

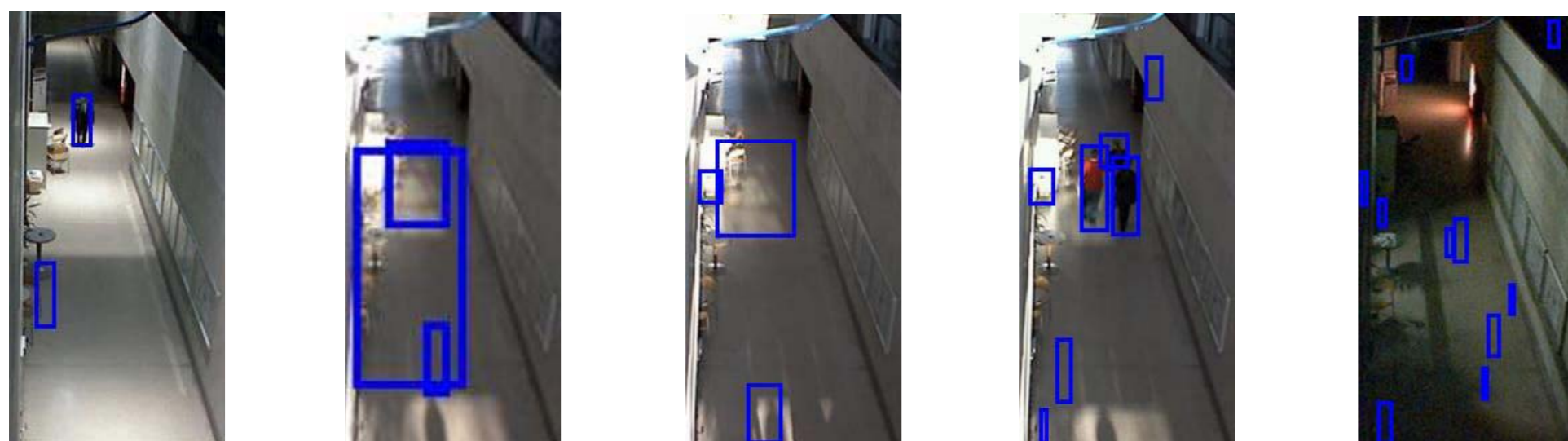
# Robust Adaptive Classifier Grids for Object Detection from Static Cameras\*

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**Abstract** We introduce classifier grids in order to develop an adaptive but still robust real-time object detector for static cameras. We propose to train a separate classifier for each image location, obtaining a specific object detector. For each classifier corresponding to one grid element we estimate two generative representations in parallel, one describing the object's class and one describing the background. These are combined in order to obtain a discriminative model. The on-line learned classifiers enable our system to be adaptive to changing environments. To ensure a stable system, which is needed for continuously learning, we keep the object representation fixed while only the representation of the background is updated.

