Extended
Human Upper Body Detection

Bachelor-Thesis

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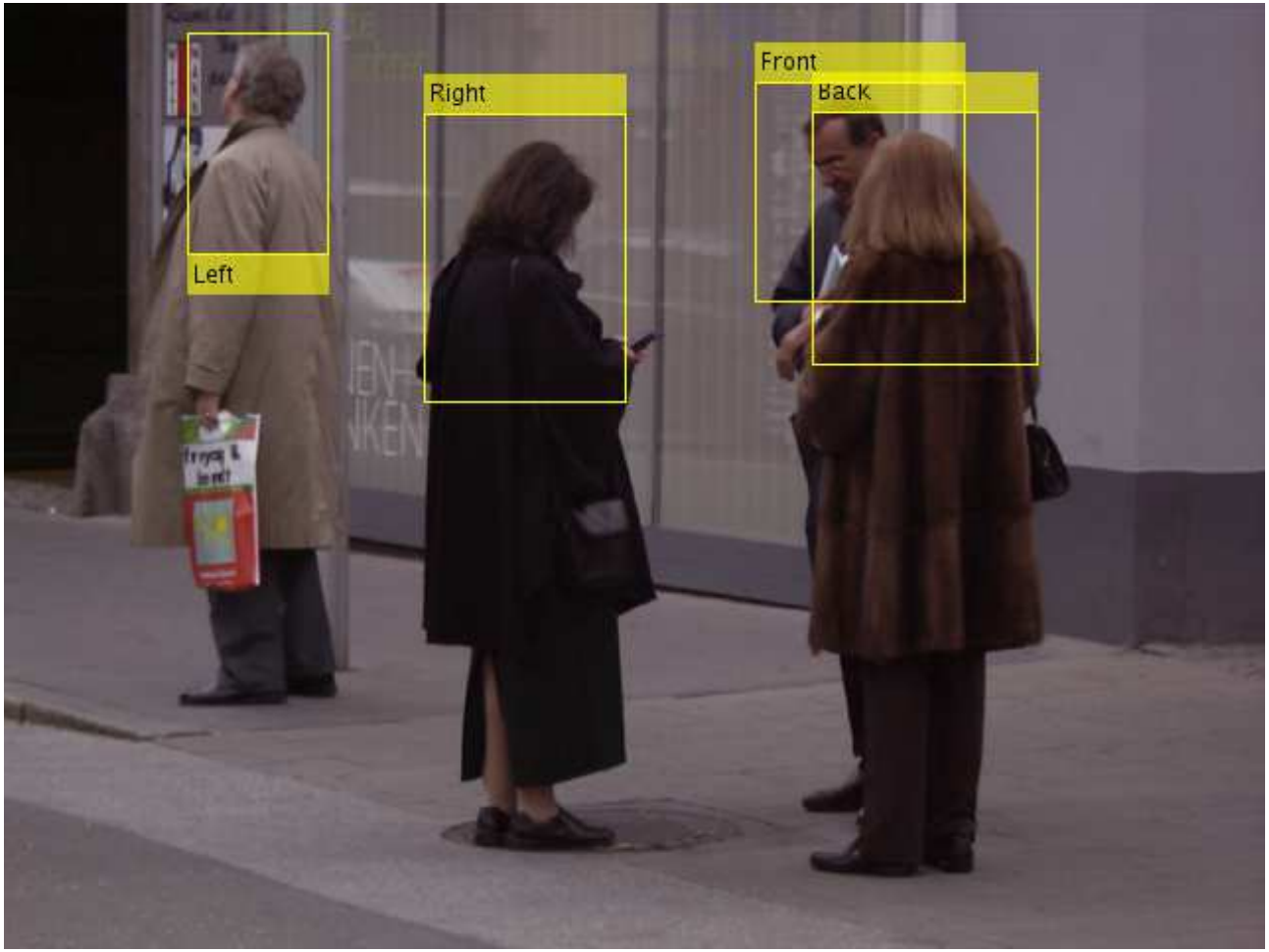
08/13/2015

Contents

INTRODUCTION

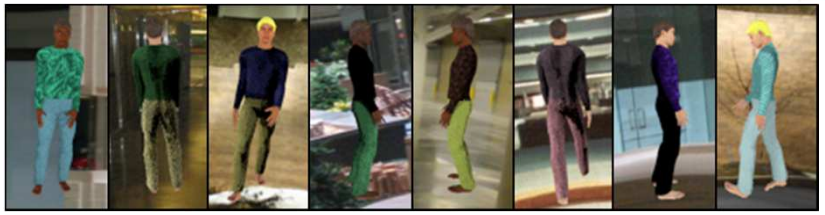
Motivation and Aim



- Human detection for surveillance and autonomous driving systems
- Reliable detection of humans in all postures
- Upper body detection more robust than whole body detection

