



Vehicle monitoring using digital video sequences

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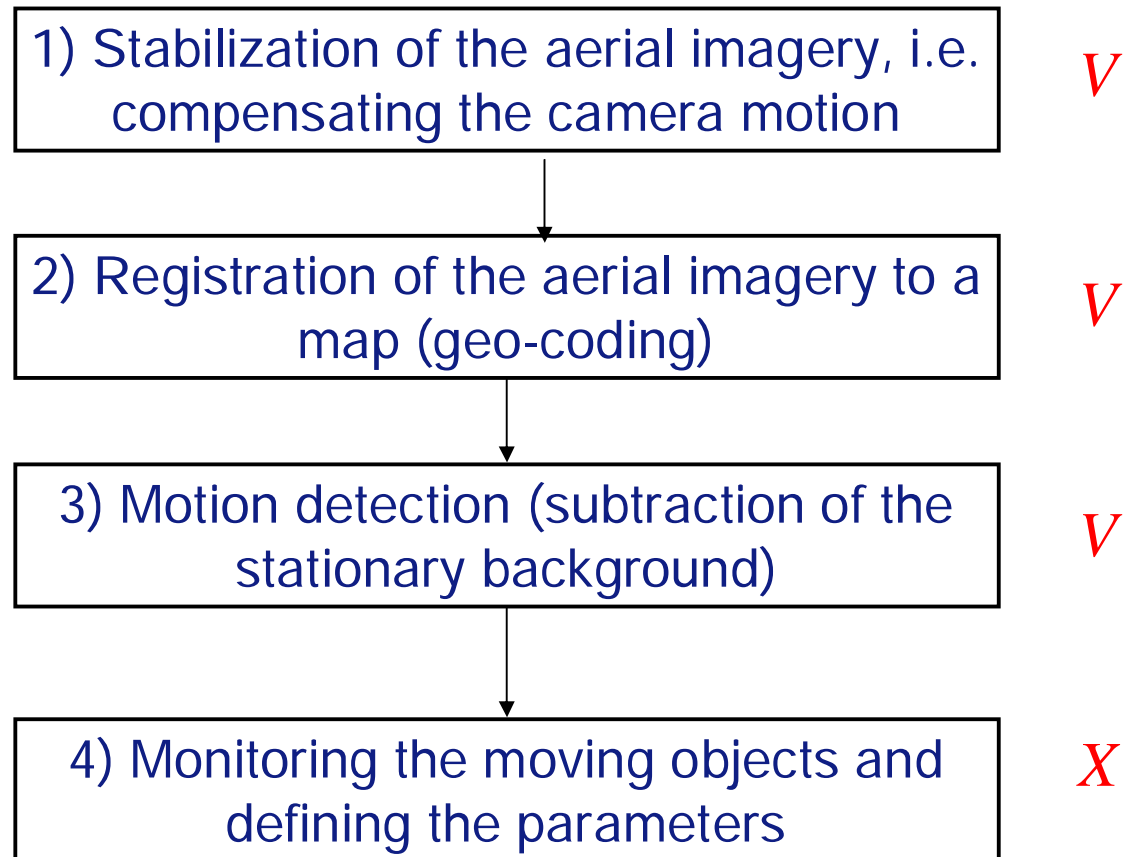
Introduction

- This presentation introduces the results of the ENVIMON traffic monitoring application
- The presentation includes video clips that are archived in a zip-file (traffic1.zip), which is separately downloadable from the ENVIMON website
 - The names of the video clip files are presented in the slide titles in brackets
- The original objectives of the application
 - General:
 - Detecting, locating and identifying velocity of the traffic flow and individual traffic objects (car, bus) from aerial imagery
 - Method development:
 - As automatic processing chain as possible for preprocessing and analysis of aerial imagery
 - Delivering the results to the customer in a appropriate form
 - System development:
 - Prototype of the whole processing chain : descriptions, preprocessing, analysis

Traffic application present state

- Material shot at summer 2002 used in the method development
- Baseline was using motion as the detection technique
- Method development focused on the video sequences with frame rate of 25 fps (requirement over 10 fps)
- Method development done in Matlab environment, where are existing procedures for image processing
- Method prototype for preprocessing and detecting moving objects from video sequences ready