## Motivation

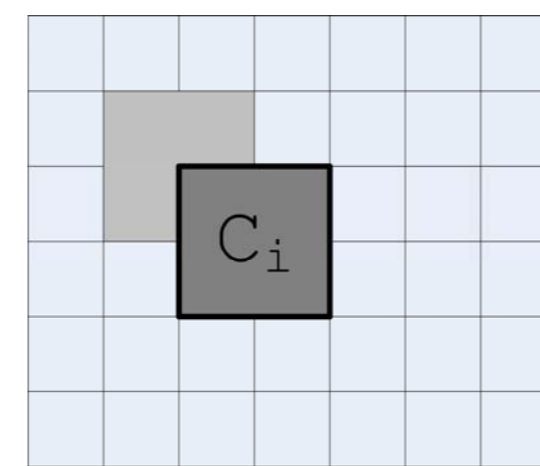


Generic object detector – large number of false positives



Adaptive object detector – able to deal with environmental changes

## Classifier Grids

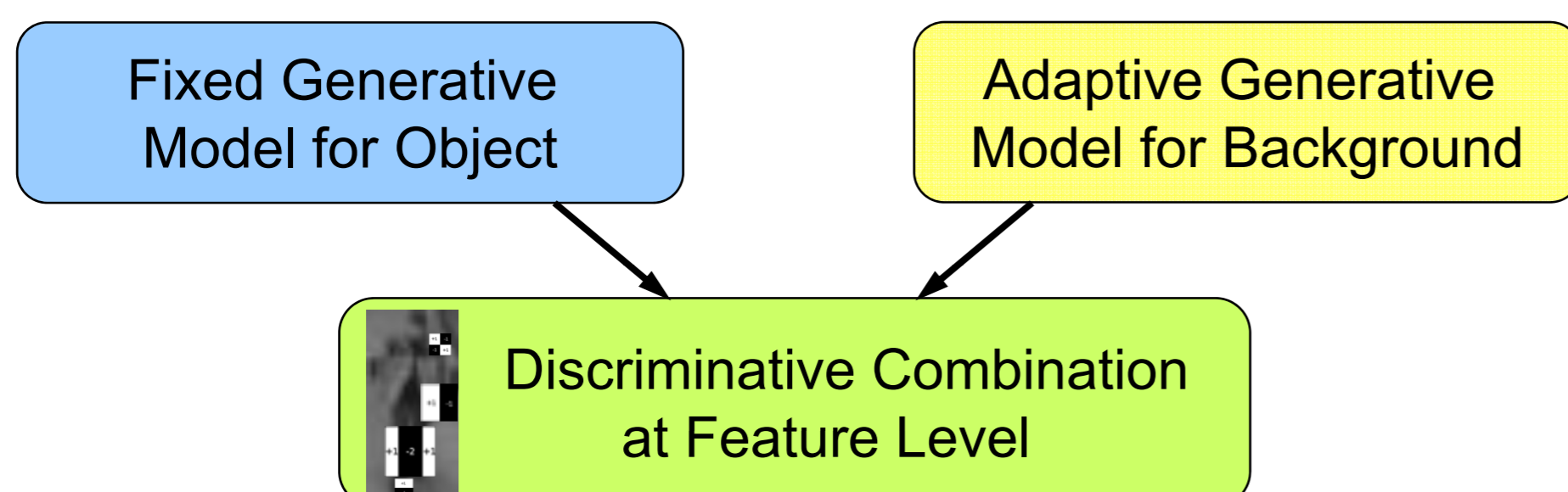


- Sample image by fixed highly overlapping grid
- Each grid element  $i$  has own classifier  $C_i$
- Less complex classifiers due to simplification
- Scene calibration to reduce search space

