interesting" frame if necessary.

- Cutting long videos to "interesting" frames only.

- Setting a valid image.

- Coping with neutralizing of a camera.

THE SOLUTION

```
Program activation          Creating the ROI
and film uploading
        |                          |
        v                          v
Creating reference          * Creating the mask
frame
        |                          |
        v                          v
Planting the visual         Presenting the
information in the          final result
original frame
        |                          |
        v                          v
If the current              Display the
frame is an                 "interesting"
"interesting" frame         frames video
updating the
database
```

* Creating the mask

```
Creating a          Noise reduction and       Conversion to a
difference frame    object tagging            binary frame
        |
        v
Checking frame      Combining the ROI         Updating the red
legality, canceling data with the mask        trail
camera if necessary frame
```

Creating reference frame

- Dividing the film into segments (K frames each)

Noise reduction and object tagging

The original frame
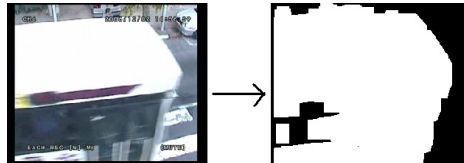

The background

The difference frame

After noise reduction

Checking frame legality

- Vision blockage by a very large object:

- Noisy frame in case of:
    - Temporary blindness of the camera:

- Shadow appearance:

Even after the shadows disappear, the picture is still invalid because both of the pictures are in the same segment, and the background frame is distorted.

CONCLUSIONS & SUGGESTIONS FOR FUTURE DEVELOPMENT

- Implement the program in C.
- Method of frames subtraction requires many adjustments.
- Adjustments are the result of trial and error.
- The current format of the program allows to study the properties of movement.
- The ultimate goal is the construction of an alert system that runs in real time for drivers and pedestrians in order to reduce traffic accidents at intersections.

3. Automated conflict analysis at intersections
by Prof. David Mahalel et al., Technion
Civil Engineering

Feasibility of computerized monitoring
system for flow and risk measurement on
the signalized intersection

By
Prof. David Mahalel
Ms. Yelena Blumovitch

Standard Behaviour
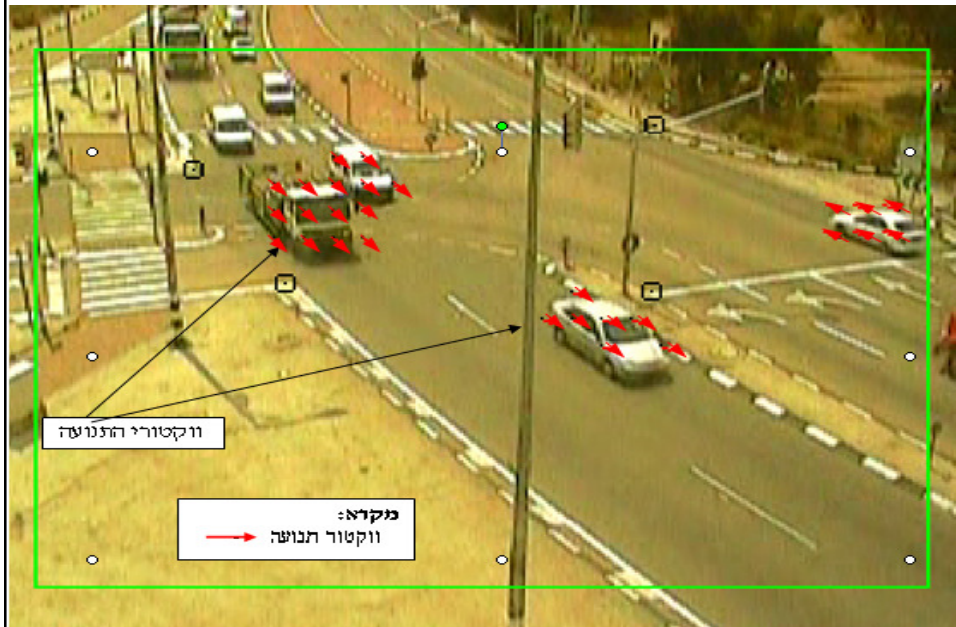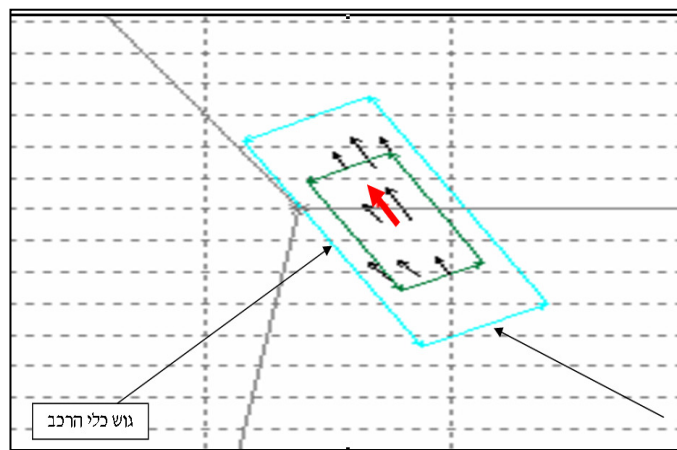
Errors in Driving Behaviour

