Human Detection in Difficult Scenarios by Combining Motion and Appearance

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ADVANCED COMPUTER VISION
Ein Unternehmen der Austrian Research Centers

Motivation

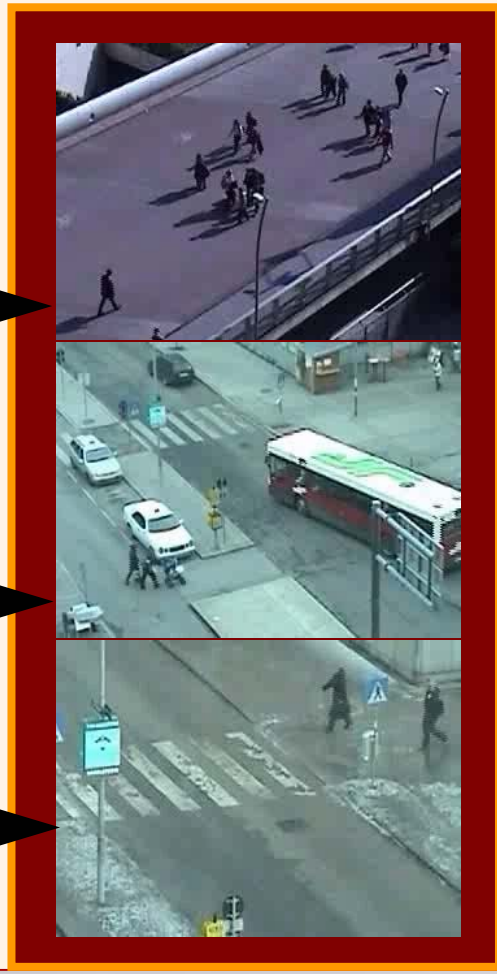
Reliable detection of moving humans by a static camera.

Detection probabilities less than one

- Occlusions
- Low contrast

False alarms by:

- Shadows
- Moving vehicles
- Shaking camera



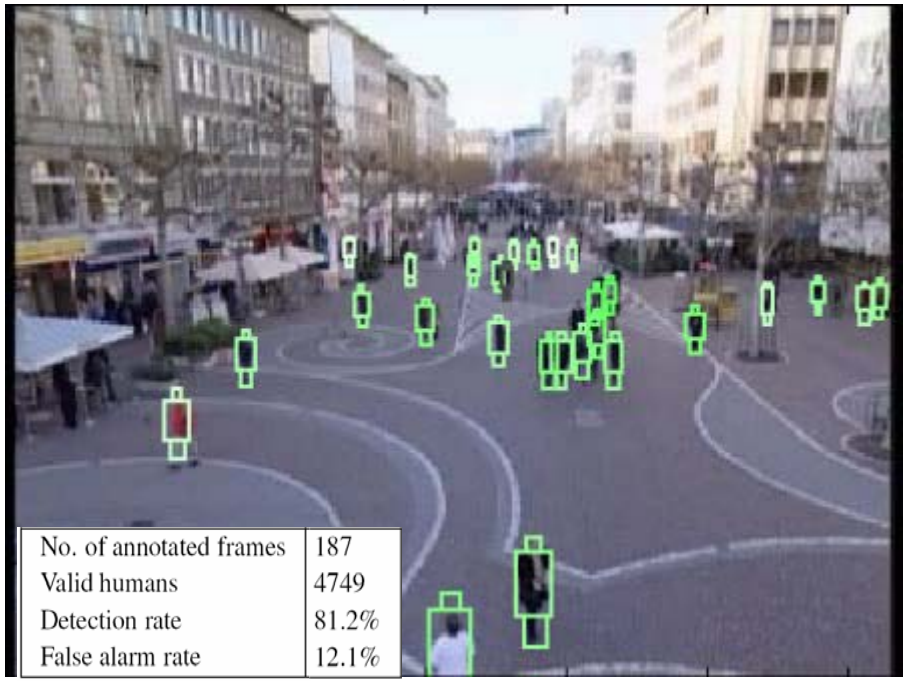
Contents

- **Detecting humans by motion detection**
  - Data-driven clustering complemented with the use of a human model.
- **Combining motion detection with statistical learning**
- **Results**
  - Crowd
  - Shadows
  - Moving vehicles, low contrast, shaking camera
- **Outlook**
  - Video data sets for evaluation / basis for cooperation