Processing steps of the prototype



Erottaja: 200 m, 20 s video (25 frames/s), raw data [200-20sec.avi]

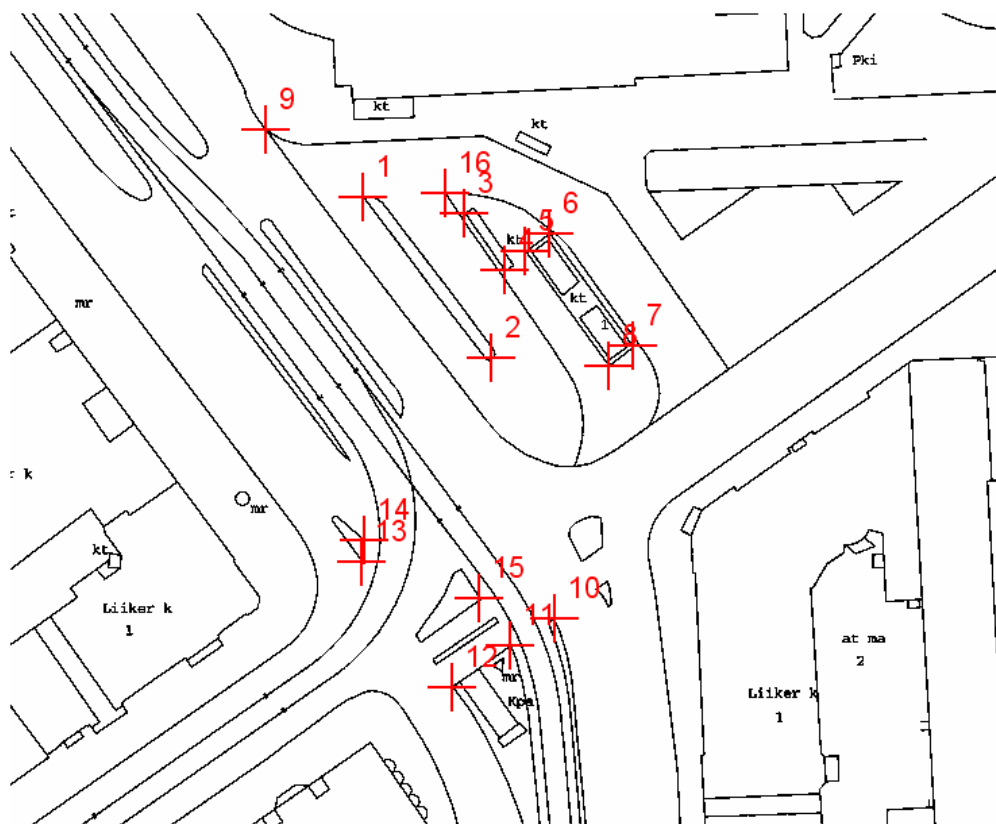


Registration to 1st frame of the sequence (step 1) [200-mosaic.avi]