Traffic Conflicts

Accidents

Frequency
of Events

Dangerousness
of Events

Example

1	2
לוחית ראשית	לוחית ראשית
	לוחית זיהוי

מקרא :

■ - זיהוי עצם (לוחית רישוי) ■ - זיהוי העצם (לוחית זיהוי) מחדש במיקום שונה

Vector of movement

Safety area

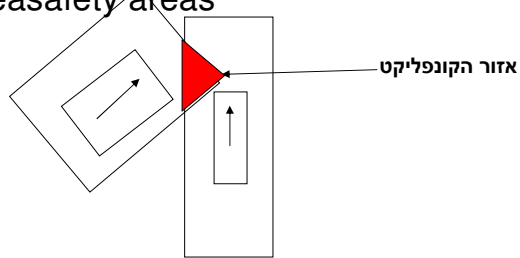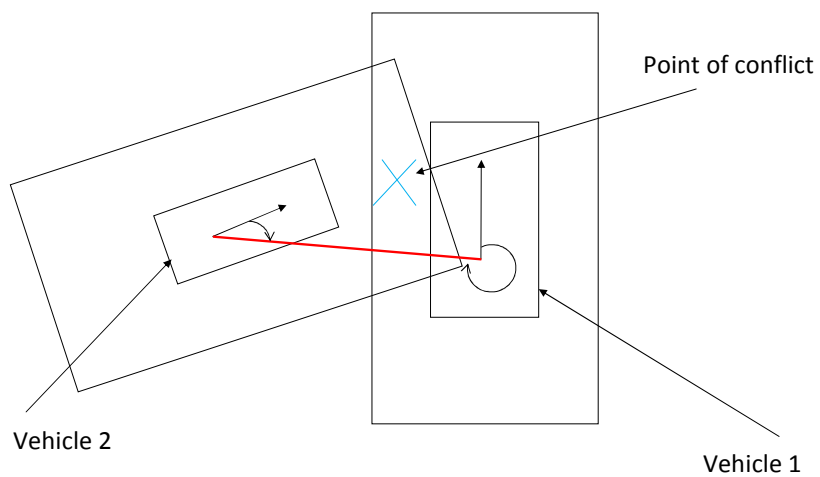**Safety area – a square that is parallel to the lines of the object**
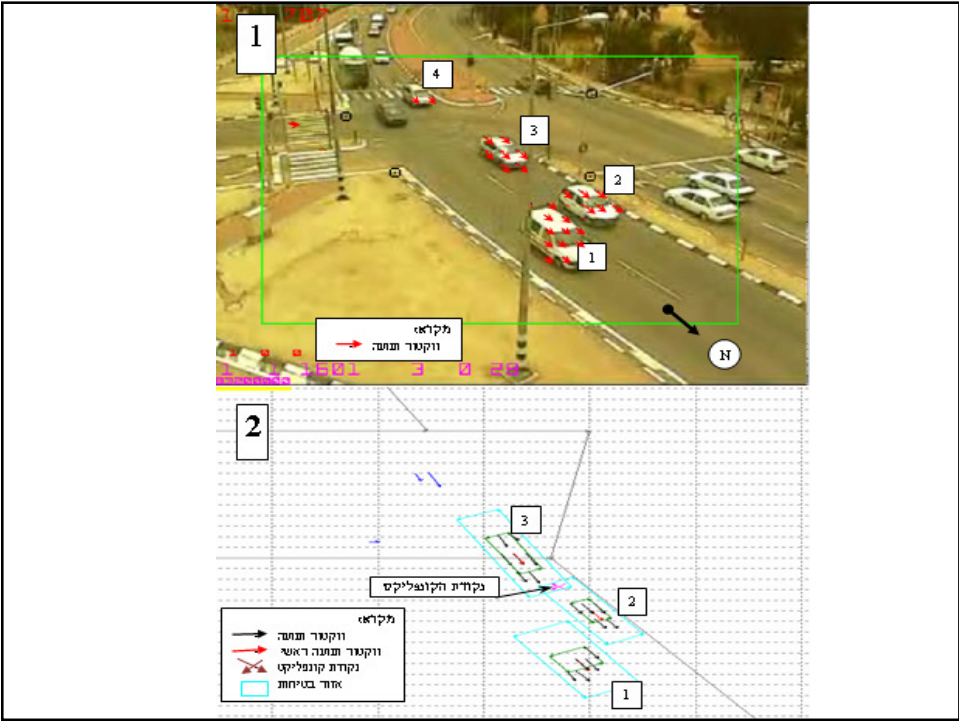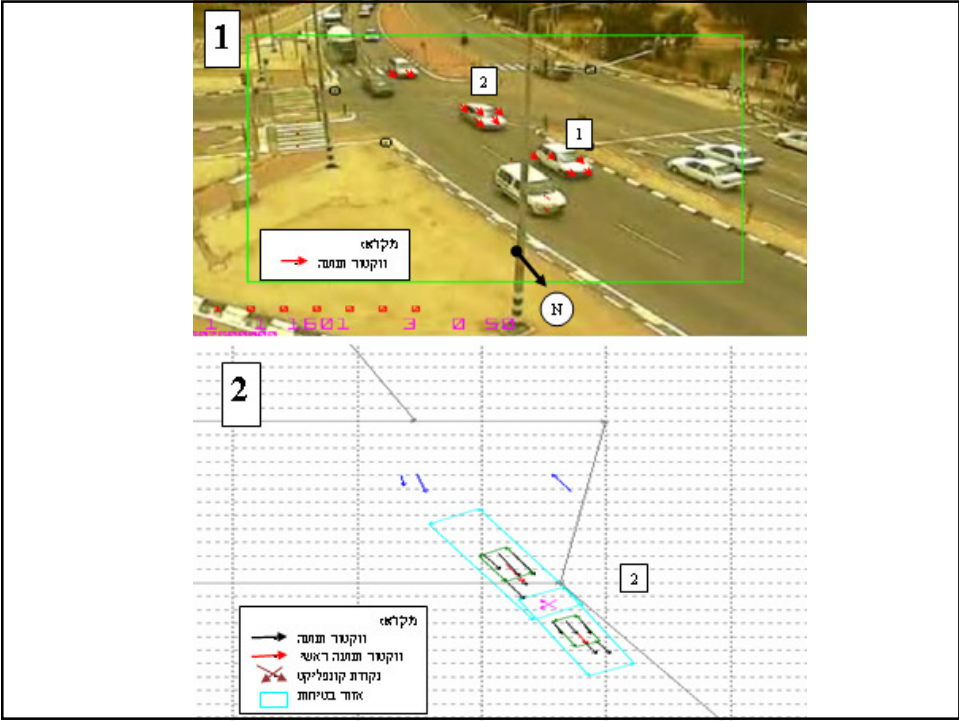
Conflict