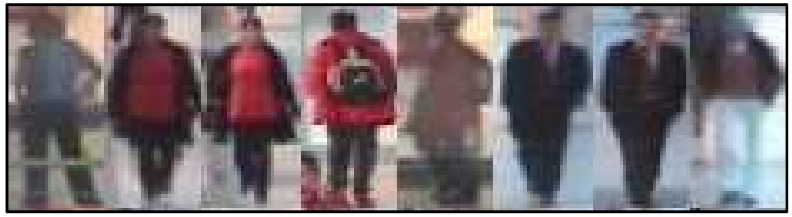
Image Databases

Graz-02

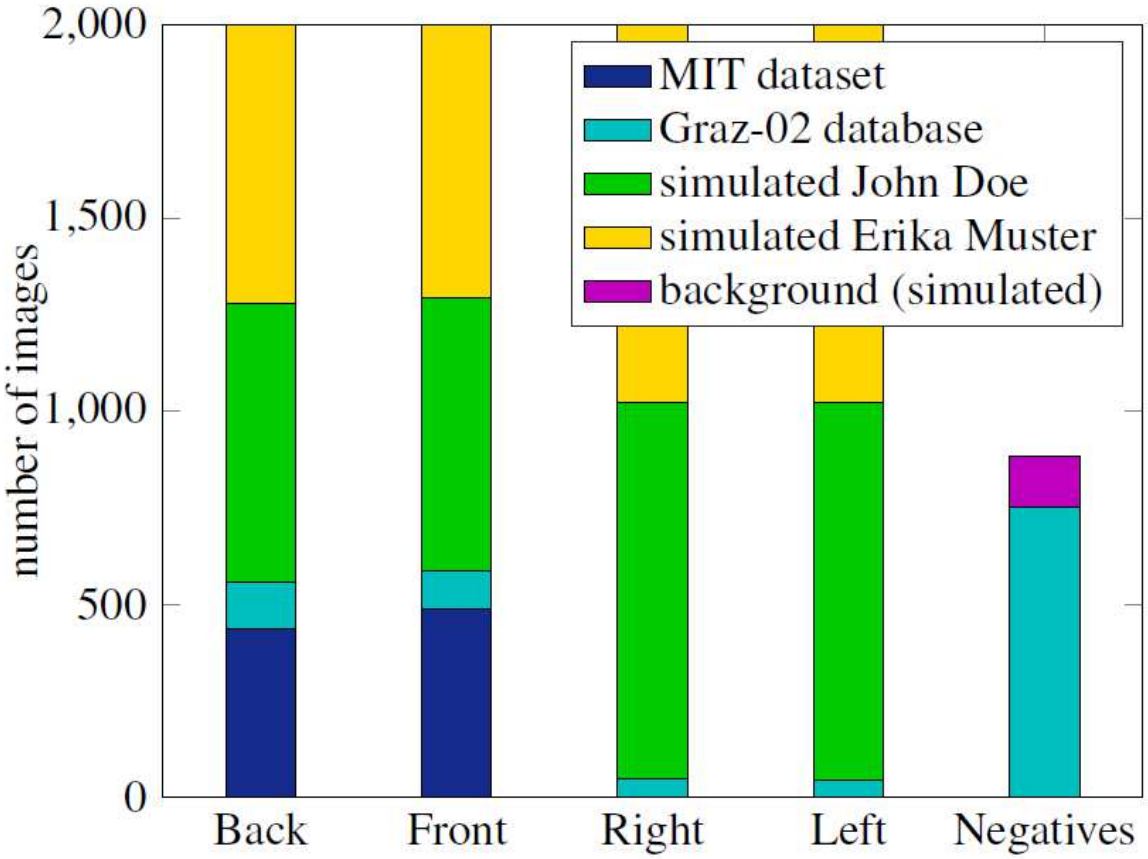


John Doe

MIT dataset

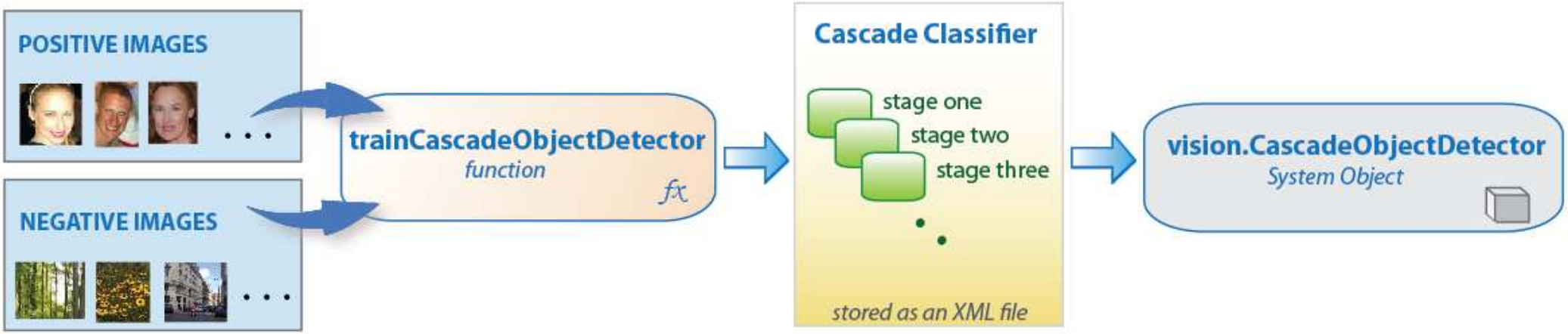


Erika Muster



Train a Detector

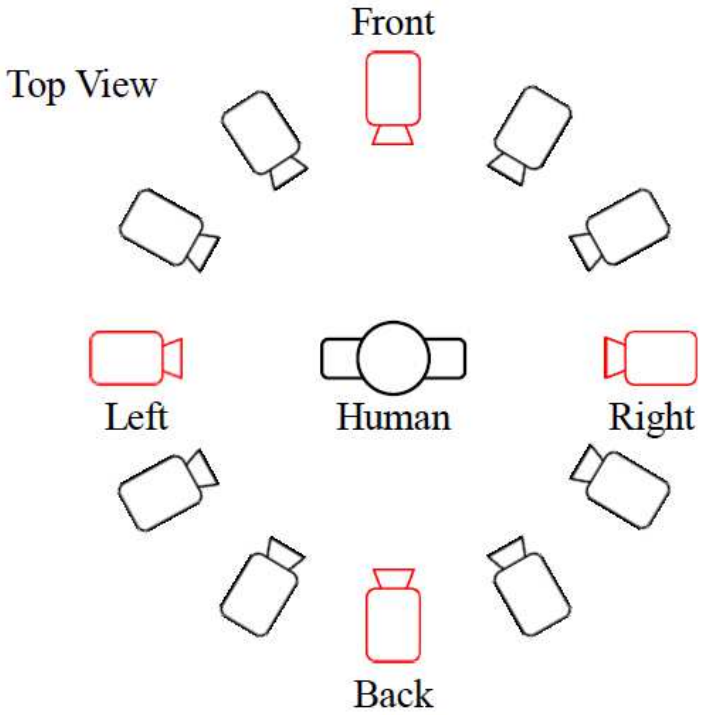
Matlab Cascade Object Detector



Pretrained classification models

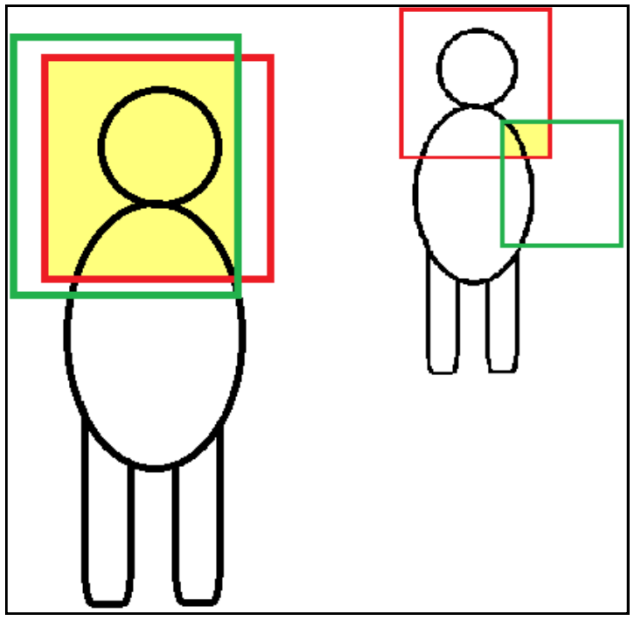
e.g. face, nose, eye, upper body

Custom classifier made by training function



Evaluation Metric

Calculation of a match: PASCAL measure



$$a_0 = \frac{area(BB_{dt} \cap BB_{gt})}{area(BB_{dt} \cup BB_{gt})} > 0.5$$

Evaluation of a classifier with precision and recall:

$$precision = \frac{TP}{TP + FP} \qquad recall = \frac{TP}{TP + FN}$$

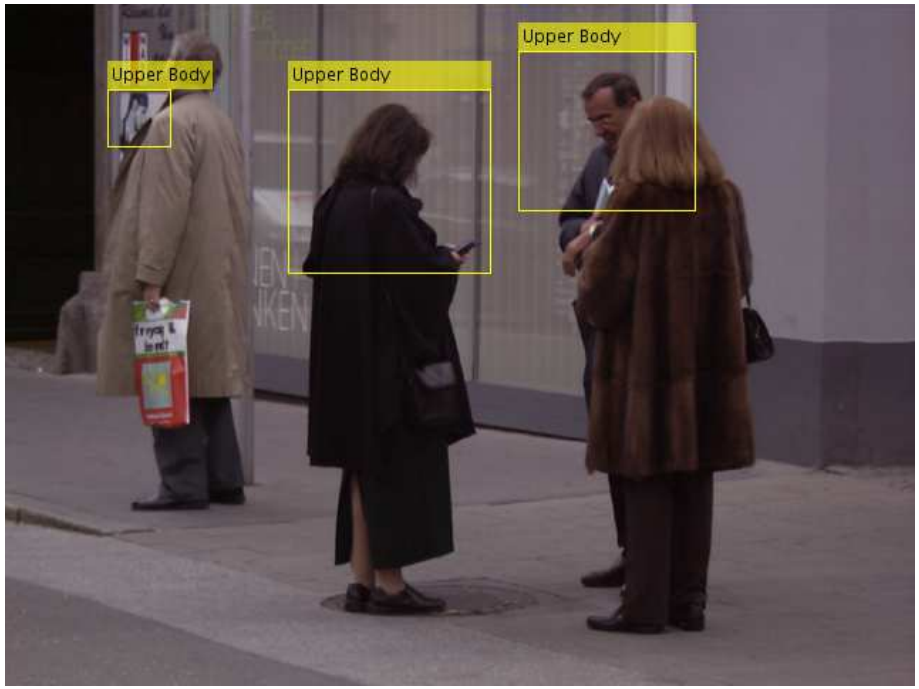
Precision: fraction of retrieved instances that are relevant

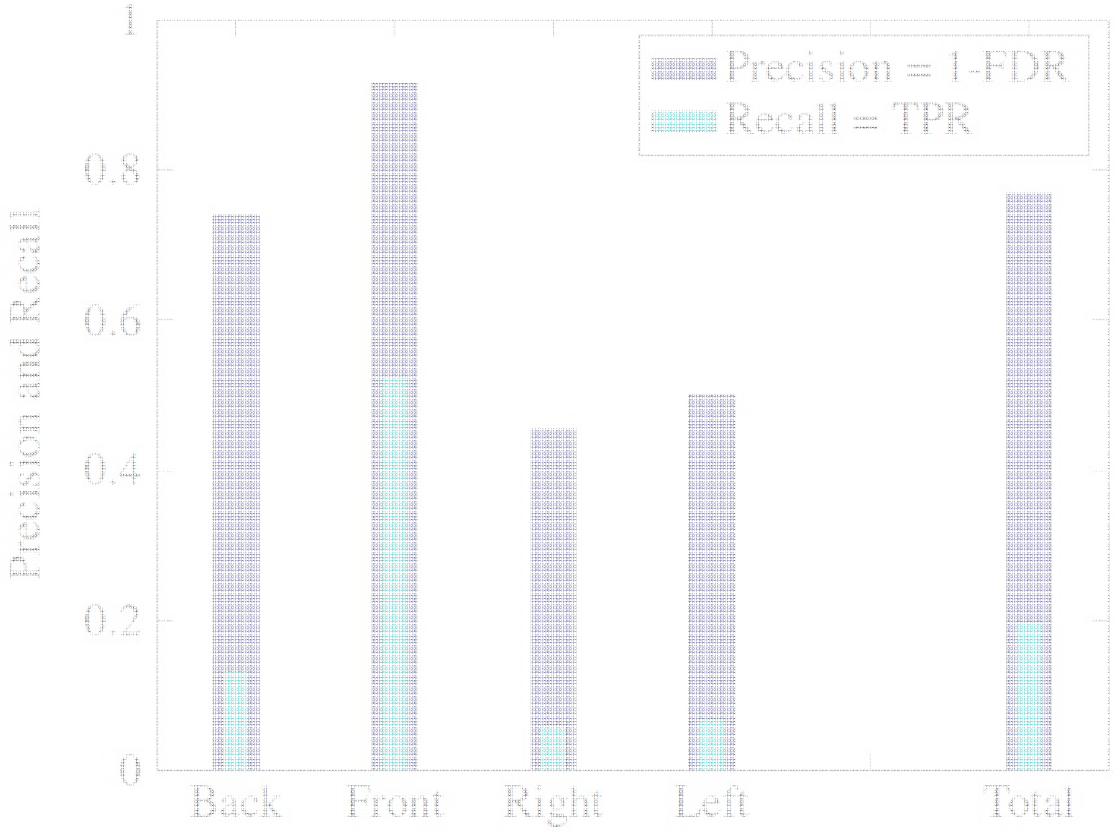
Recall: fraction of relevant instances that are retrieved

EVALUATION

Starting Conditions

Evaluation of pretrained upper body detector:

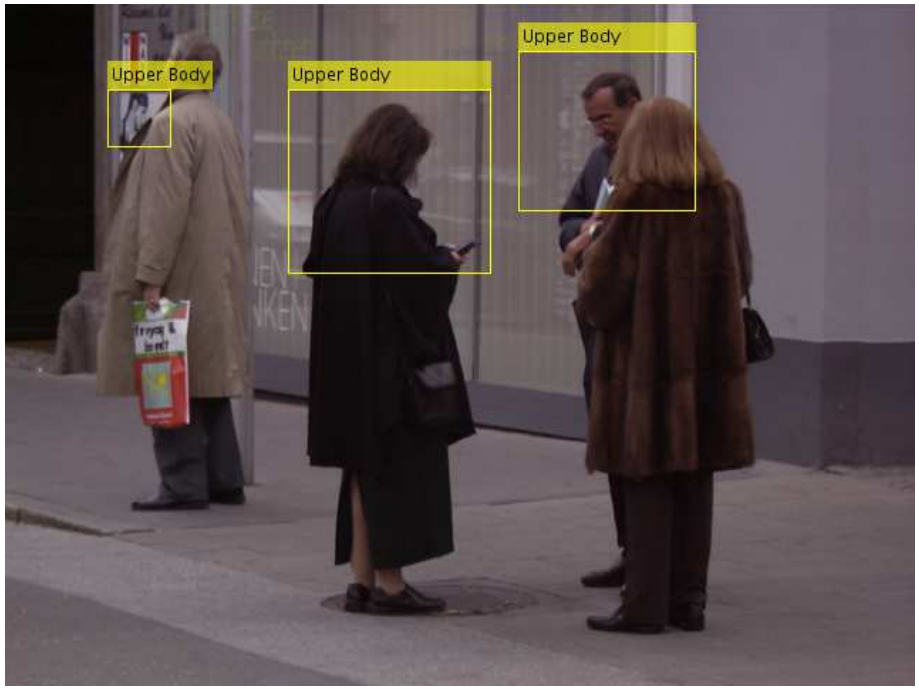


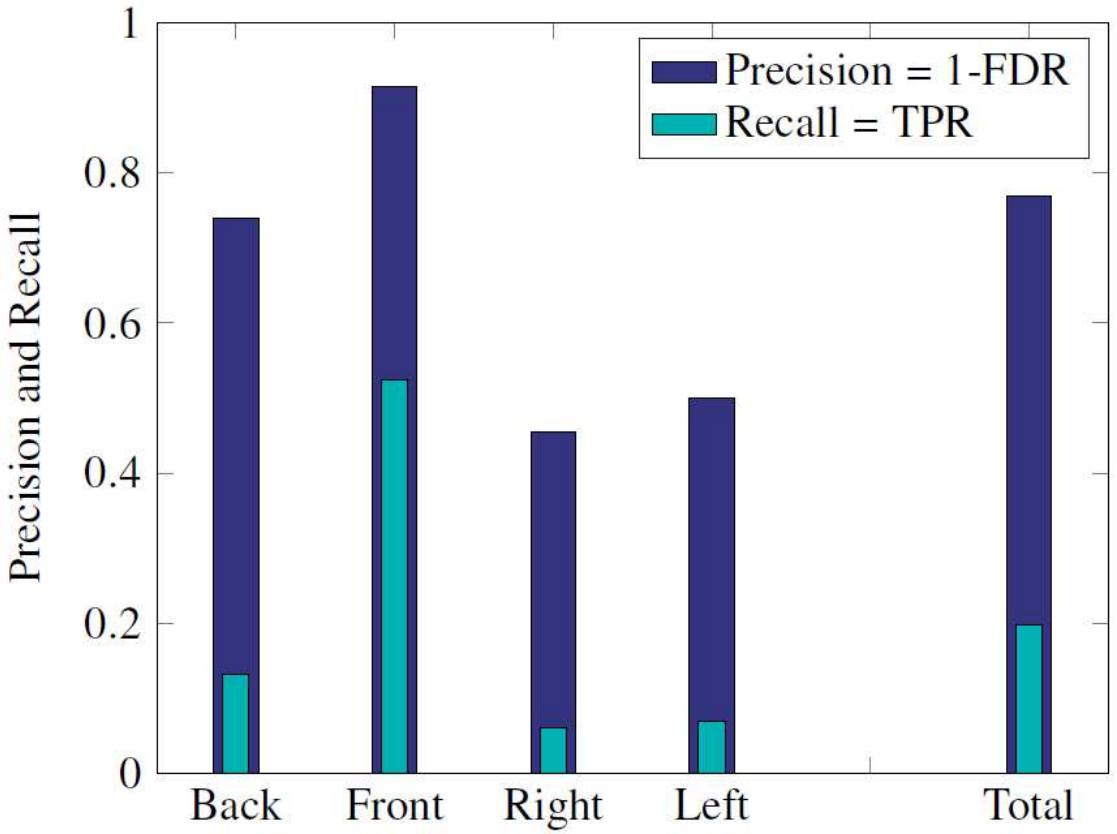


- Less than 10% of side view persons are detected (recall)
- Precision for side views under 50%
- Detection of front view persons insufficient as well

Starting Conditions

Evaluation of pretrained upper body detector:





- Less than 10% of side view persons are detected (recall)
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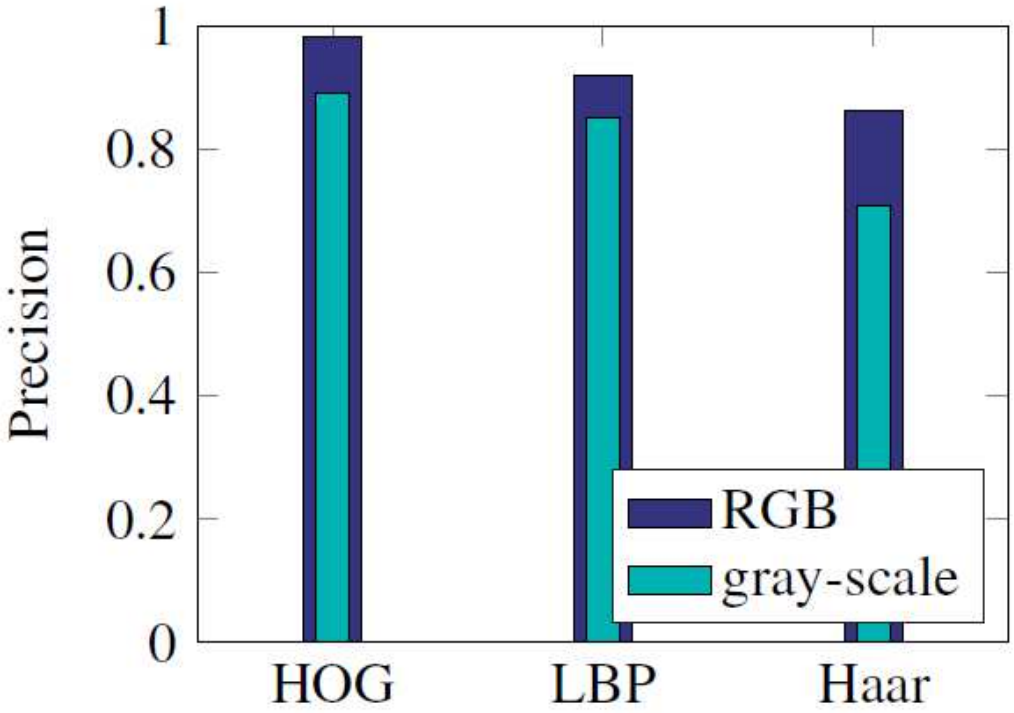
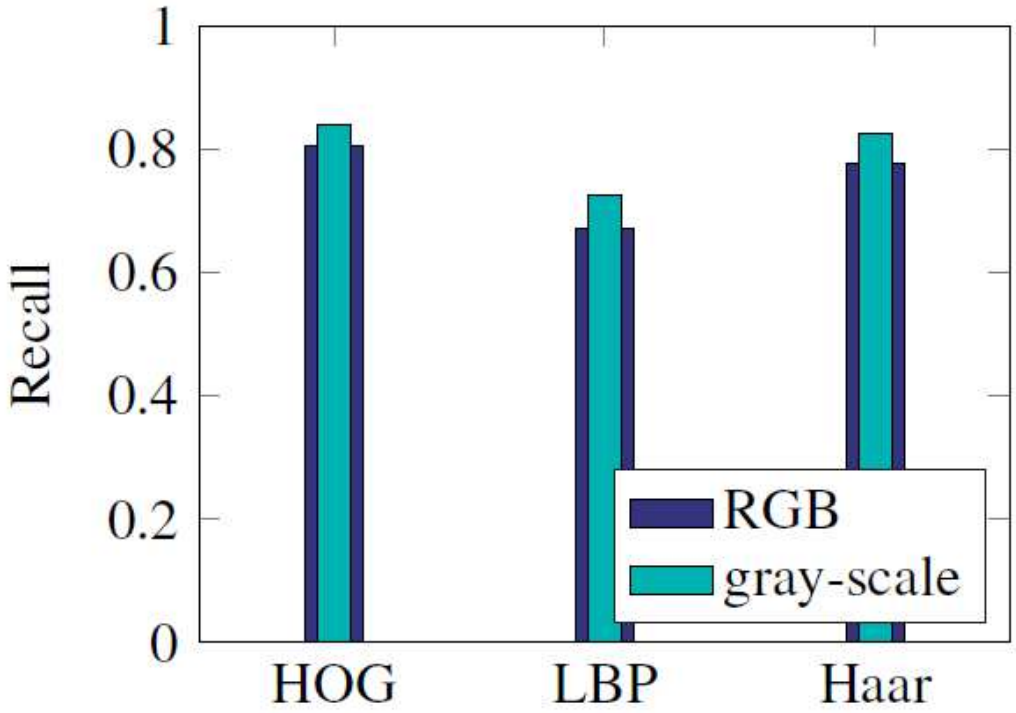
RGB vs. Gray-Scale Images