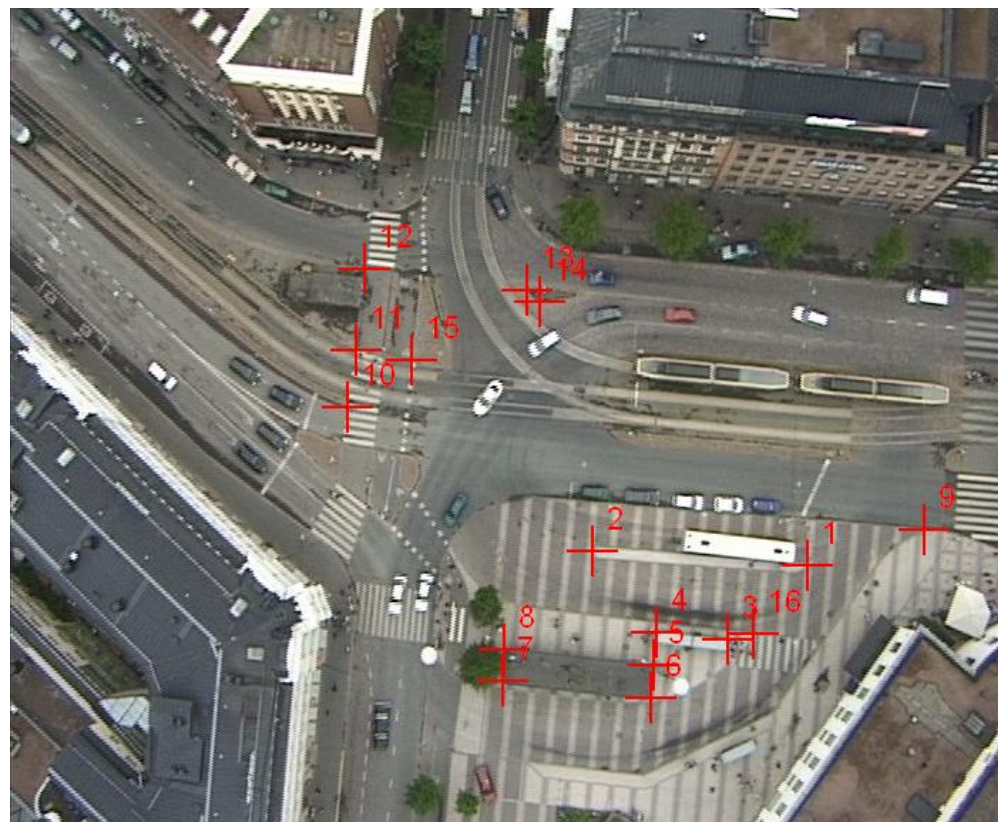


Registration to the digital map (step 2)