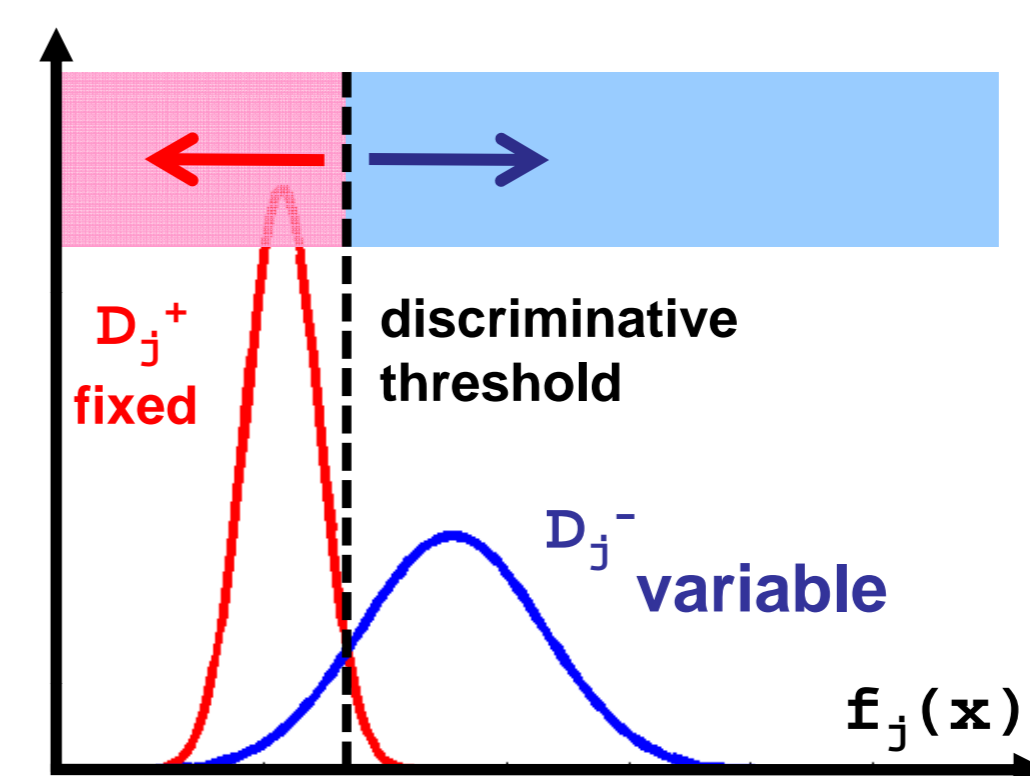
## Adaptive systems

- Able to deal with changing environments
- Main problem of adaptive systems: **drifting**
- Avoid drifting by using fixed update rules [2]
  - **Positive updates:** hand-labeled set, correct by definition
  - **Negative updates:** low probability  $P(x_i = \text{object}) = \frac{\# p_i}{\Delta t}$  of wrong negative update

## Robust Adaptive Grid-based Detector [1]

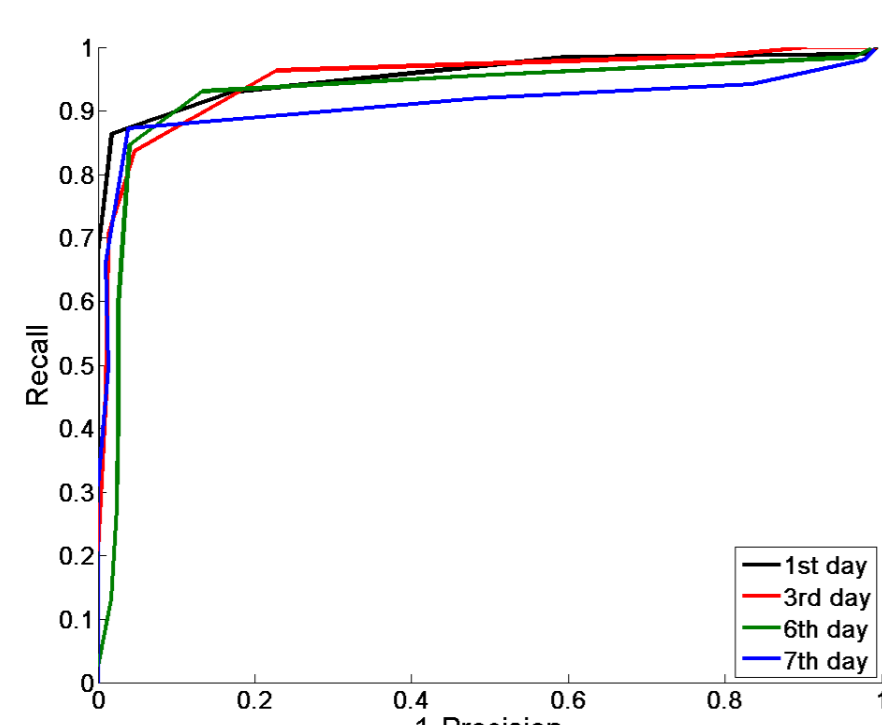
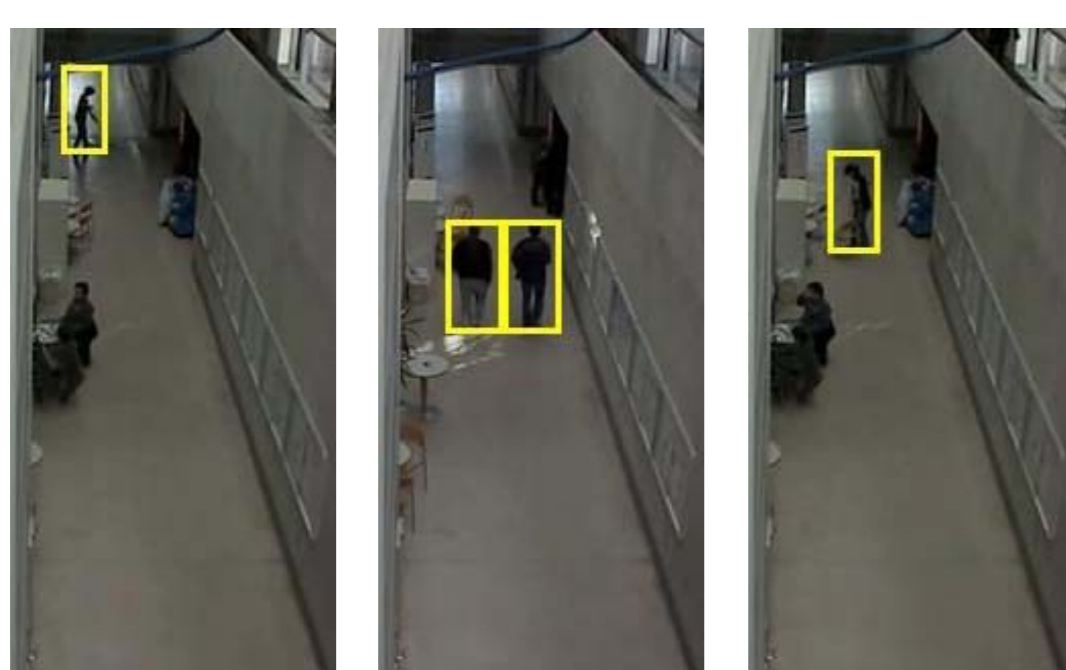