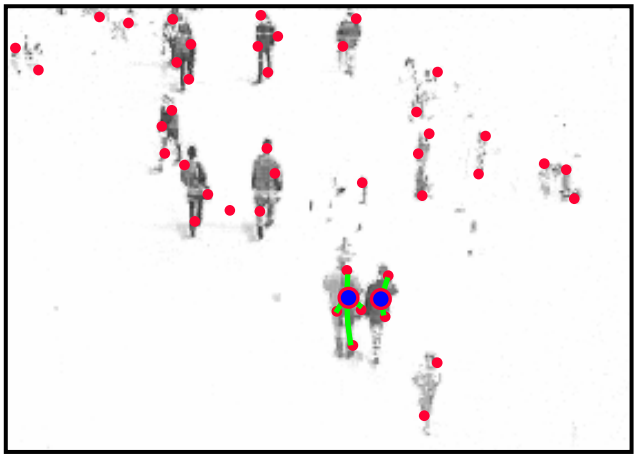
Motion-based human detection

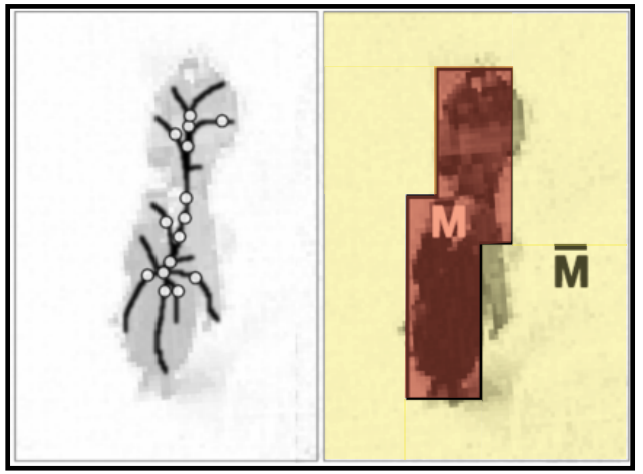
■ Fast clustering of the difference image

- Mean Shift procedure using integral images.
- Model-based validation of hypothesized configurations:
  - Removing spurious detections
  - Occlusion handling



No. of annotated frames	187
Valid humans	4749
Detection rate	81.2%
False alarm rate	12.1%





C. Beleznai, B. Frühstück and H. Bischof,
"*Tracking Multiple Humans using Fast Mean Shift Mode Seeking*",
PETS 2005 Workshop