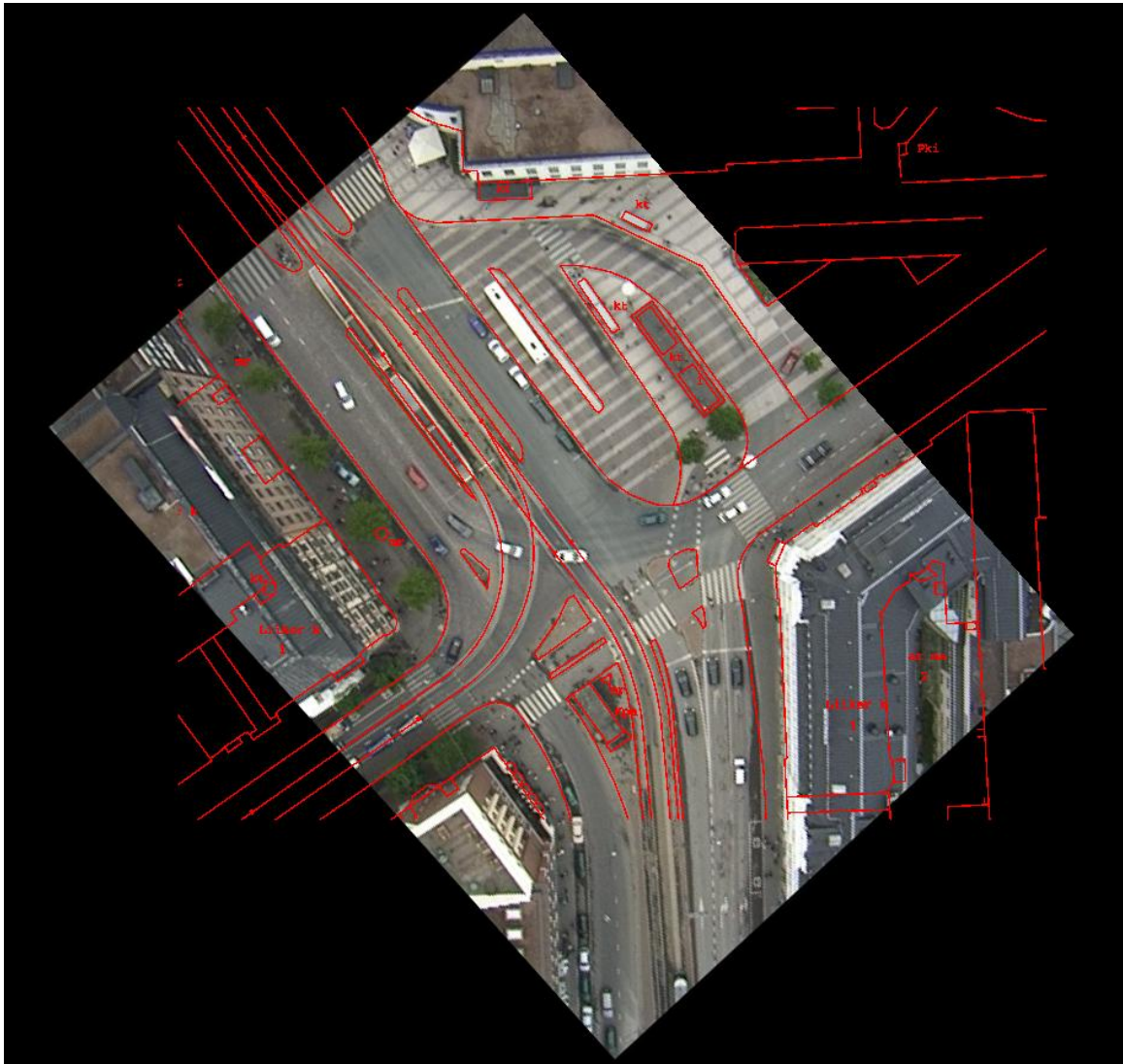
City map



1st image of the sequence

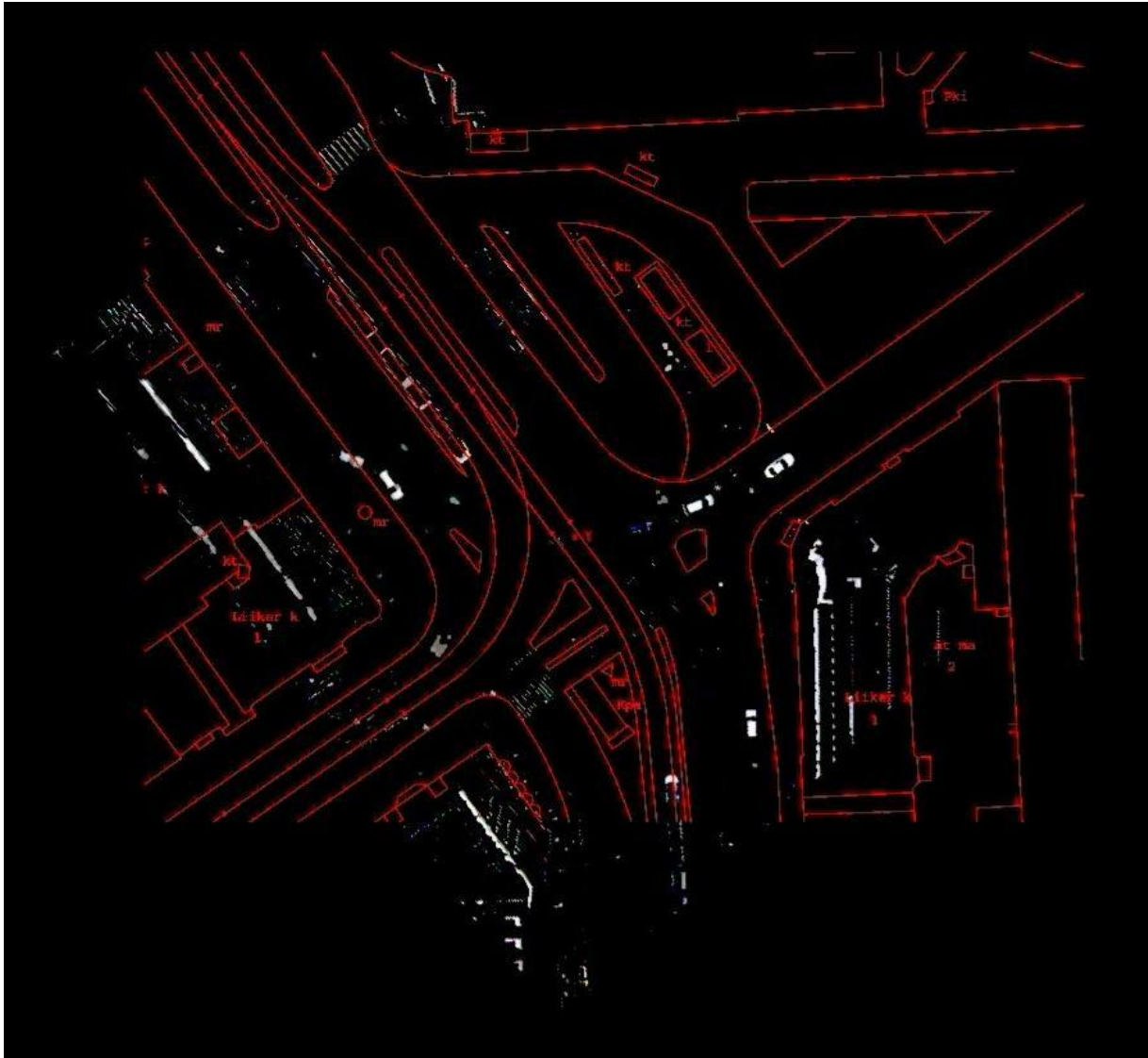


Geo-coded, stabilized video sequence (step 2) [200-mosaic_reg.avi]



- Some camera movement remained, visible mostly in building walls
- Feasible for extracting moving objects

Removing (subtraction) of the stationary background from the sequence per frame (step 3) [200-MVOdetection.avi]



- Cars, busses, trams remained
- Imperfect stabilization can be seen, e.g., at the crosswalks

Further development (y. 2005 vision)

- Objective to define the traffic load (number of cars, locations, speeds) of the desired area
- Increasing the automation
- Testing with the existing sequences and possibly with new ones
- New imaging flight in the Helsinki metropolitan area
 - Shooting from a helicopter with a video camera or a fast digital camera (min. 6 images per second)
 - Better resolution
- Design and implementation of the prototype system (ENVIMON concept)
 - Workflow processing
 - User interface

Alternative development directions (y. 2005 vision)

- Re-definition/focusing of the application
 - Using fixed camera platforms (towers, balloons)
 - Monitoring intersections and junctions
- Usage
 - Separate imaging campaigns
 - Continuous monitoring
 - Real-time requirement (definition: information less than 5 min. old) ?
- Imagery processing (application + ENVIMON)
 - Definition of the desired parameters
 - Representation
 - Delivery

Intersection monitoring - preliminary study

- Detecting cars stopping in a given zone with a fixed camera (ground / near ground level)
- Test dataset : Kamppi, 25fps colour imagery, aquired by Helsinki KSV
- New challenges
 - occlusions of cars (by other cars, by trees, ...)
 - vehicle shadows overlapping
- Preliminary results
 - background subtraction + tracking
 - improved accuracy in speed estimation

raw sequence [Kamppi.avi]



background image
(vehicles removed)

