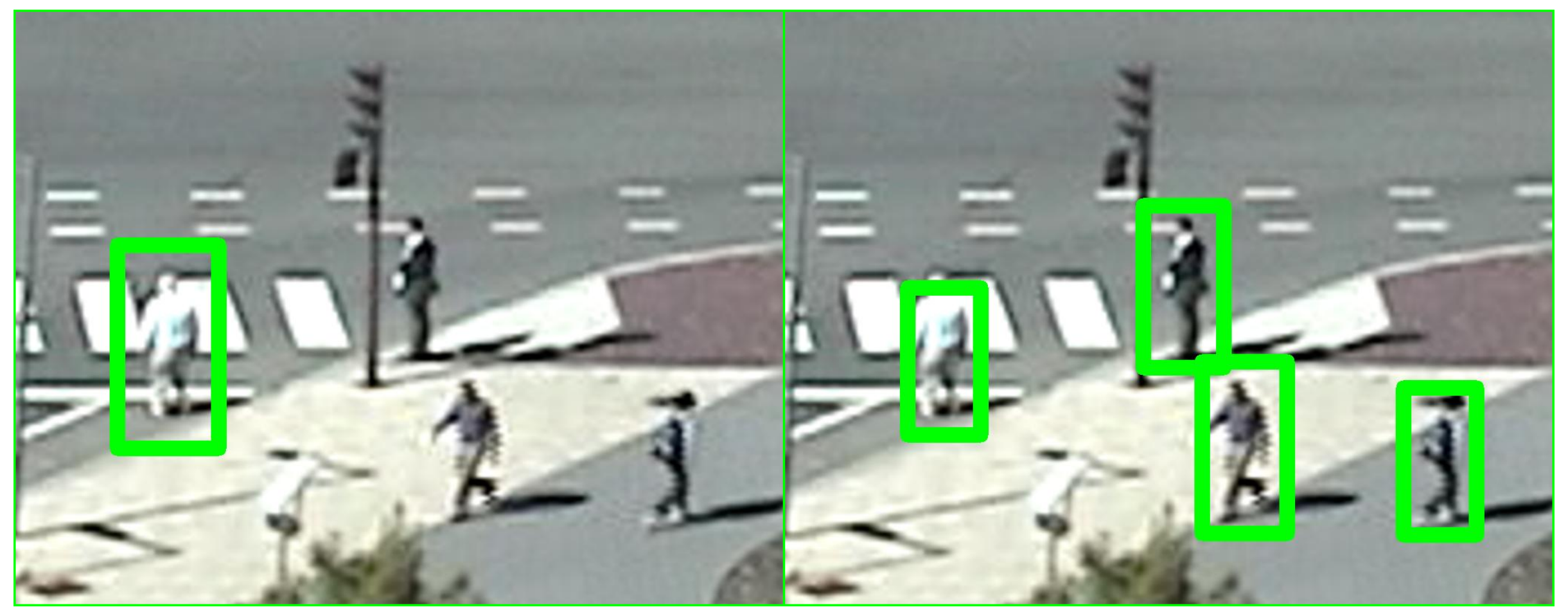

Automatic Adaptation of a Generic Pedestrian Detector to a Specific Traffic Scene

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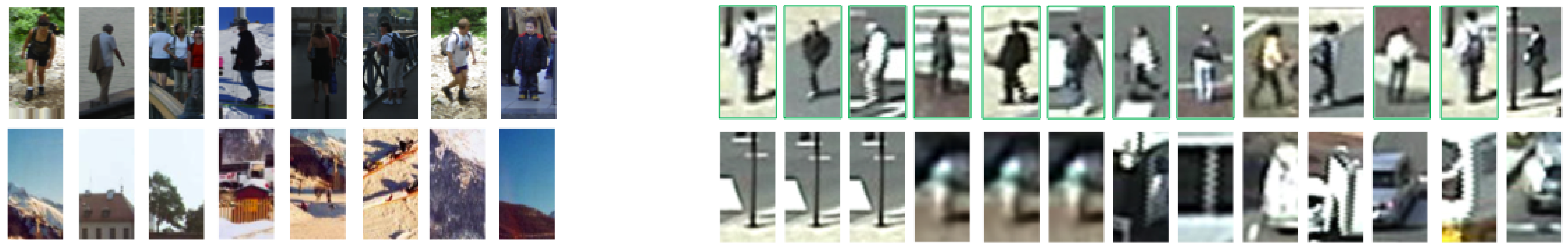
Introduction: Pedestrian Detection in Surveillance



Examples from the INRIA dataset (left) and the MIT traffic dataset (right). There are both true positives (first row) and false positives (second row).