- **Conflict**- a situation where there is danger of 2 vehicles colliding if they do not take evasive action
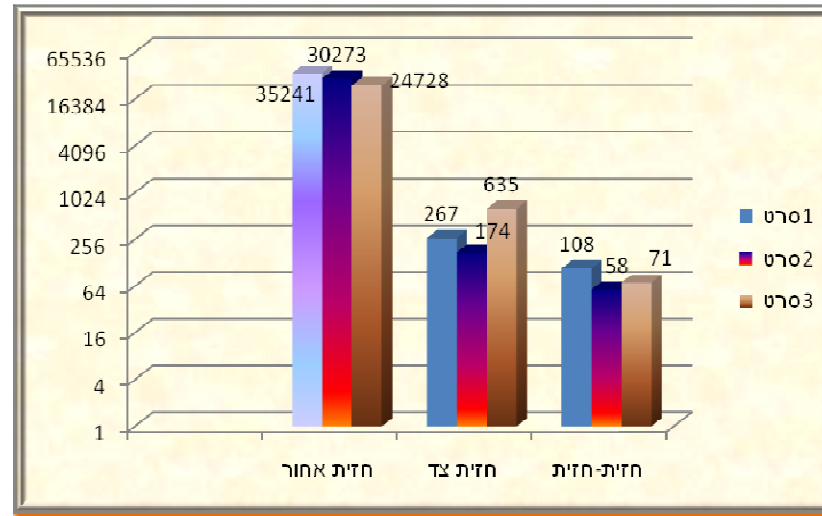- **Conflict situation –** when there is an overlap of the . The area of overlap is the conflict areasafety areas