- **Off-line pre-training**  
Appearance of object stays the same → off-line pre-calculated
- **On-line weak classifier update**  
On-line adaption necessary due to background changes
- **On-line feature selection**  
Features are selected depending on off-line and on-line error

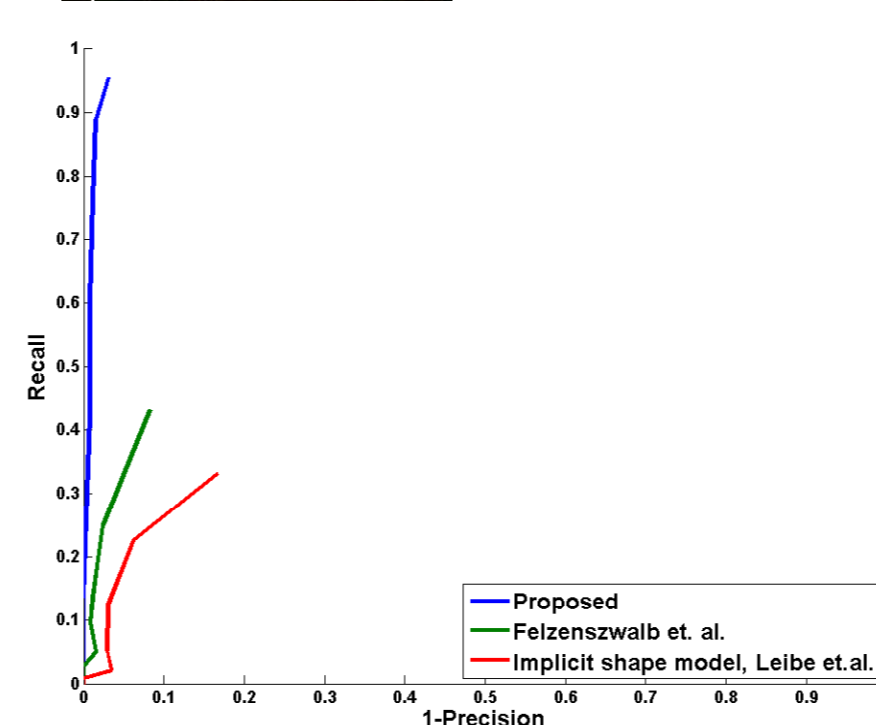
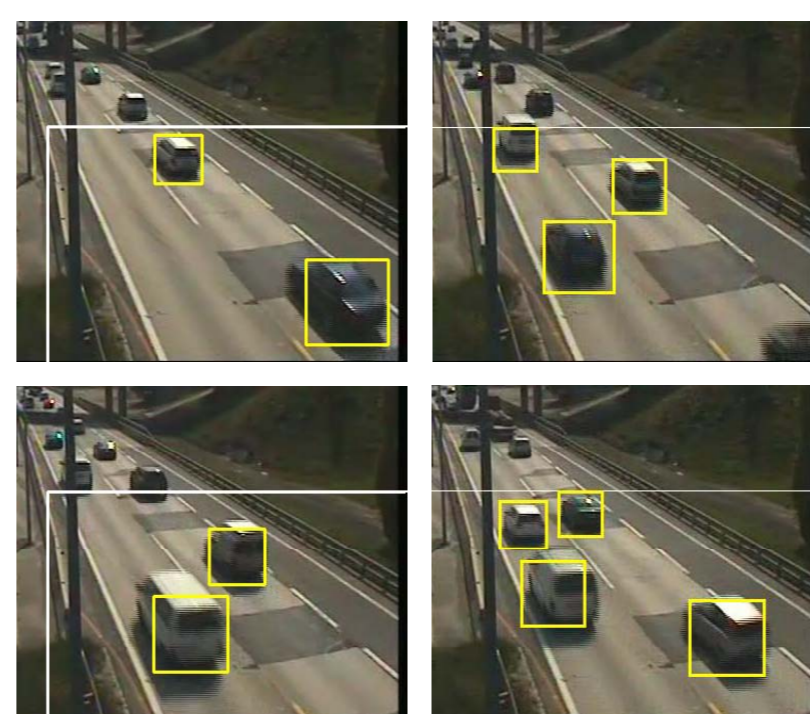