Detectors with default parameters





With RGB images reach higher precision

better to be sure an object is an upper body

With gray-scale images reach higher recall

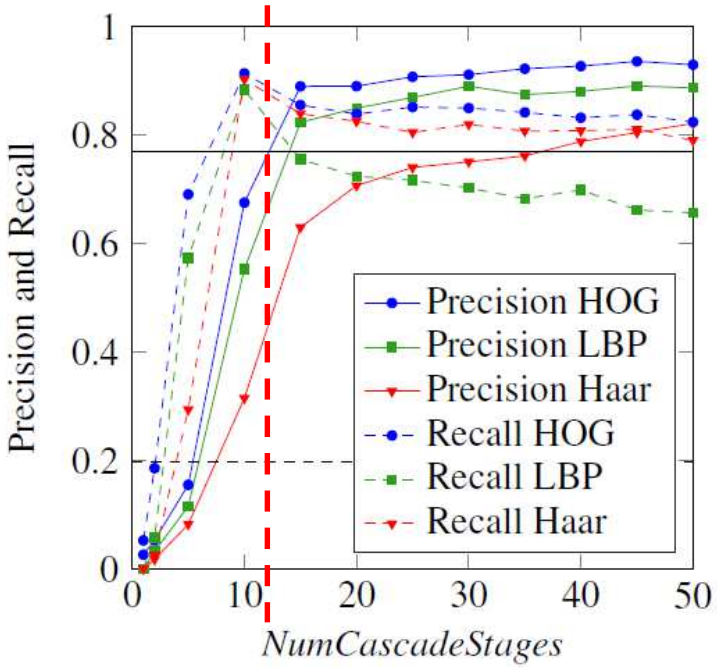
better to detect as many upper bodies as possible

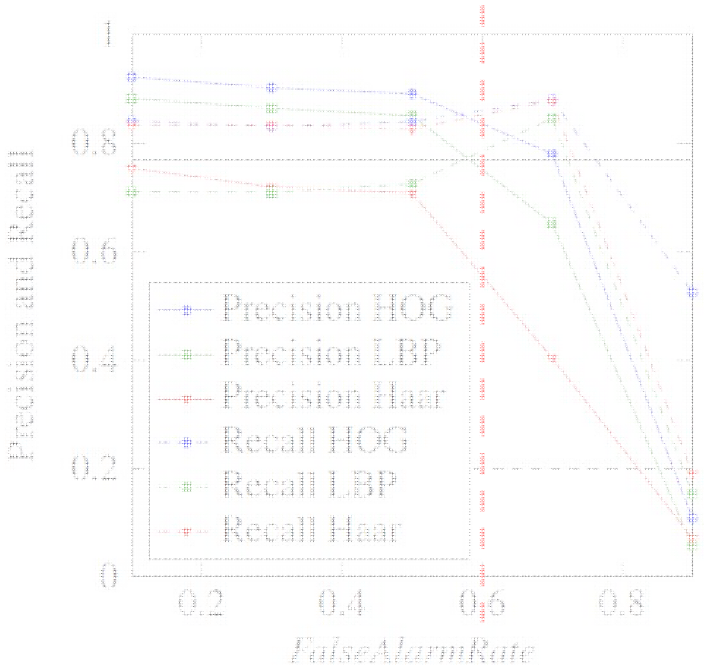
Single Parameters of Cascade Detector

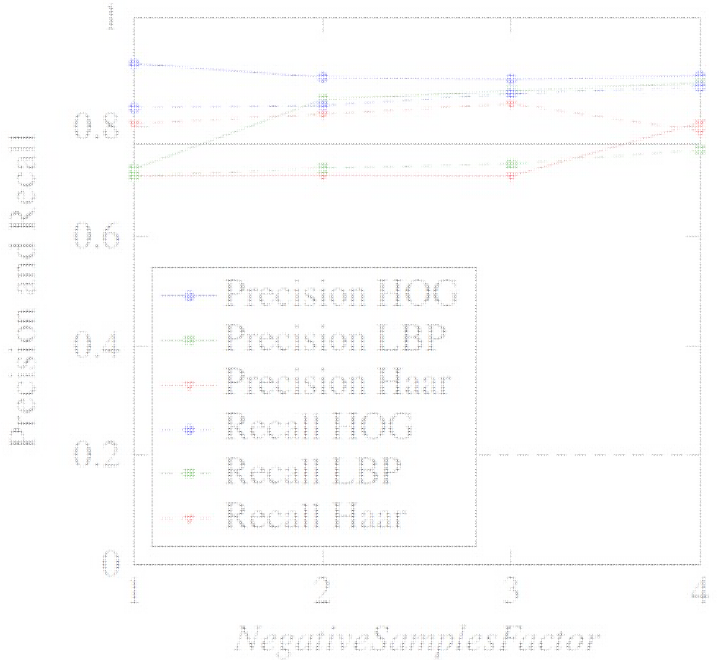
Training Parameters

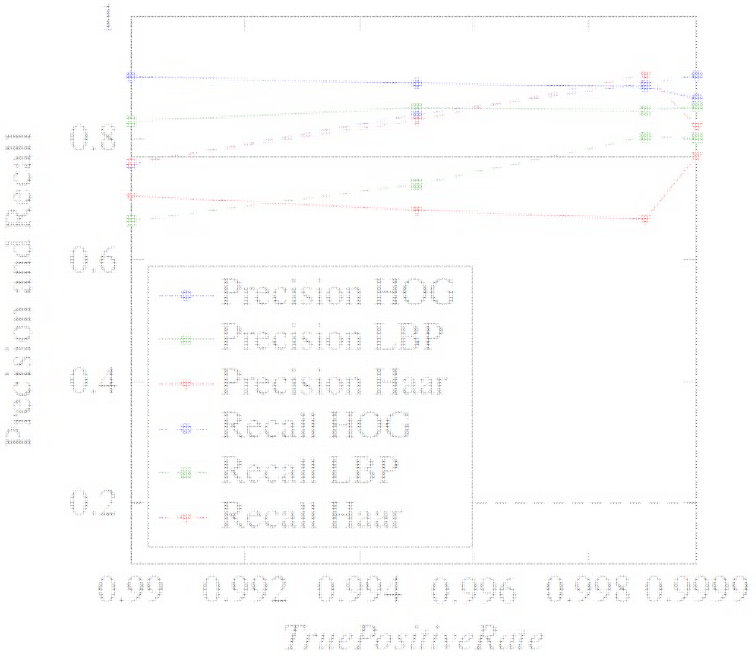
Parameter Name	Values
ObjectTrainingSize	**Auto**
NegativeSamplesFactor	1, **2**, 3, 4
NumCascadeStages	1, 2, 5, 10, 15, **20**, 25, 30, 35, 40, 45, 50
FalseAlarmRate	0.1, 0.3, **0.5**, 0.7, 0.9
TruePositiveRate	0.99, **0.995**, 0.999, 0.9999
FeatureType	**Histograms of Oriented Gradients (HOG)**, Local Binary Pattern (LBP), Haar-like features

