



# People Detection Techniques for the segmentation of persons inside infrared images

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# Agenda

- ▶ Motivation and Challenges
- ▶ Performance Index
- ▶ Approaches
- ▶ Horizontal segmentation
- ▶ Vertical segmentation
- ▶ Literature

# Motivation and Challenges

- ▶ Automatic detection of pedestrians for development of driving aids
- ▶ Development of intelligent vehicles.

# Motivation and Challenges

## ▶ Pros:

- People tend to be brighter than the background
- Less variation caused by lighting, colour, texture and shadows



## ▶ Cons:

- Influenced by additional heat sources, weather conditions
- People orientation, clothes and accessories
- Smaller intensity range => low image quality

# Performance Index

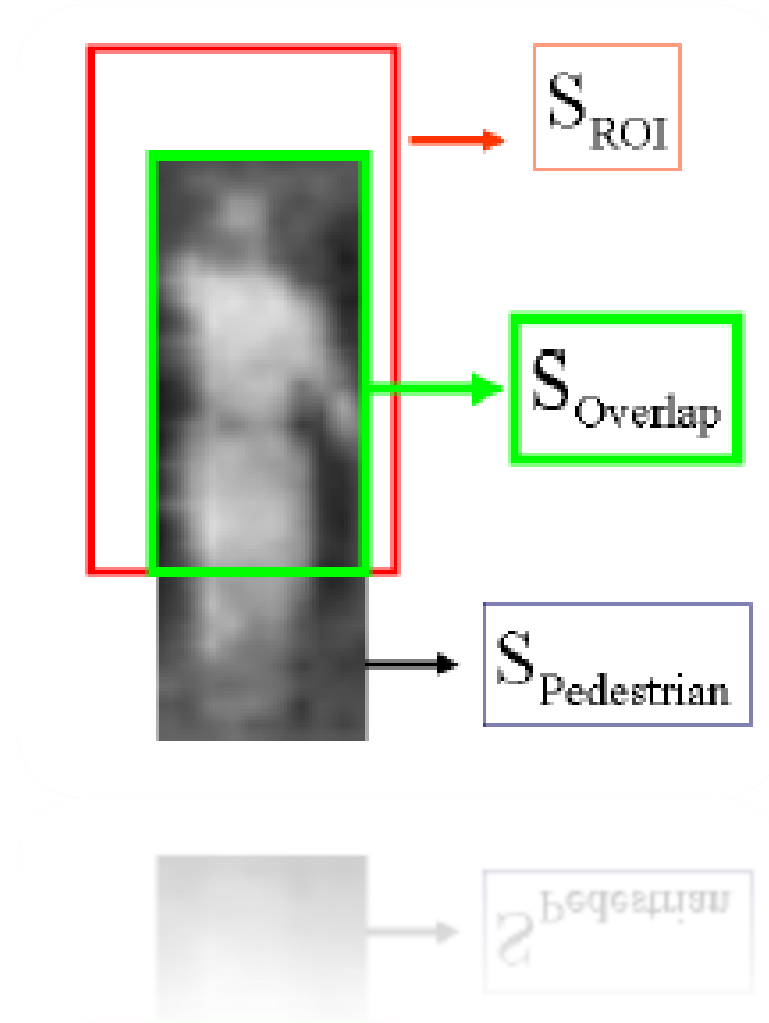
- ▶ Processing stages:
  - Segmentation
  - Classification

# Performance Index

- ▶ Processing stages:
  - Segmentation
    - Regions of interest
    - Performance measure:
      - Side-accuracy
      - Side-efficiency

