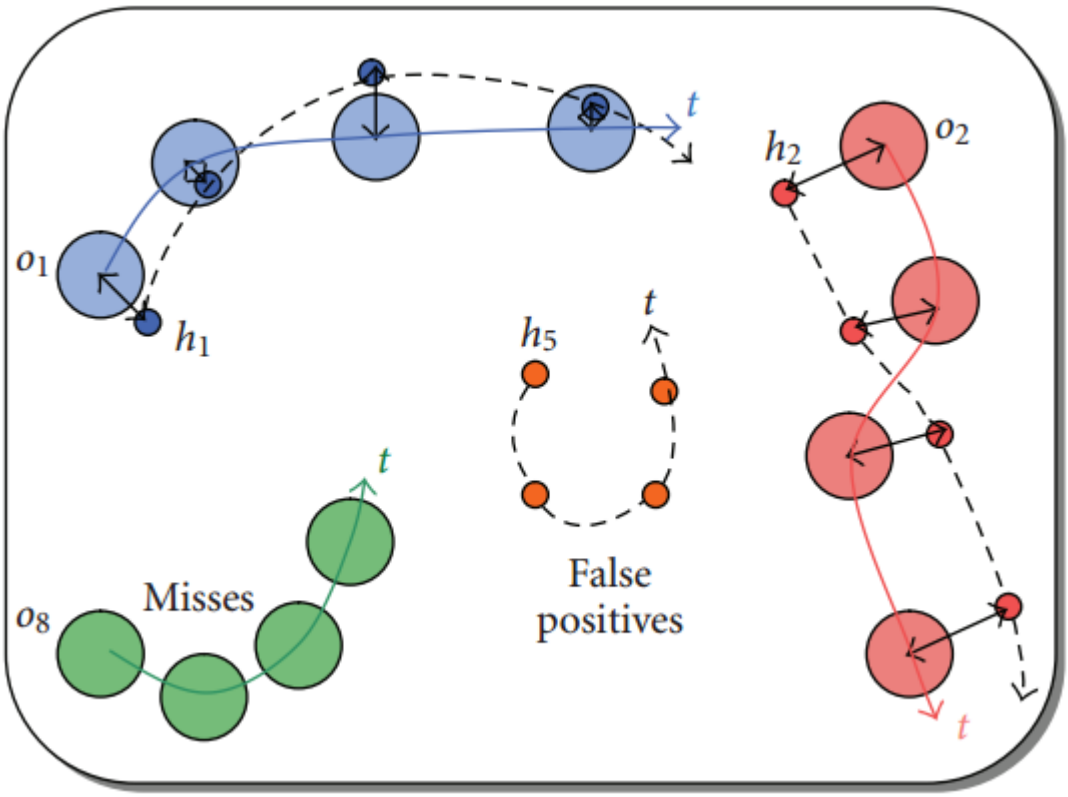
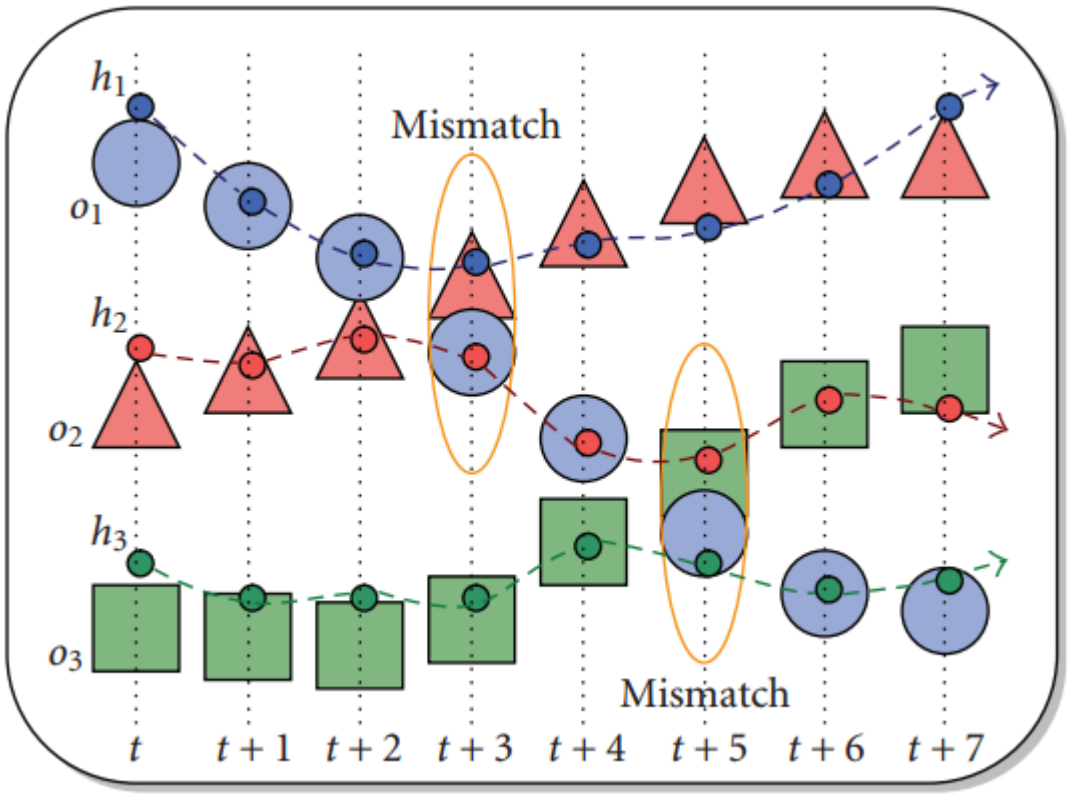
> Bernardin K, Stiefelhagen R. **Evaluating multiple object tracking performance: the CLEAR MOT metrics**[J]. EURASIP Journal on Image and Video Processing, 2008, 2008(1): 246309.