אזור הקונפליקט

Conflict

Point of conflict

Vehicle 2

Vehicle 1

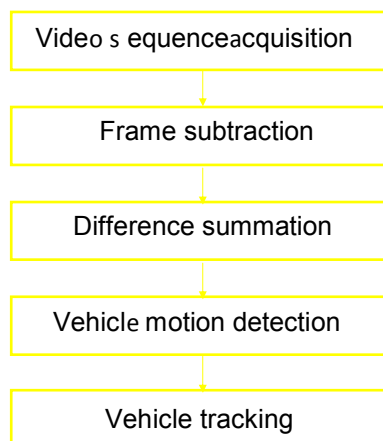## Distribution of types of conflicts at junction

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4. Trajectory detection on freeways
by
Dr. Tomer Toledo and Dr. Sagi Filin
Technion
Civil Engineering
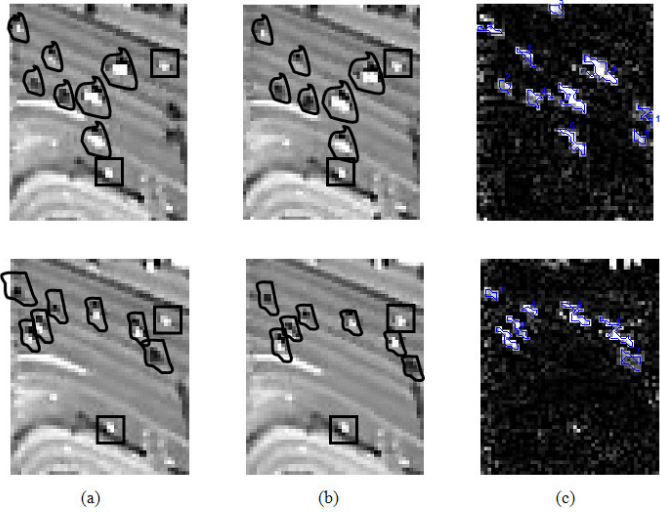
Detection in the far field

- Tilted camera
- Far field
  - Small part of picture, but ~50% of space
  - Focus on detecting movement rather than vehicle objects
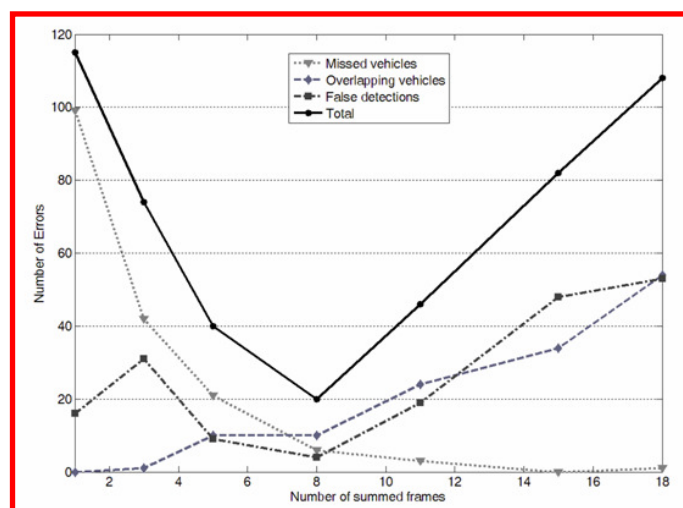

Detection steps

```
┌─────────────────────────────────┐
│  Video sequence acquisition     │
└─────────────────────────────────┘
                │
┌─────────────────────────────────┐
│      Frame subtraction          │
└─────────────────────────────────┘
                │
┌─────────────────────────────────┐
│     Difference summation        │
└─────────────────────────────────┘
                │
┌─────────────────────────────────┐
│   Vehicle motion detection      │
└─────────────────────────────────┘
                │
┌─────────────────────────────────┐
│       Vehicle tracking          │
└─────────────────────────────────┘
```

Motion detection

(a)   (b)   (c)

Detection errors

Obstructions

Trajectories

Event detection

Summary

- Tracking method relies on movement, not feature identification
  - Useful with small number of pixel vehicles
  - Able to obtain early detection in the far field
  - Can increase length covered by a camera

- Reference
  - Klein I. et al. (2008), Vehicle detection in far field of view of video sequences, Transportation Research Record 2086, pp. 23-29

5. Research applications of Mobileye
by
Eran Erez
Mobileye