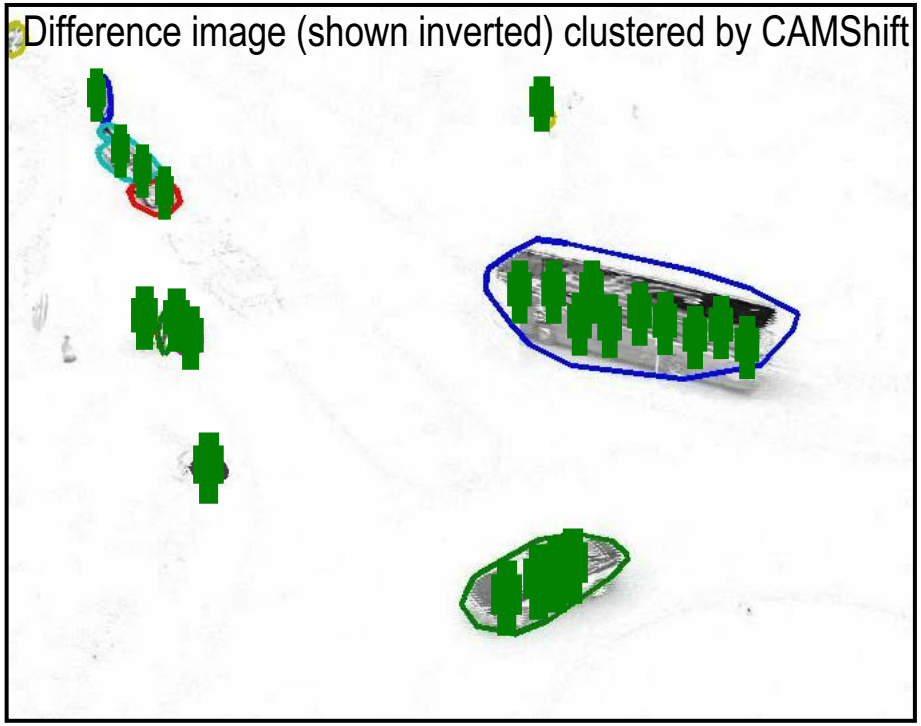
Dual-hypothesis propagation

Problem:

Model-based human detection is not discriminative enough.

Ambiguity:

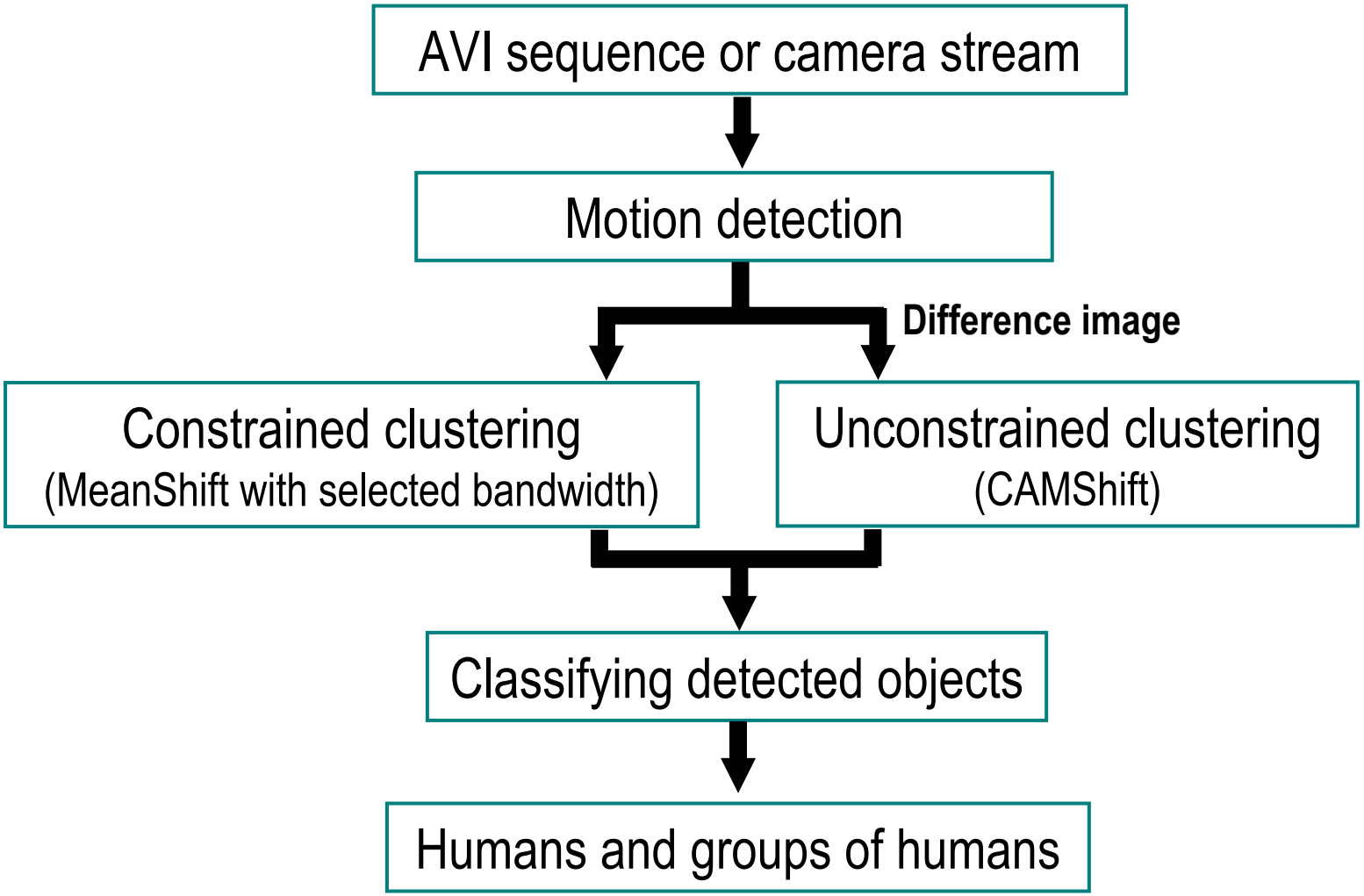
- **Group of humans**
- **Vehicles, motion clutter**