Single Parameter Evaluation

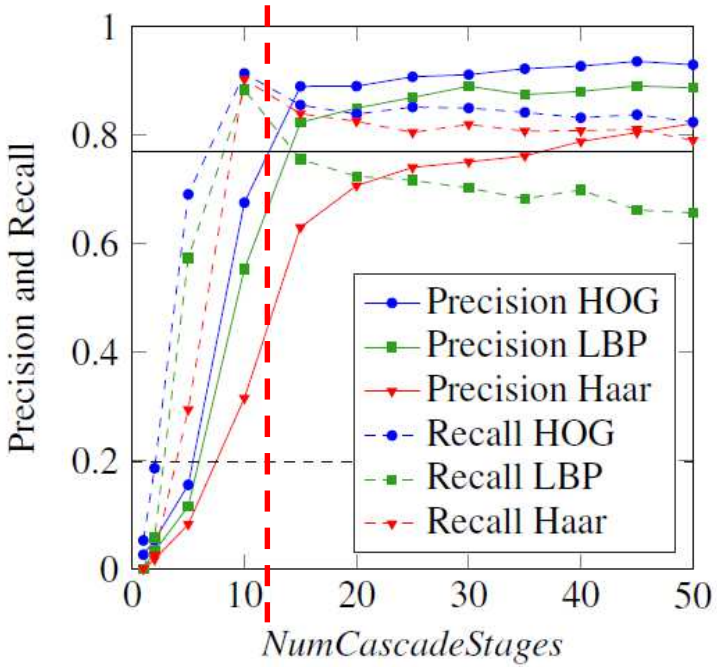


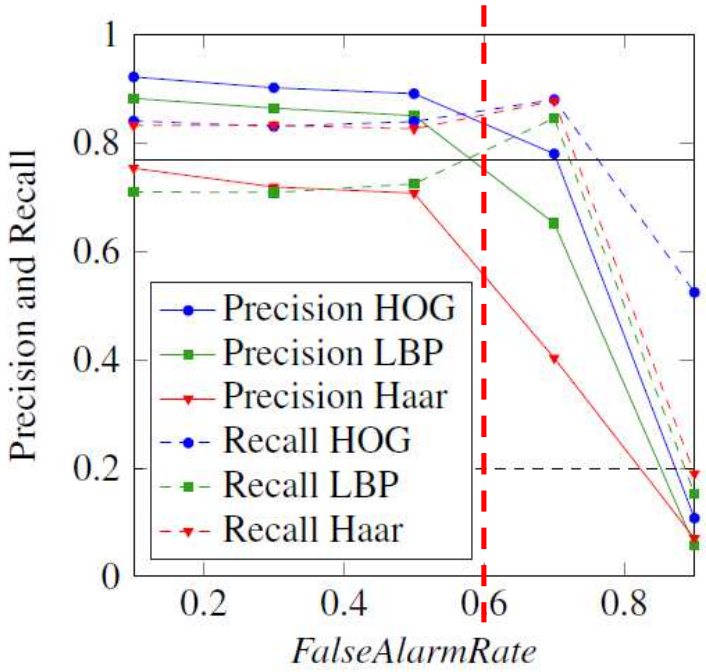


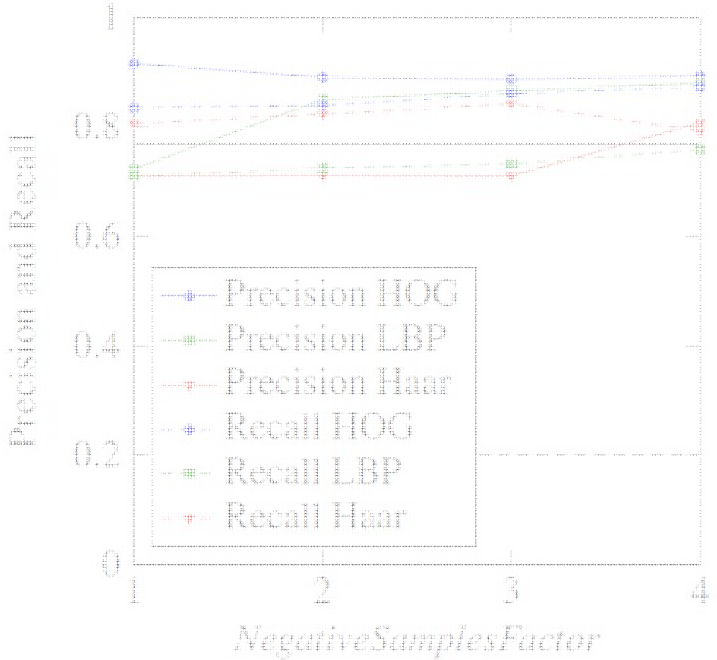


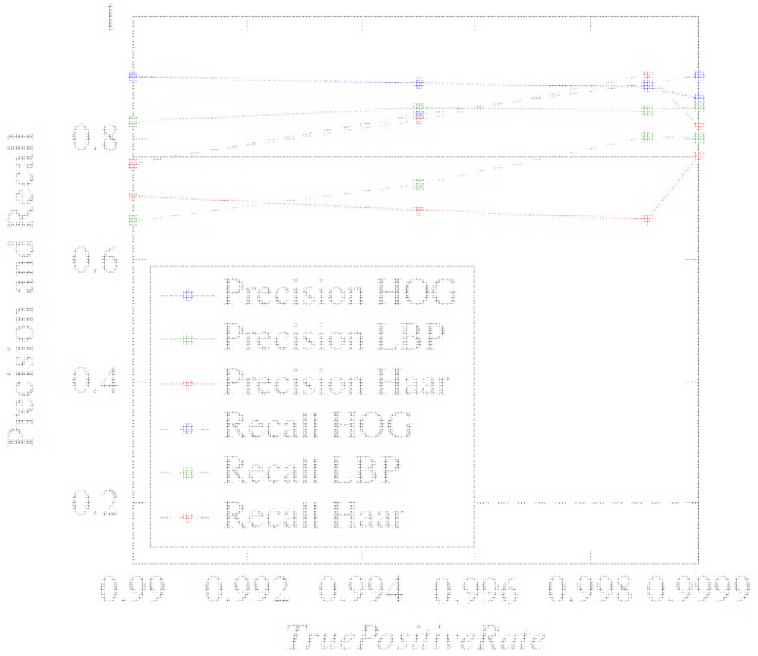


Single Parameter Evaluation

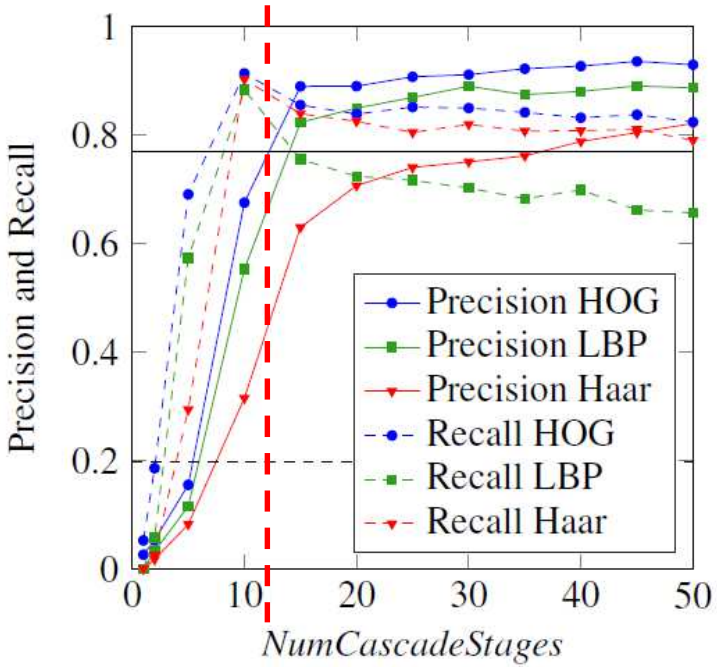


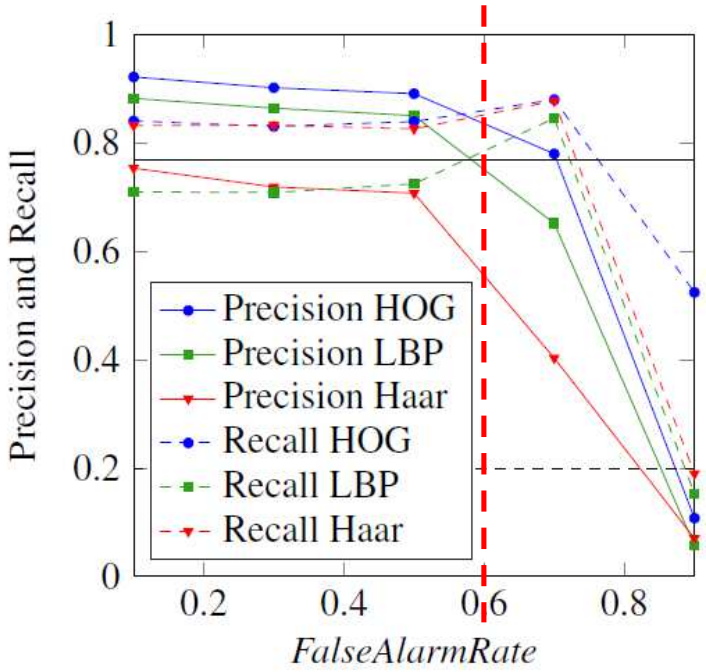


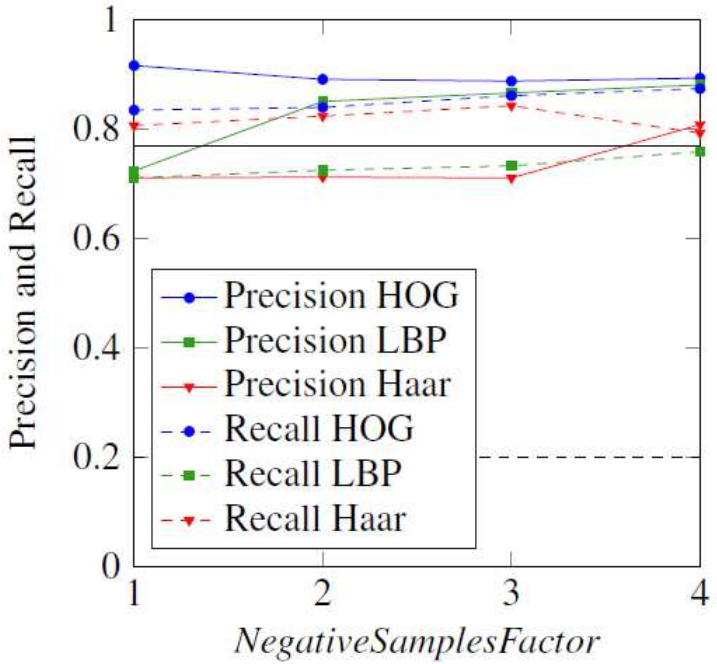