$$SA = \sqrt{\frac{S_{Overlap}}{S_{Person}}}$$

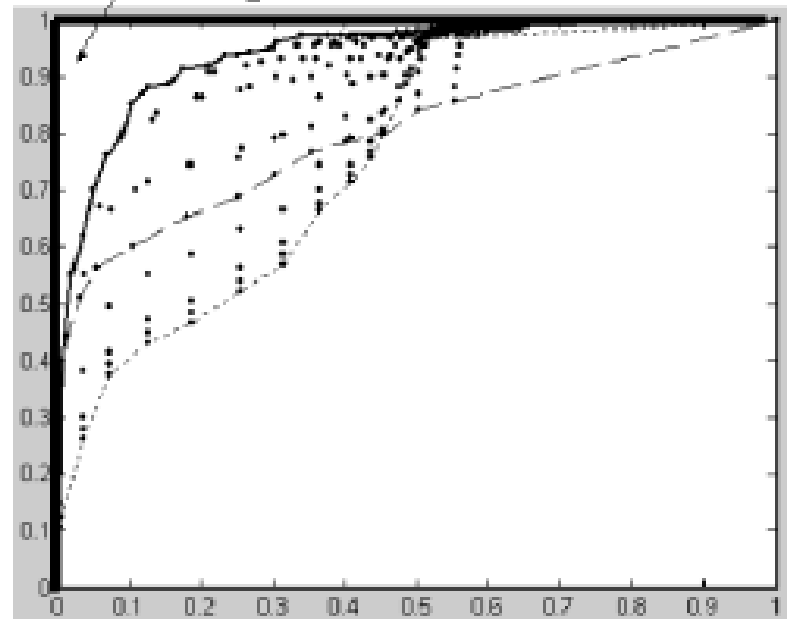
$$SE = \sqrt{\frac{S_{Overlap}}{S_{ROI}}}$$



# Performance Index

- ▶ Processing stages:
  - Classification
    - False alarm/Detection rate

Ideal ROC Boundary



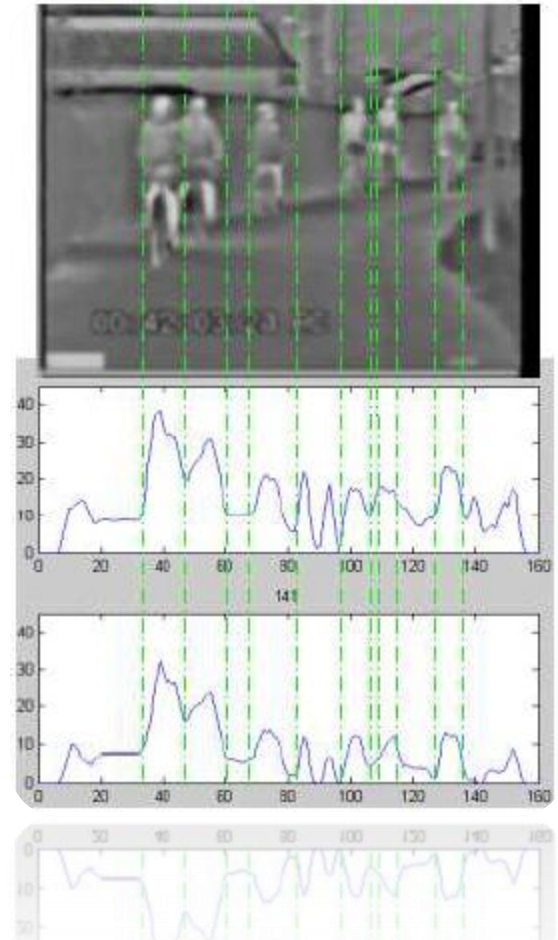
# Approaches

- ▶ Template–Shape based multiscale brute force searching
- ▶ Indirect similarity comparison (Neural nets, Radial basis functions, SVM)
- ▶ Shape–independent detection
- ▶ Multiple image based (motion based)



# Horizontal Segmentation

- ▶ Bright pixels vertical projection curves
  - Bright pixel threshold =  $\max(\text{image intensity}) - \text{intensity margin}$
- ▶ Curve divided into bumps and flat regions corresponding to image stripes with many and little bright pixels respectively.
- ▶ These features are robust to variations in threshold choice and problems mentioned earlier.



# Vertical Segmentation

- ▶ Segmentation based on brightness
  - Gives decent results on images taken in winter, in less urban environment, when stripe width fits person more tightly.
- ▶ Segmentation based on “bodyline”
  - Image rows within person’s region
  - Rapid change of intensity on bodyline terminals.



# Literature

- ▶ Yajun Fang, Yamada K, et al, “A Shape-Independent-Method for Pedestrian Detection with Far-Infrared-Images”, *IEEE Transactions on Vehicular Technology*, 2004.
- ▶ M.Bertozzi, A.Broggi, P.Grisleri, T.Graf, and M.Meinecke, “Pedestrian detection and tracking with night vision”, *Proc. of IEEE Intelligent Vehicles Symposium*, pages 662-667, 2003.
- ▶ Gian Luca Foresti, Christian Micheloni, Lectures in Artificial Vision, The Summer School on Foundations of Information Technology, Novi Sad, 2009.
- ▶ Wikipedia, <http://www.wikipedia.org>

# Q&A

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