PFT: a Protocol For evaluating video Trackers

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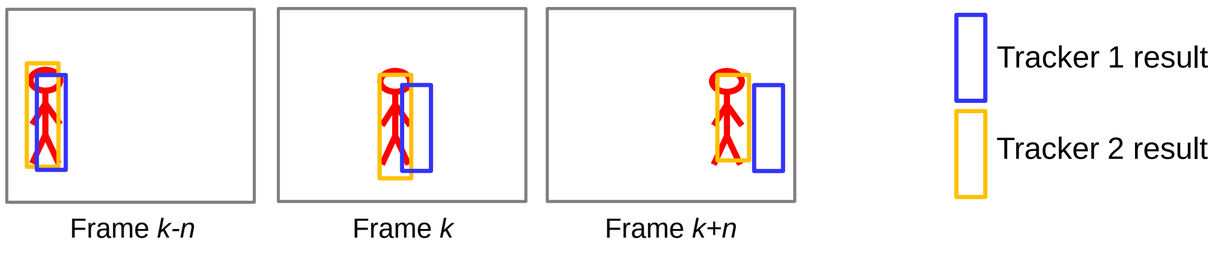
1. Motivation

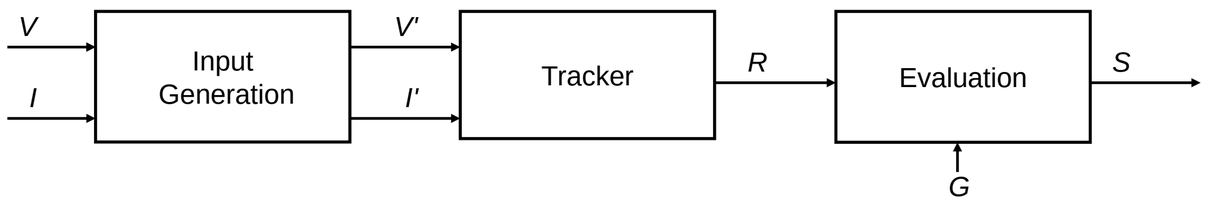


- Which tracker is preferable?
  - Accuracy: deviation of the tracker's result from a ground truth
  - Robustness: performance variations when the input is corrupted
  - Repeatability: consistency over different runs with the same conditions

- Absence of a commonly used evaluation framework
  - Need objectivity in the evaluation measures
  - Need simple and easy-to-use evaluation criterion
- Evaluation campaigns
  - CLEAR [1]; ETISEO [2]; PETS [3]; CAVIAR [4]
- Small-scale evaluations
  - Black et al. 2003 [5]; Bashir and Porikli [6]; Pan et al. 2009 [7]

2. Evaluation protocol

- Evaluation criterion
- Dataset
- Trials (a set of evaluation procedures)



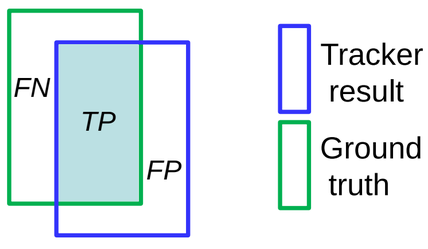
V: Original video
I: Tracker's initialization

V': Modified video
I': Modified initialization

R: Estimated trajectory
G: Ground truth
S: Performance score

3. Evaluation criterion

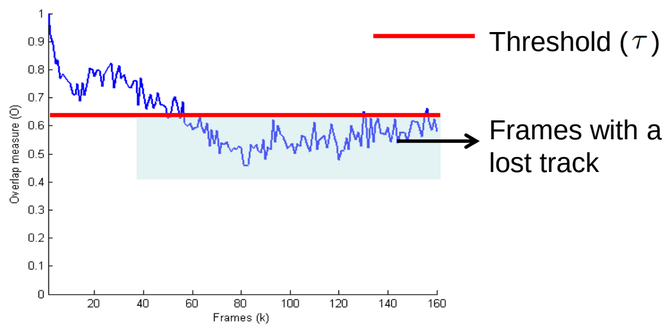
Overlap measure



$$O_k = \frac{|TP_k|}{|TP_k| + |FP_k| + |FN_k|}$$

O_k: Overlap measure at frame *k*
$|TP_k|$: Number of true positive pixels in frame *k*
$|FP_k|$: Number of false positive pixels in frame *k*
$|FN_k|$: Number of false negative pixels in frame *k*

