Semi-Supervised On-line Boosting for Robust Tracking

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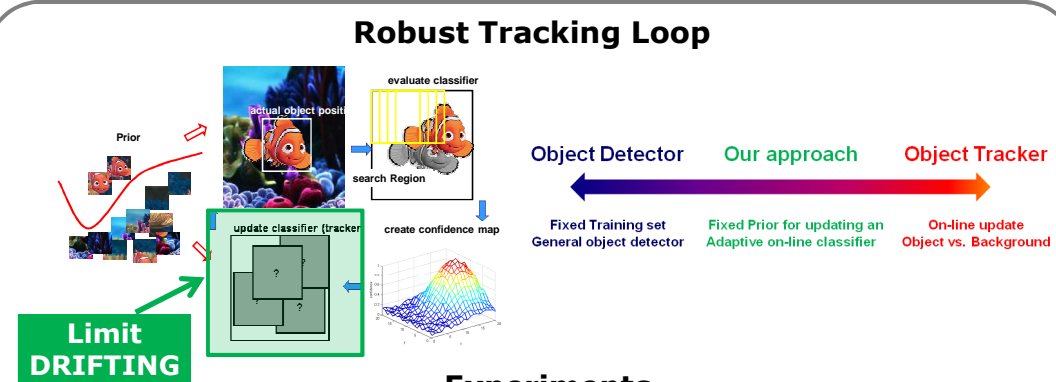[2] Computer Vision Laboratory, ETH-Zurich, Switzerland

Abstract. Recently, on-line adaptation of binary classifiers for tracking has been investigated. On-line learning allows for simple classifiers since only the current view of the object from its surrounding background needs to be discriminated. However, on-line adaptation faces one key problem: Each update of the tracker may introduce an error which, finally, can lead to tracking failure (drifting). The contribution of this paper is a novel on-line semi-supervised boosting method which significantly alleviates the drifting problem in tracking applications. This allows to limit the drifting problem while still staying adaptive to appearance changes. The main idea is to formulate the update process in a semi-supervised fashion as combined decision of a given prior and an on-line classifier. This comes without any parameter tuning. In the experiments, we demonstrate real-time tracking of our SemiBoost tracker on several challenging test sequences where our tracker outperforms other on-line tracking methods.

Motivation

Tracking Challenges

Appearance Changes

Robustness / Real-time

Any object (without/minimal prior learning)

DRIFTING
Label Noise AND Label Jitter

Tracking as Binary Classification Problem

from time t to t+1   evaluate classifier on sub-patches

search Region

actual object position

update classifier (tracker)

analyze map and set new object position

create confidence map

Former Tracking Loop [1].

Approach

Include unlabeled data directly in the traning Process.

On-line Boosting [2].

$$H(\mathbf{x}) = \sum_{n=1}^{N} \alpha_n \cdot h_n(\mathbf{x})$$

$S(\mathbf{x}_i, \mathbf{x}_j)$

Semi-Supervised Boosting [3].

Semi-Supervised On-line Boosting

An (honest) off-line classifier serves as similarity measure.

Robust Tracking Loop

evaluate classifier

Prior

actual object position

search Region

update classifier (tracker)