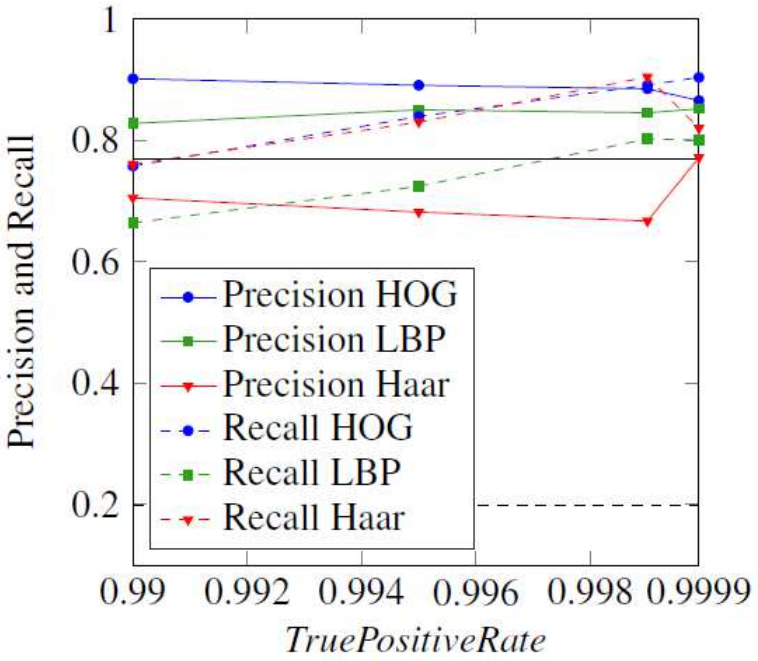


Single Parameter Evaluation



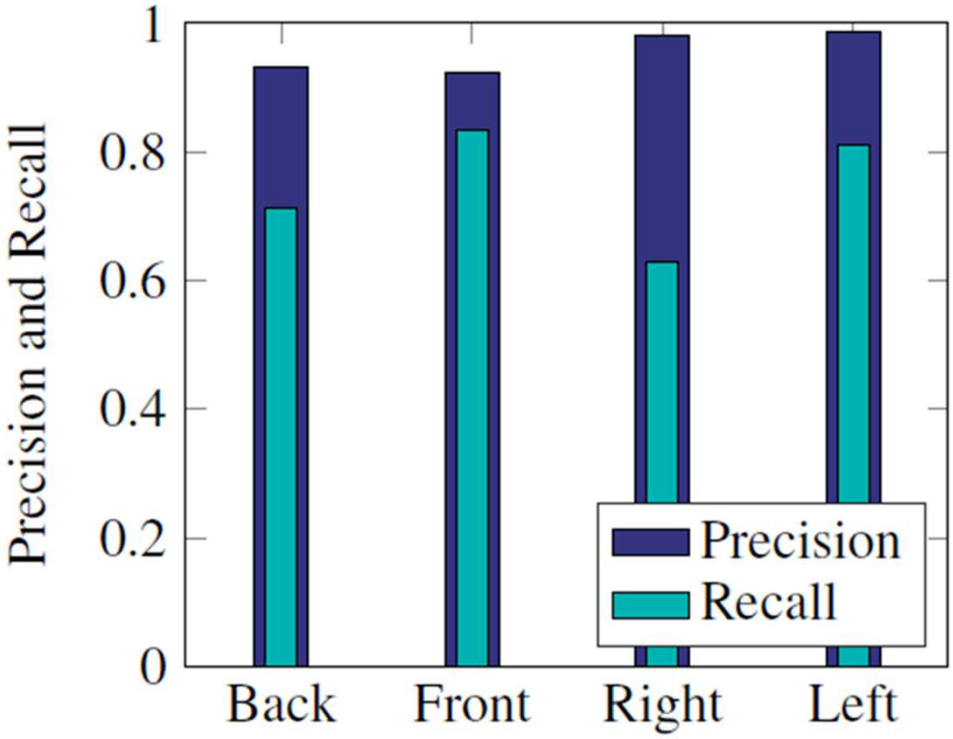




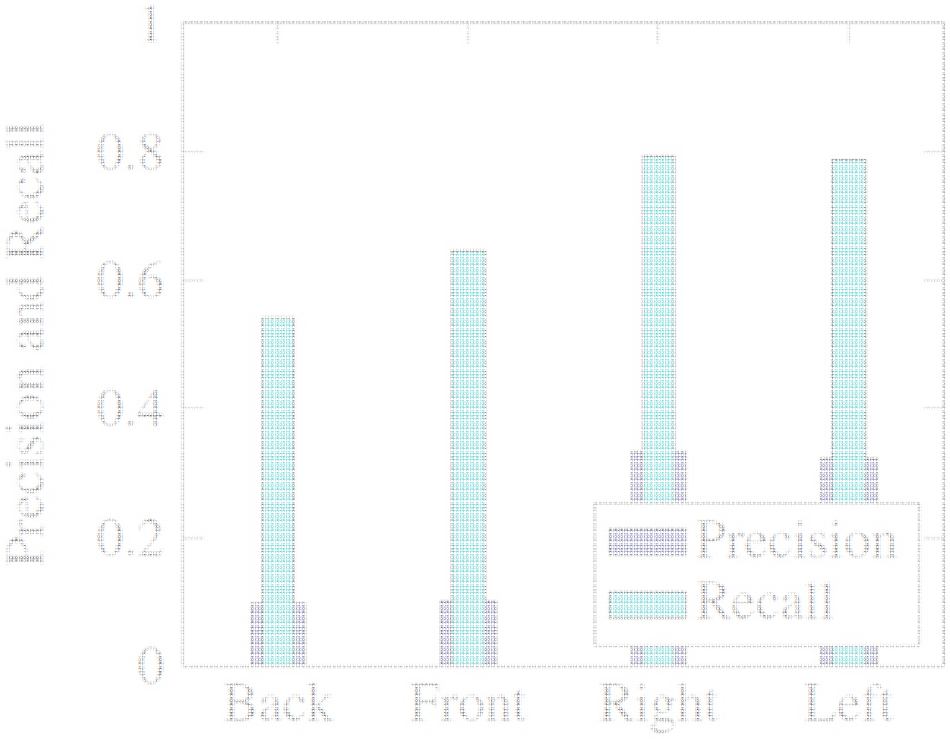


Combination of best Single Parameters

Combination for Best Precision

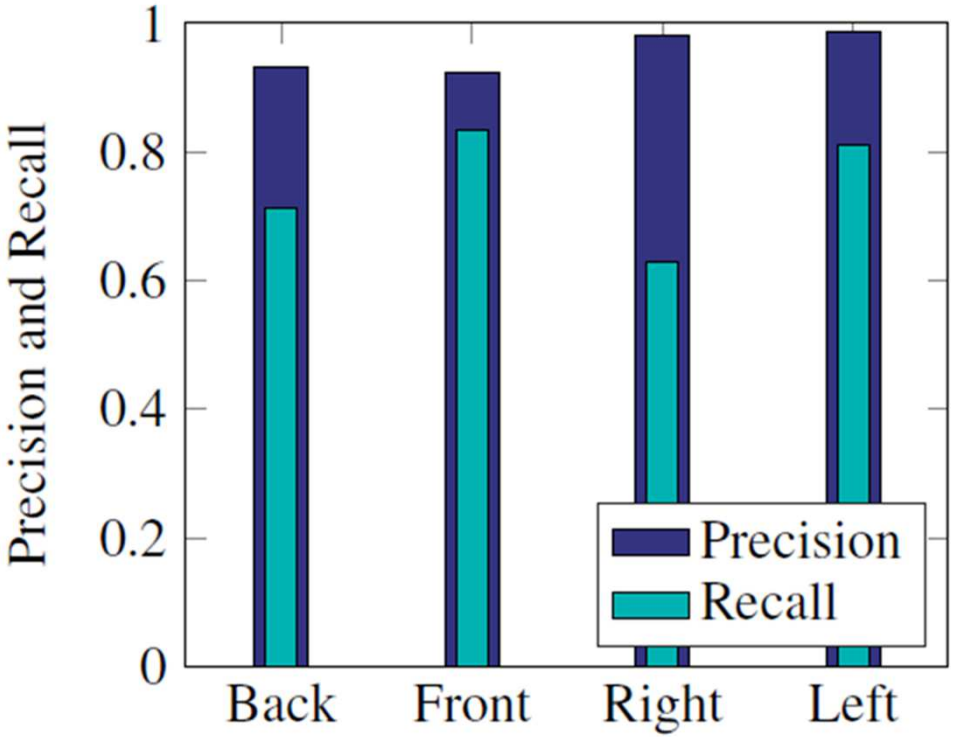


Combination for Best Recall

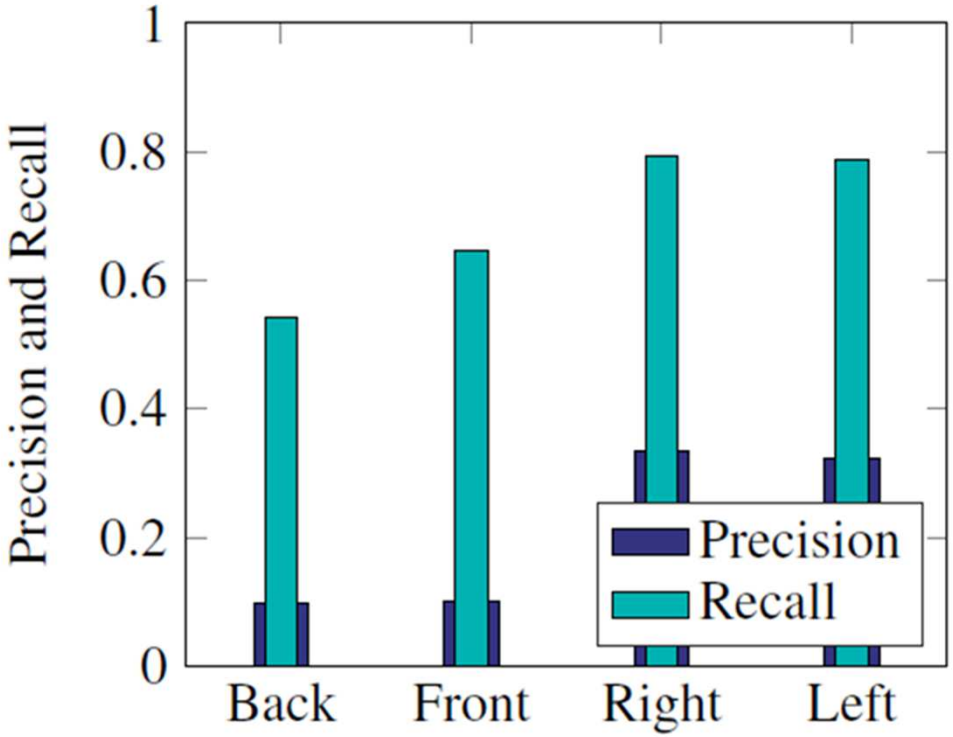