Approach:

1. **Data-driven clustering (CAMShift)**
2. **Model-based human detection**
3. **Classifying the output of motion detection** *{human, other}*
4. **Region-based statistics** *{group of humans, other}*

Combining motion detection with classification

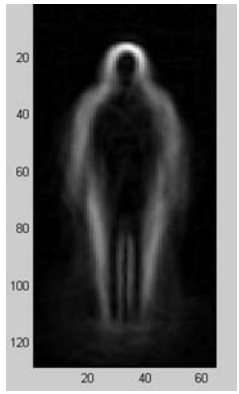


Classifier-based human detector

- **Features:**
  - Integral orientation histograms
- **Classifier:**
  - Cascade of weak classifiers trained by AdaBoost

First 16 eigenvectors

Mean edge strength



Detection and tracking results – Visual Surveillance Sequence A

Sequence VS_A

- 3930 frames
- 25 fps
- 720 × 576 pixels
- human size:
  22-32 pixels

Difficulties:

- shadows cast by humans
- crowded situations
- moving flag
- moving vehicles

Detection and tracking results – Visual Surveillance Sequence B

Sequence VS_B

- 4773 frames
- 25 fps
- 720 × 576 pixels
- human size:
  18-34 pixels

Difficulties:

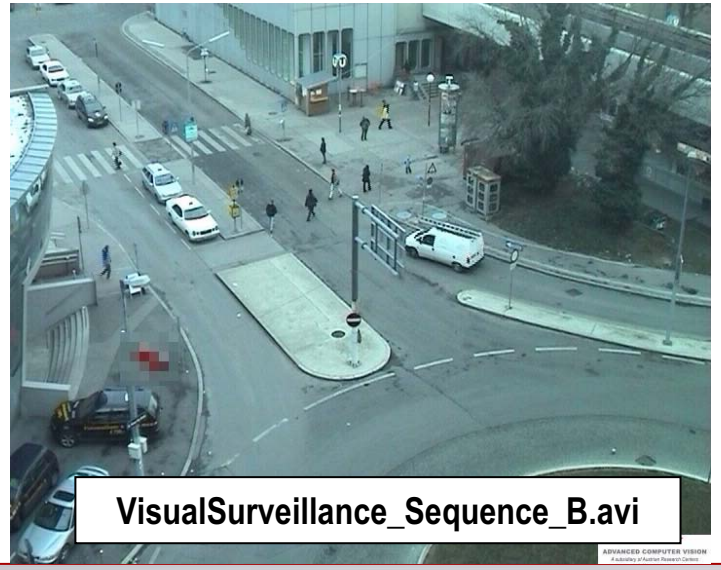
- crowded situations
- moving vehicles
- reflections

Results: Shaking camera

Results: low (human - background) contrast

Video data

- **Ground truth will be soon available**
  - Annotation according to the CAVIAR ground-truthing scheme
  - Bounding box positions
  - Trajectories
- **Testing your algorithms on the data**



Conclusion

- **Promising detection and tracking improvements for challenging data:**
  - No ghost objects.
  - Eliminating detections caused by shadows.
  - Spurious detections by motion clutter greatly reduced.
  - Operating in real-time (8-12 fps, 3 GHz PC)
- **Quantitative analysis is needed to assess improvements.**