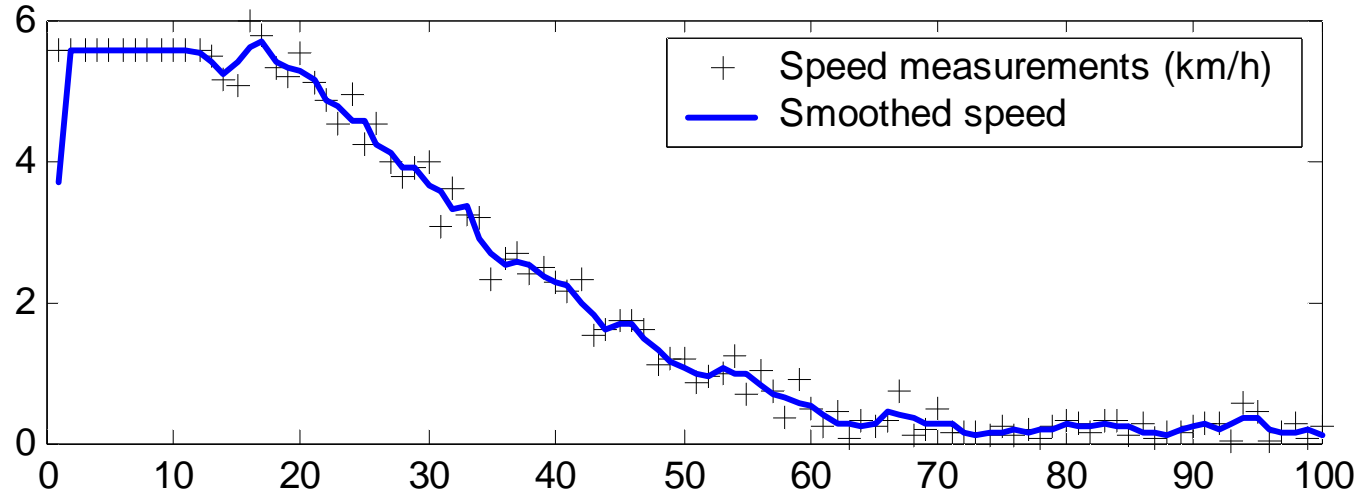


Moving pixels detection [Kamppi-MVOdetection.avi]

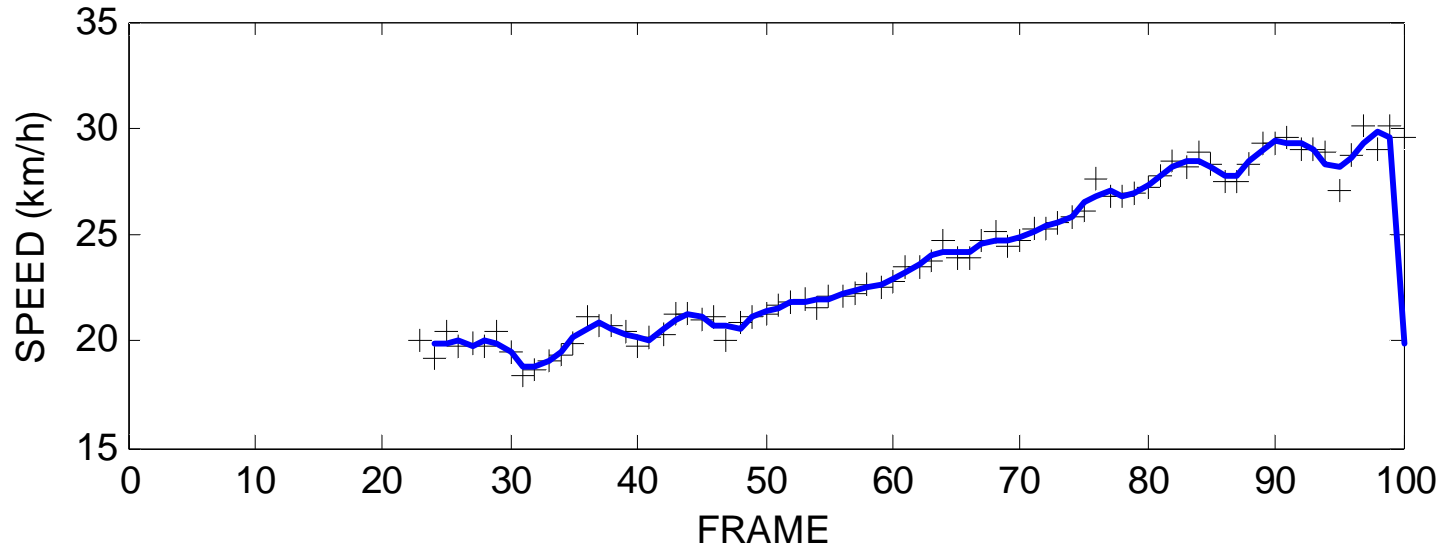


Velocity profiles for two cars

Vehicle 13 stopping



Vehicle 20 accelerating



Tracking vehicles [Kamppi-Speeds.avi]