Combination of best Single Parameters

Combination for Best Precision



Combination for Best Recall

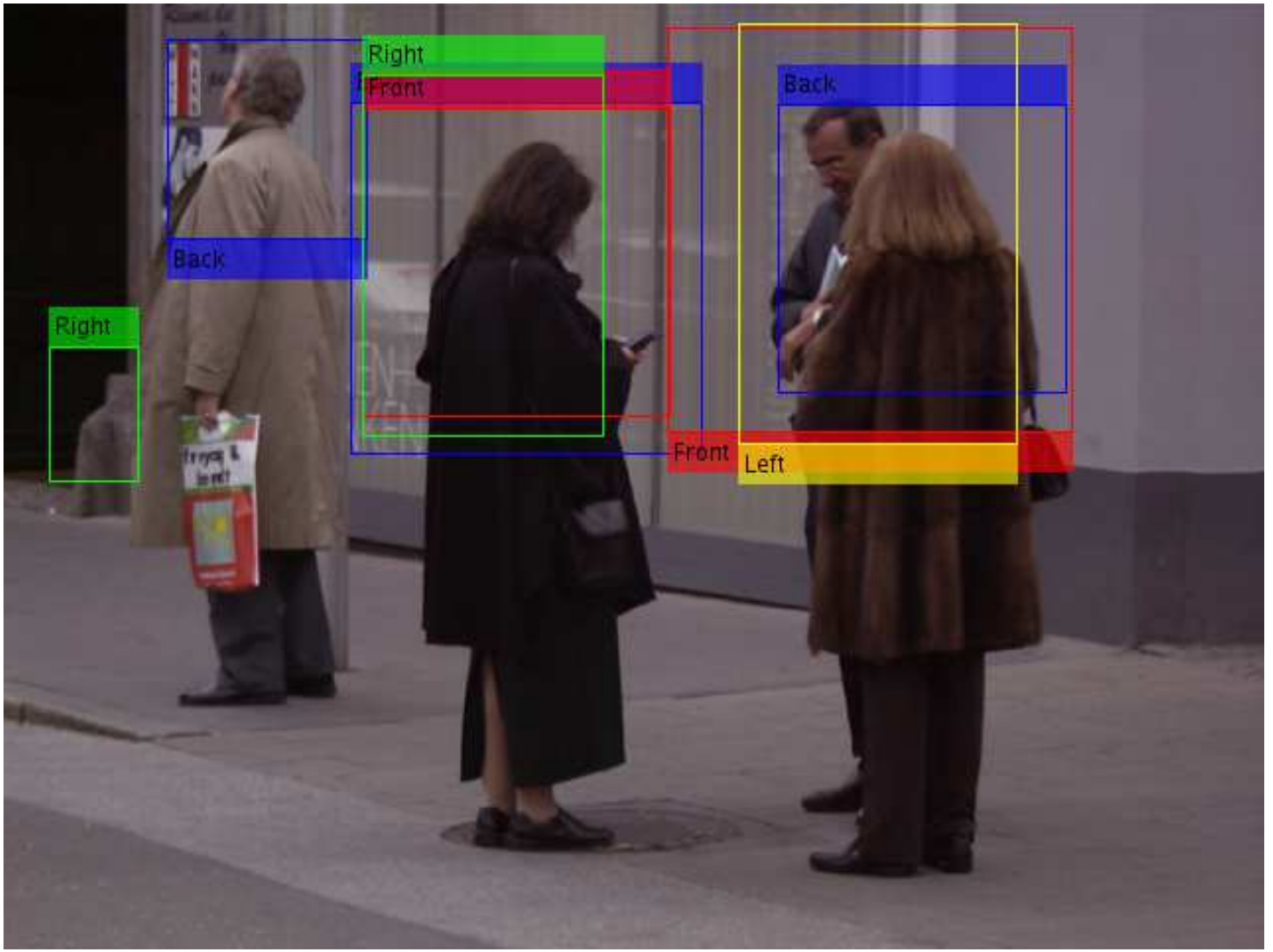


Detectors are not suitable for reliable detection of humans

Complex parameter combinations

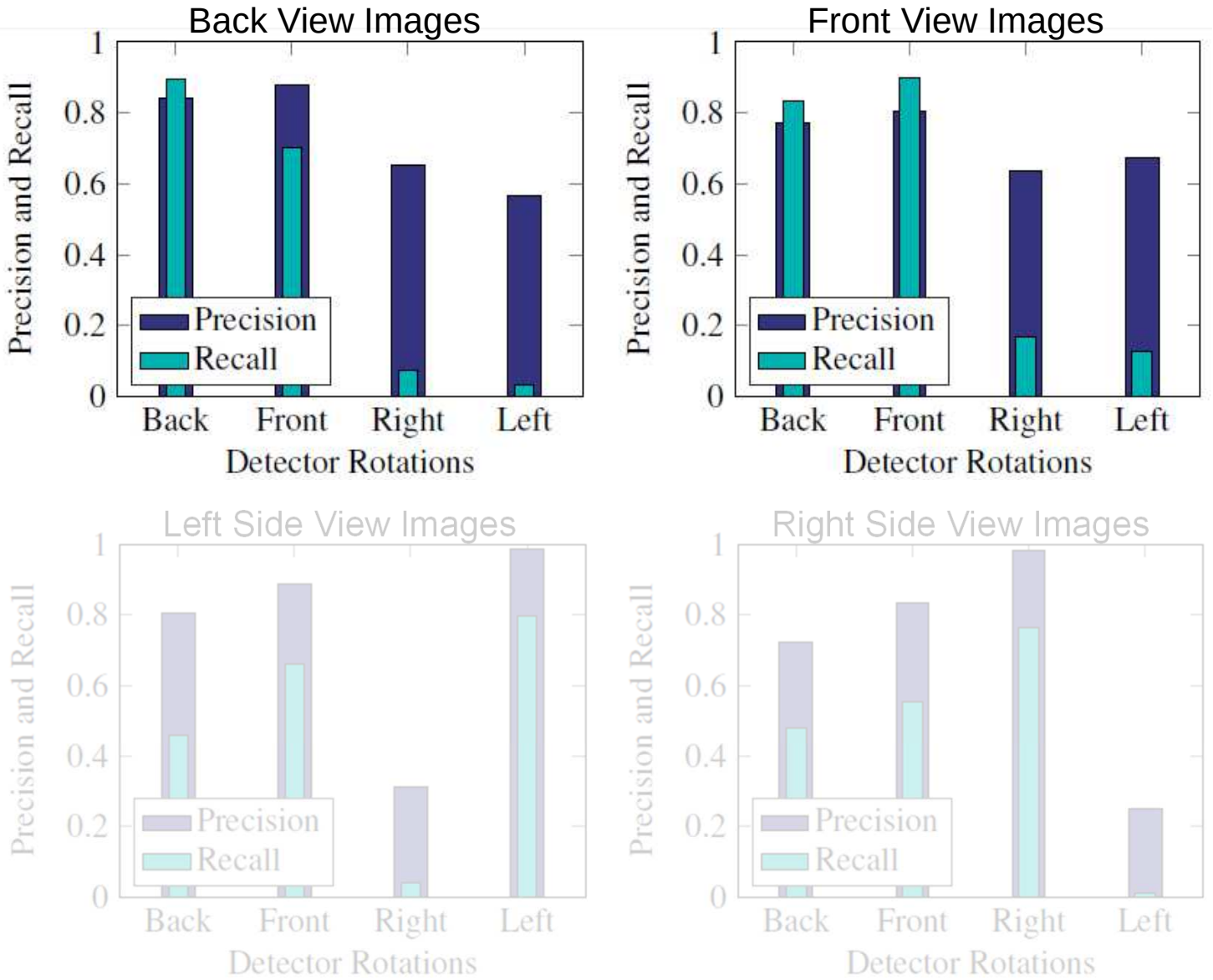
Combination of Rotation Plane Detectors

Example Image:



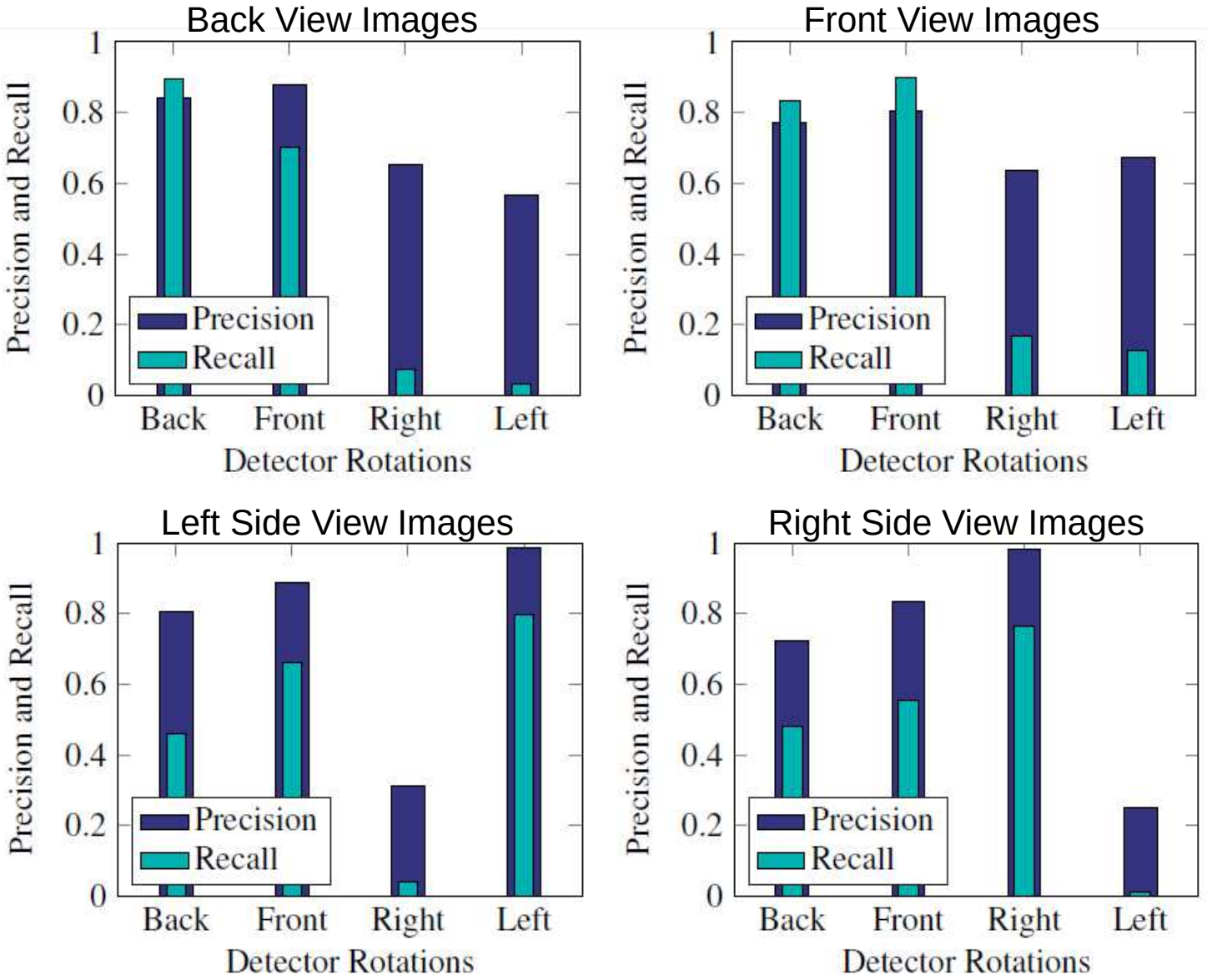
Combination of Rotation Plane Detectors

Detectors running on all evaluation images:



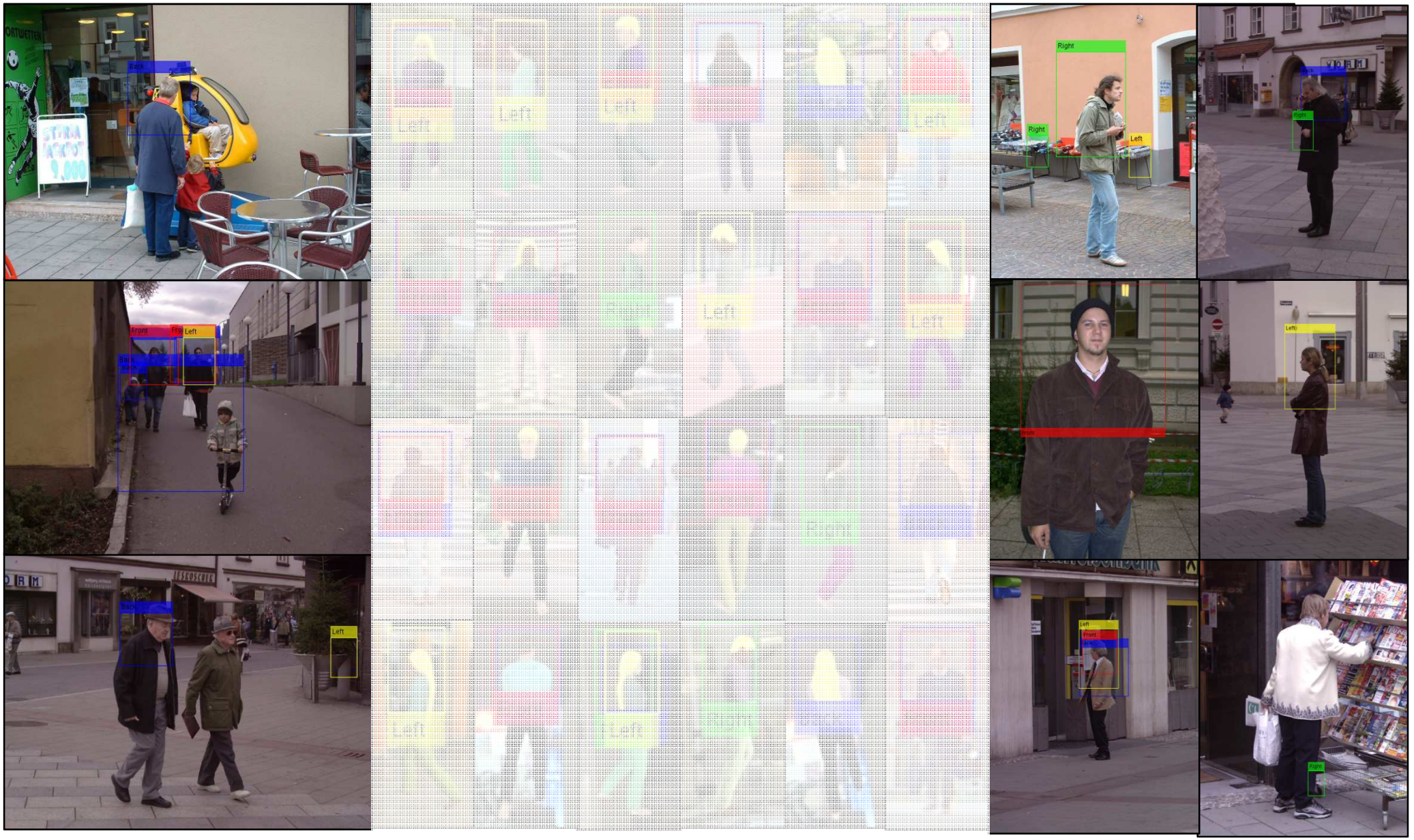
Combination of Rotation Plane Detectors

Detectors running on all evaluation images:



Combination of Detectors

Detected bounding boxes on evaluation images



Combination of Detectors

Detected bounding boxes on evaluation images

SUMMARY

Summary

Default Cascade Detector

- 70% recall improvement for side view

RGB vs. Gray-Scale

- with RGB images reach higher precision
- with gray-scale images reach higher recall

Single Parameters

- high correlation of parameters

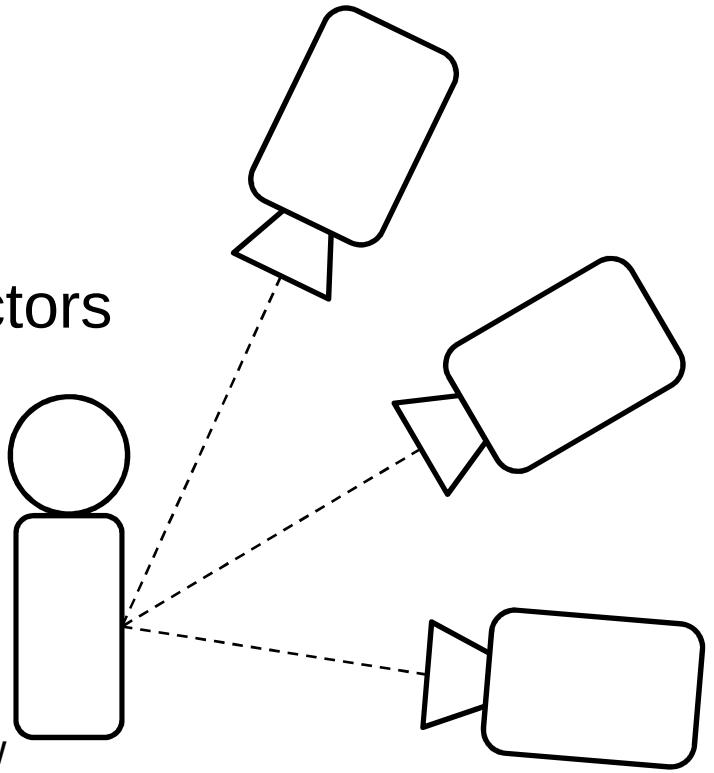
Combination of Rotation Plane Detectors

- combination results in higher overall recall

Conclusion and Outlook

- High correlation of training parameters → difficult to find “perfect” parameter settings
- Additional detector parameters
- Dependence on field of application and images
- Differences in image type

- Next step: evaluation as a function of two parameters, than three, etcetera
- Influence of amount of rotation plane detectors
- Additional detectors for different angles?



Human Upper Body, Side View

Thanks for your attention…

Questions?