create confidence map

Limit DRIFTING

Object Detector → Our approach → Object Tracker
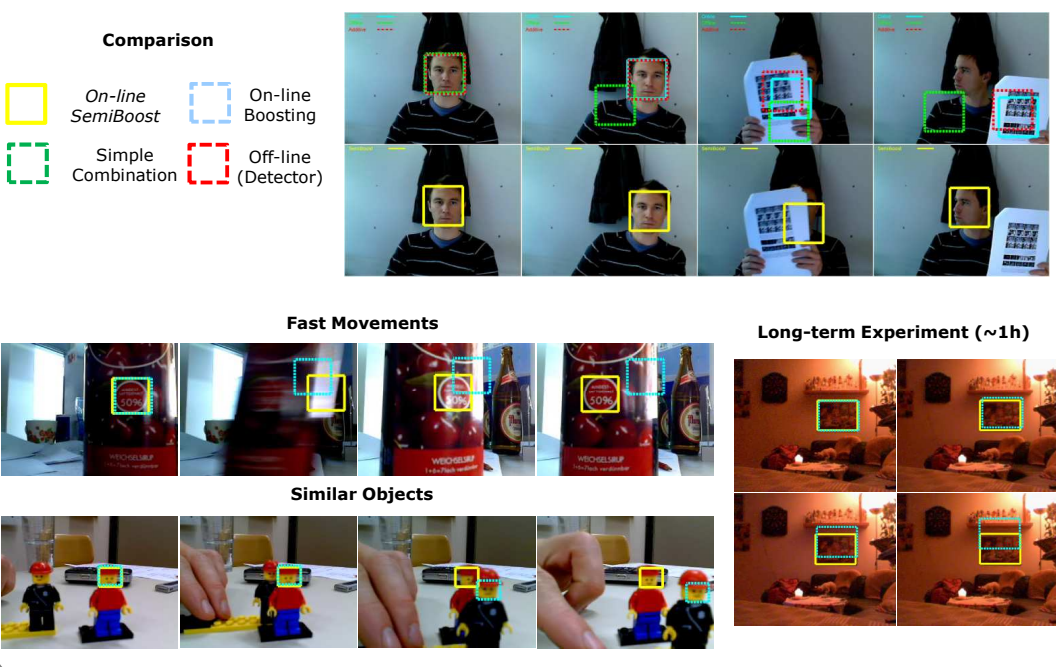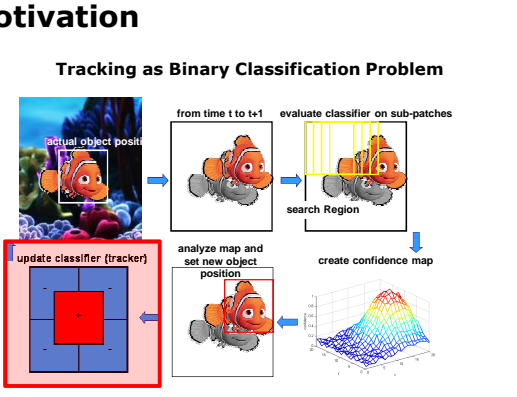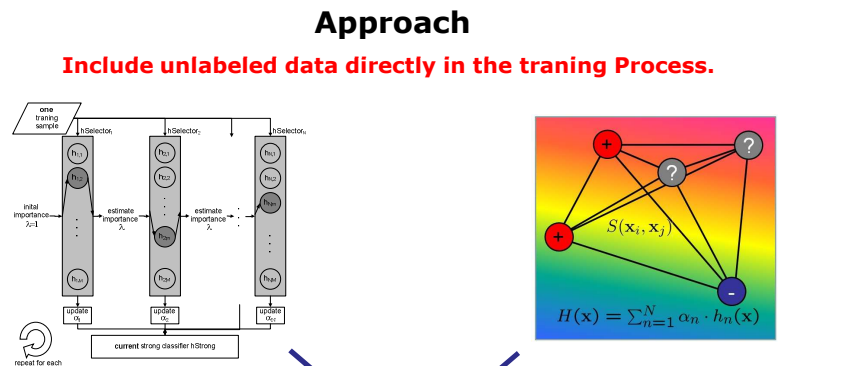
Fixed Training set
General object detector

Fixed Prior for updating an
Adaptive on-line classifier

On-line update
Object vs. Background

Experiments

Comparison

On-line SemiBoost (yellow)

On-line Boosting

Simple Combination

Off-line (Detector)

Fast Movements

Similar Objects

Long-term Experiment (~1h)

References

[1] H. Grabner, M. Grabner, and H. Bischof. *Real-time Tracking using On-line Boosting*, BMVC, 2006.
[2] H. Grabner, and H. Bischof. *On-line Boosting and Vision*, CVPR, 2006.
[3] C. Leistner, H. Grabner, and H. Bischof. *Semi-supervised Boosting using Visual Similarity Learning*, CVPR, 2008.