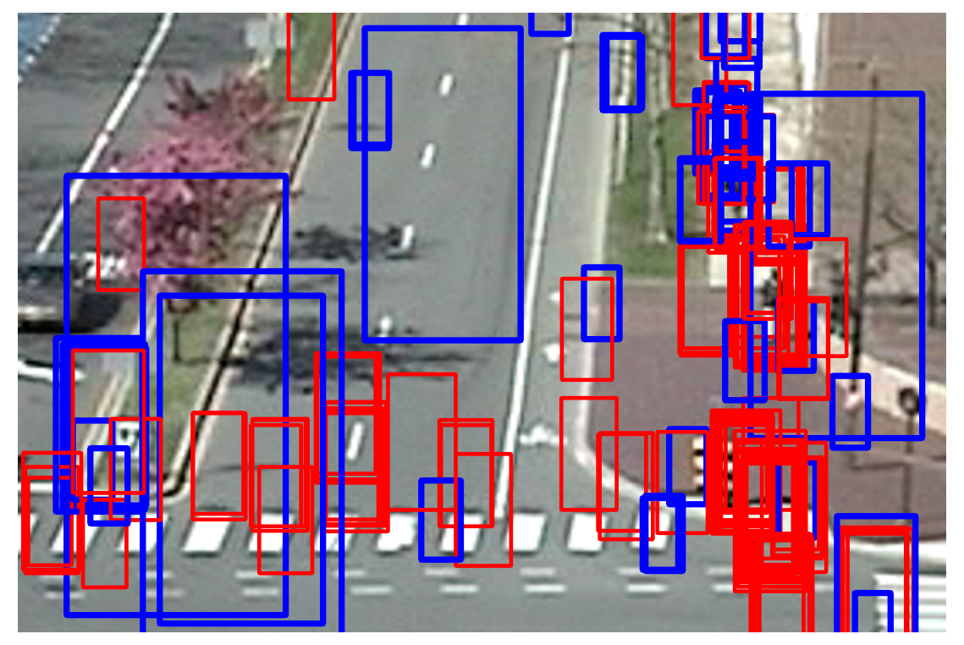
- ***A generic detector doesn't work well on a specific scene.*** It may achieve a 90% detection rate on the INRIA dataset, but drop to 20% on the MIT traffic dataset, both at approximately 1 false positive per image.
- ***It should be a much simpler problem on a specific scene.*** Once the scene is fixed, the diversity of both positive and negative examples will be significantly reduced.
- ***Our goal: A scene-specific detector.*** It is trained based on a generic dataset and examples from the specific scene ⇝ How to infer the labels unsupervisedly (so that the detector "self-adapts" to the dataset)?

Contribution: Self-adaptation of a generic detector

- Automatically infer confident positive examples and confident negative examples from the scene examples using both ***context*** and ***appearance*** information.
- ***Unsupervised.*** *No labeled example from the target dataset is required.*

Context Information

1. ***Path*** models: It is more likely for positive examples to appear on pedestrian paths.
2. ***Sizes*** of pedestrians in a target scene follow a certain distribution.
3. Pedestrians usually have ***motions***.
4. Background patches tend to repeat at the same ***location*** over time.
5. Pedestrians cannot exist on vehicle trajectories.