The combination of the fixed generative model describing the object and the adaptive generative model describing the background is located at the weak classifier level.

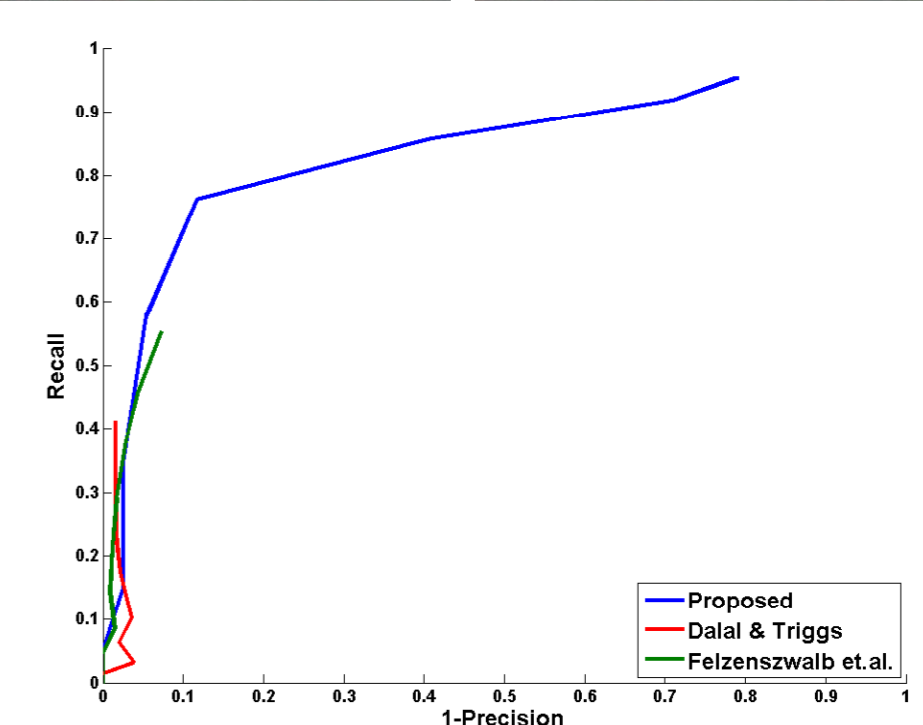
## Experiments for Robust, Adaptive and Real-time Object Detection!



Corridor sequence - 7 days  
**580.000 updates, no drifting!**



Car detection on highways  
1.000 frames, compared to SOTA approaches



Publicly available caviar sequence  
370 frames, compared to SOTA approaches

## References

1. P. Roth, S. Sternig, H. Grabner, H. Bischof, *Classifier Grids for Robust Adaptive Object Detection*, CVPR'09
2. H. Grabner, P. Roth, H. Bischof, *Is pedestrian detection really a hard task?* PETS'07

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