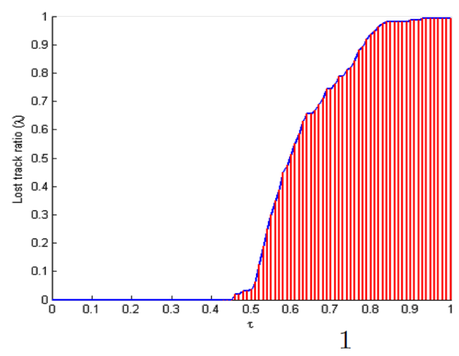
Lost track ratio



$$\lambda = \frac{N_l}{N}$$

λ: Lost track ratio
N_l: Number of frames with a lost track
N: Total number of frames

Lost-track-ratio curve

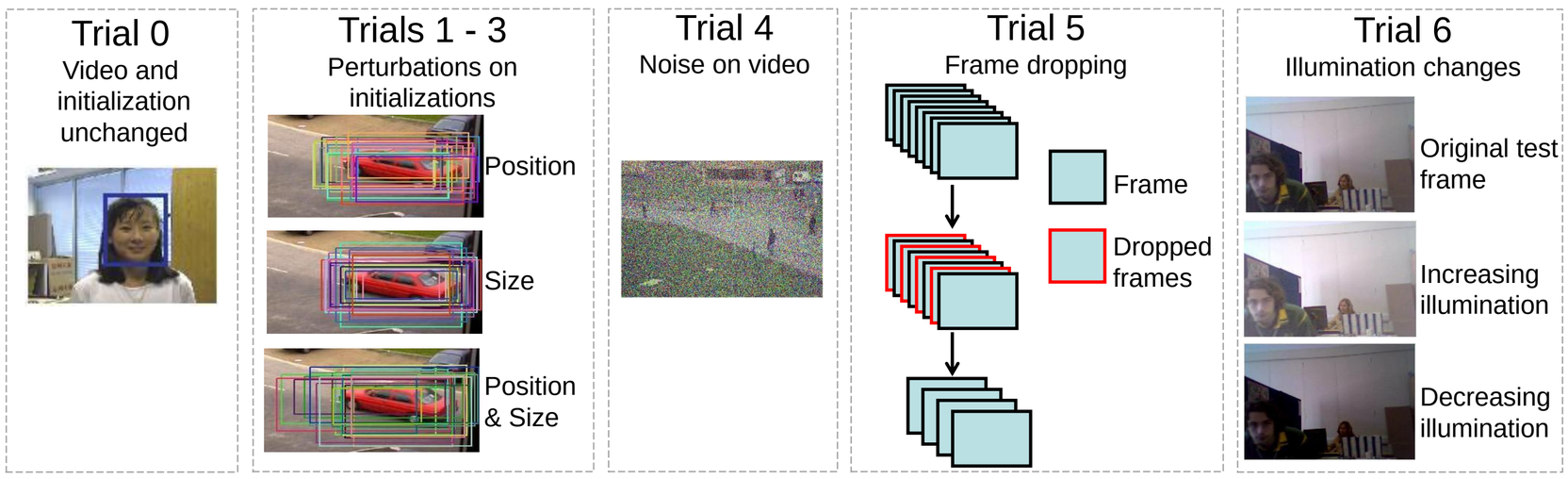


$$AUC_\lambda = \Delta\tau \sum_{\tau=0}^{1} \lambda(\tau)$$

The smaller the AUC_λ, the better the tracking result
- $\Delta\tau = 0.01$

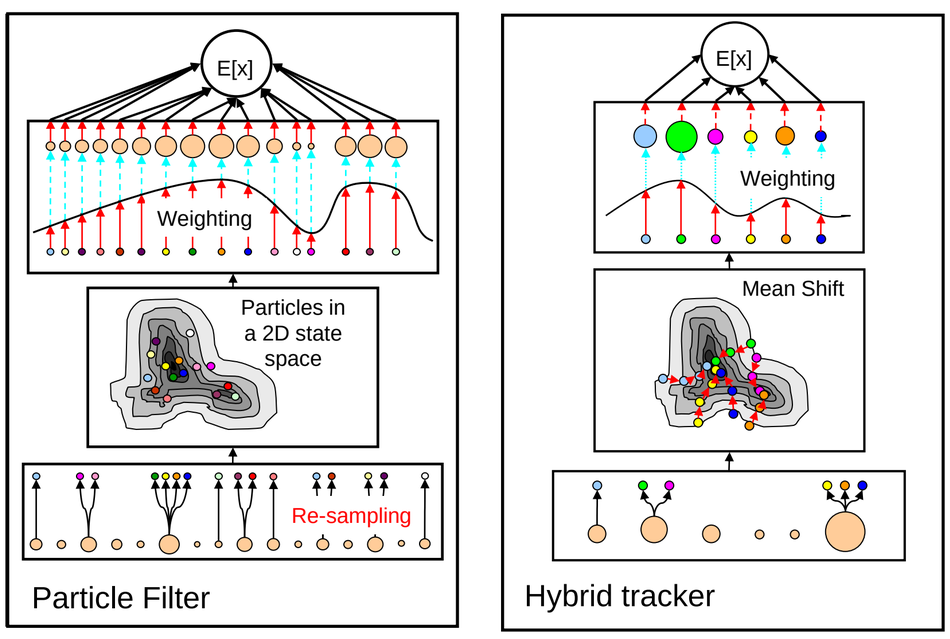
4. Dataset

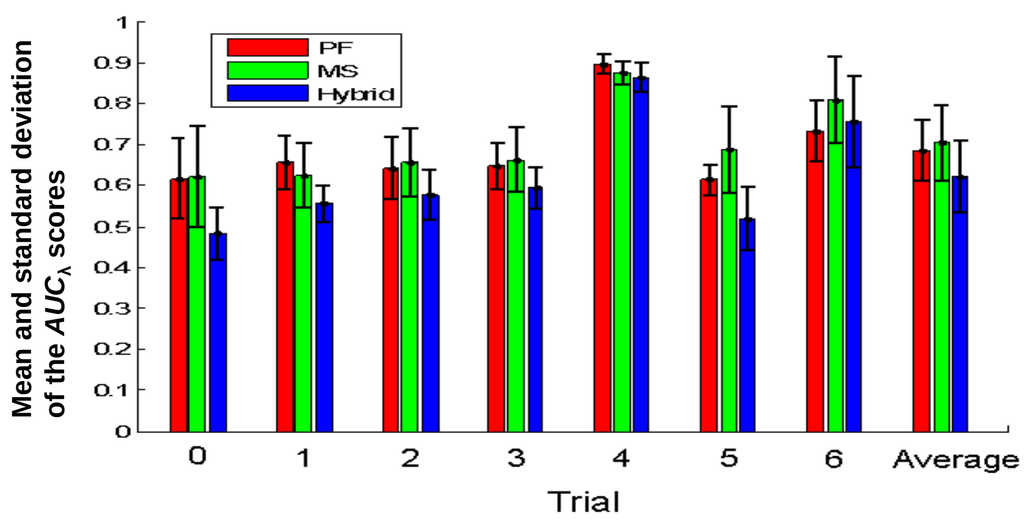
5. Trials



6. Experimental validation

Validation on
- Particle Filter (PF) [8]
- Mean Shift (MS) [9]
- Hybrid [10]





References

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[4] Context Aware Vision using Image-based Active Recognition (CAVIAR). http://homepages.inf.ed.ac.uk/rbf/CAVIAR/
[5] Black et al., "A novel method for video tracking performance evaluation," VS-PETS, 2003
[6] Bashir and Porikli, "Performance evaluation of object detection and tracking systems," IEEE PETS, 2006
[7] Pan et al., "A new method for tracking performance evaluation based on a reflective model and perturbation analysis," IEEE ICASSP, 2009
[8] Nummiaro et al., "An adaptive color-based particle filter," Image and Vision Computing, 2002
[9] Comaniciu et al., "Kernel-based object tracking," IEEE Trans. on PAMI, 2003
[10] Maggio and Cavallaro, "Hybrid particle filter and mean shift tracker with adaptive transition model," IEEE ICASSP, 2005

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Additional info: http://www.eecs.qmul.ac.uk/~andrea/pft.html