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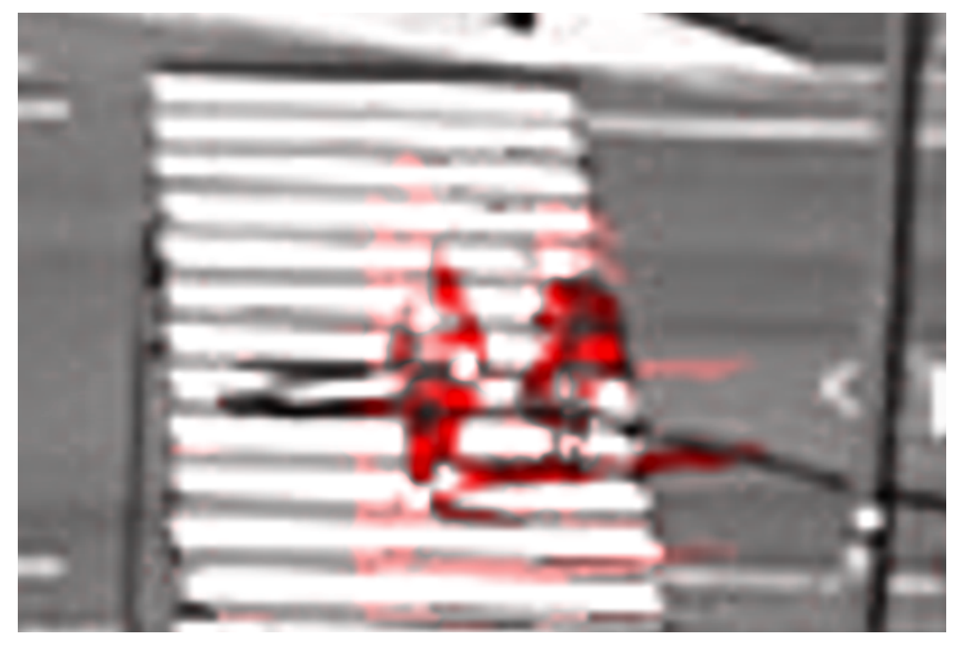

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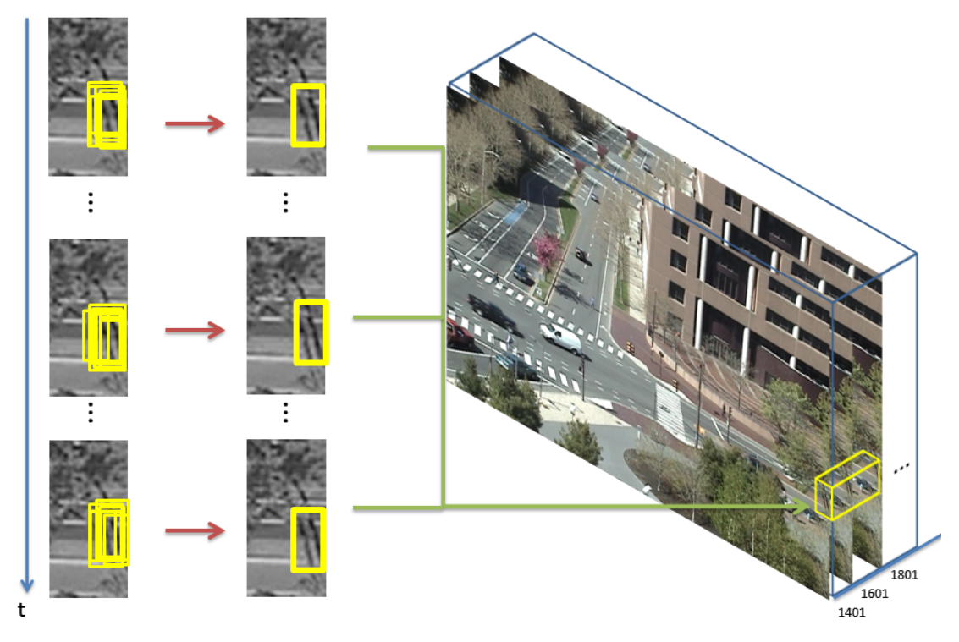

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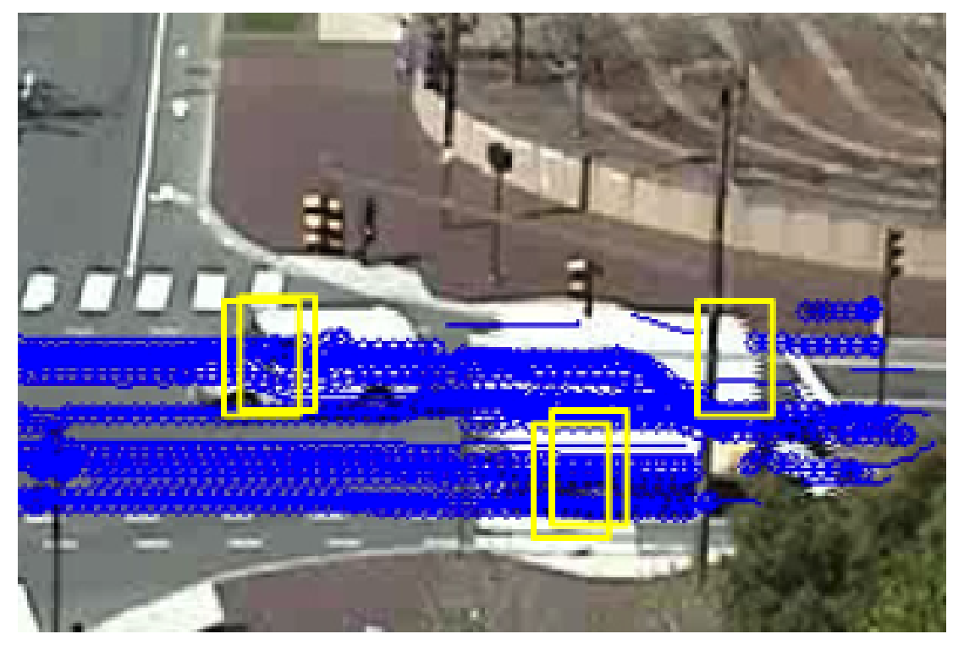

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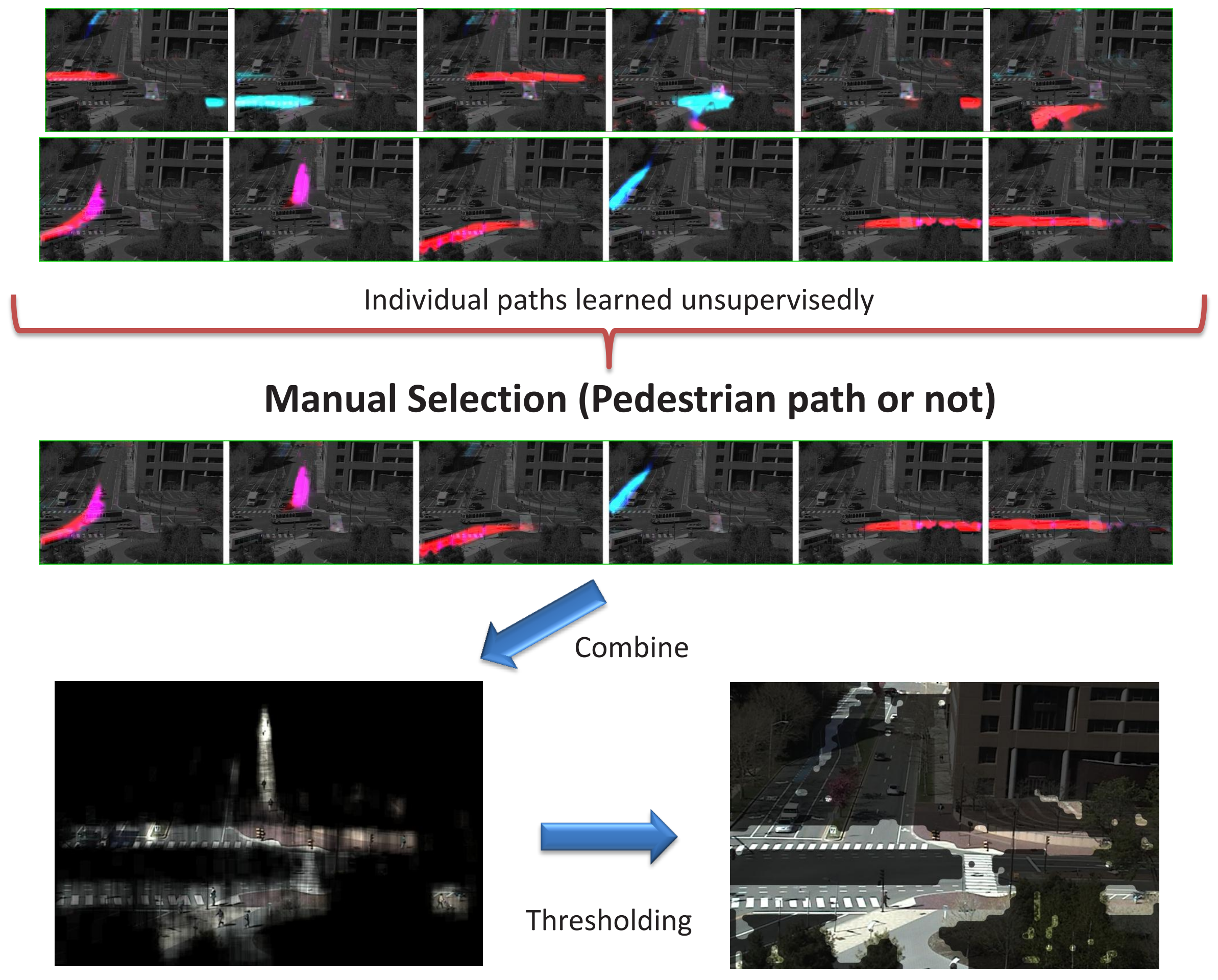
References

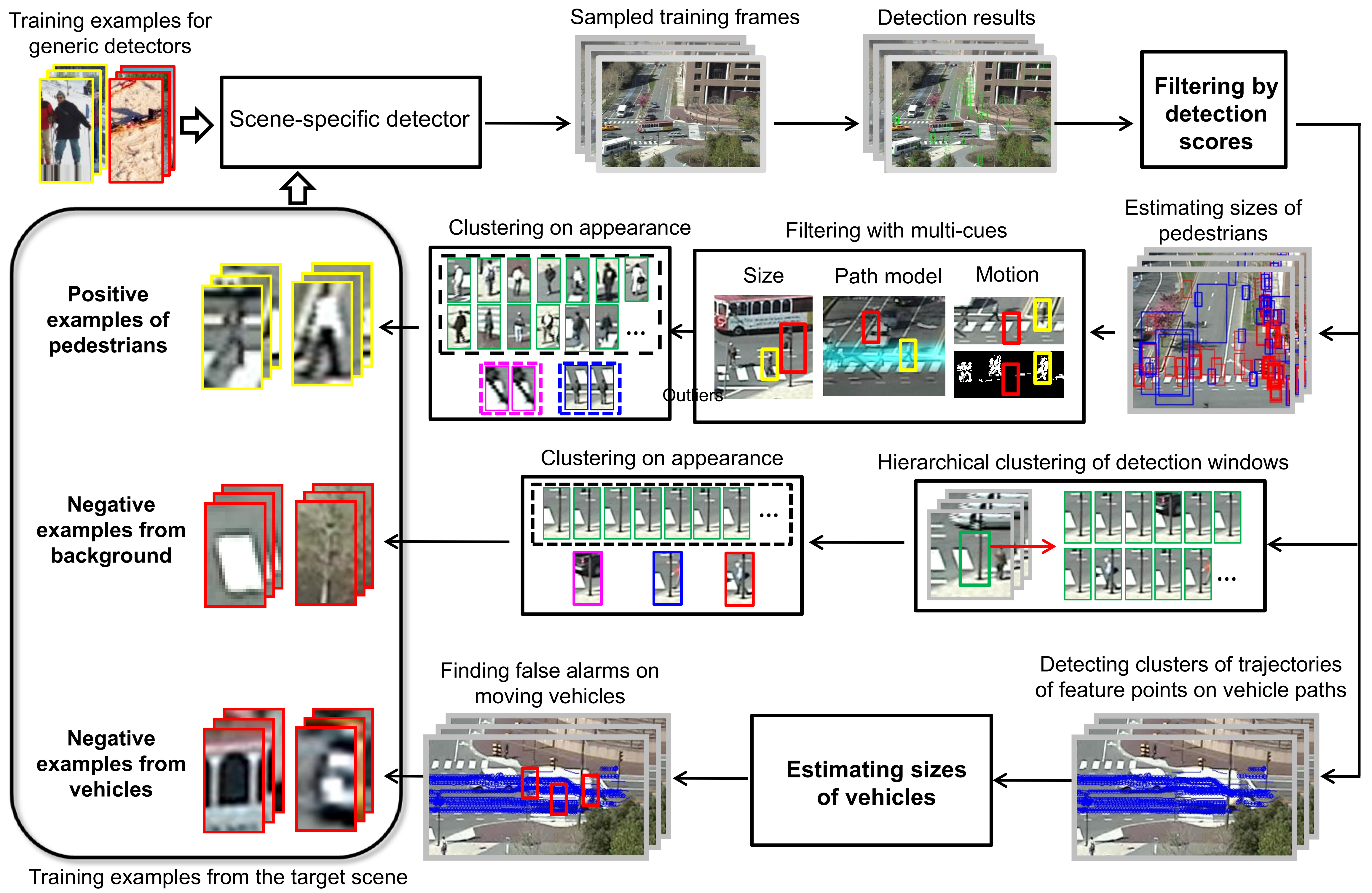
[1] X. Wang, X. Ma, W. Grimson. Unsupervised activity perception in crowded and complicated scenes using hierarchical Bayesian models. *IEEE Trans. on PAMI*, 31:539-555, 2009.

Path Model


Individual paths learned unsupervisedly
Manual Selection (Pedestrian path or not)
Combine
Thresholding

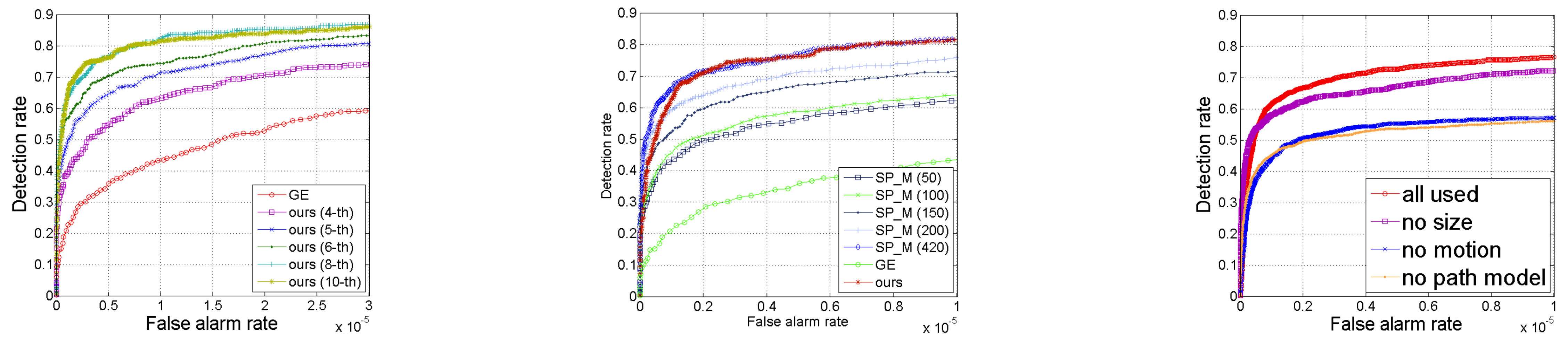
1. 29 individual semantic regions are learned unsupervisedly in [1]. We manually select 11 semantic regions where pedestrians usually appear. *This is the only manual work in this project.*
2. The selected semantic regions are combined and thresholded to yield a final path model. It serves as one of the cues in selecting the pedestrian examples.
3. Experiment (c) shows that the path model proves to be the most effective cue.

Our Approach


Training examples for generic detectors
Scene-specific detector
Sampled training frames
Detection results
Filtering by detection scores
Positive examples of pedestrians
Clustering on appearance
Outliers
Filtering with multi-cues
Size
Path model
Motion
Estimating sizes of pedestrians
Negative examples from background
Clustering on appearance
Hierarchical clustering of detection windows
Negative examples from vehicles
Finding false alarms on moving vehicles
Estimating sizes of vehicles
Detecting clusters of trajectories of feature points on vehicle paths
Training examples from the target scene

- Our approach starts with a generic appearance-based pedestrian detector pre-trained from a generic dataset.
- In each iteration, the detector is applied to the training video frames and the three types of examples are automatically selected to re-train the detector.
- The iteration stops when the detector performance does not improve significantly (normally no more than 10 iteration).

Experiment Results



(a) (b) (c)

GE: Generic detector. SP_M(N): Scene detector trained by manually labeling the first N frames out of the total 420 frames.

HOG + SVM is used as the detector. (a) Compared with the generic detector, it improves the detection rate from 21% to 62% at 10^{-6} FPPW. (b) Its performance is comparable with the scene specific detector using 300 manually labeled frames. (c) Path model and motion prove to be the most effective cues in selecting confidence positive examples.