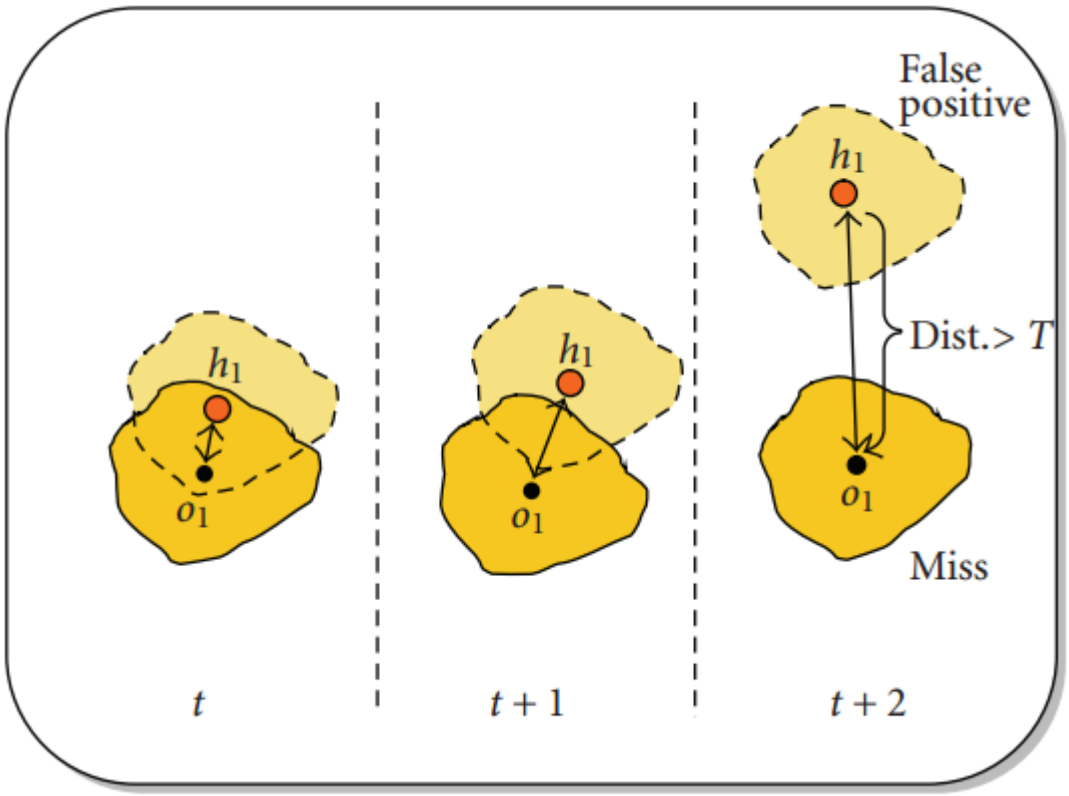


Assuming that for every time frame t, a multiple object tracker outputs a set of **hypotheses** $\{h_1, \ldots, h_m\}$ for a set of **visible objects (ground truth)** $\{o_1, \ldots, o_n\}$

- count all objects for which no hypothesis was output as **misses (false negatives)**
- count all tracker hypotheses for which no real object exists as **false positives**



- count all occurrences where the tracking hypothesis for an object changed compared to previous frames as mismatch errors.
    - when two or more objects are swapped as they pass close to each other
    - when an object track is reinitialized with a different track ID, after it was previously lost because of occlusion



- distance $dist_{i,j}$ of object o_i and a hypothesis h_j should not be made if it exceeds a certain threshold T, but should rather argue that the tracker has missed the object and is tracking something else.

The multiple object tracking precision (MOTP)

- It is the total error in estimated position for **matched object-hypothesis pairs over all frames**, averaged by the total number of matches made.

$$MOTP = \frac{\sum_{i,t} d_t^i}{\sum_t c_t}$$

- It shows the ability of the tracker to estimate precise object positions.

The multiple object tracking accuracy (MOTA)

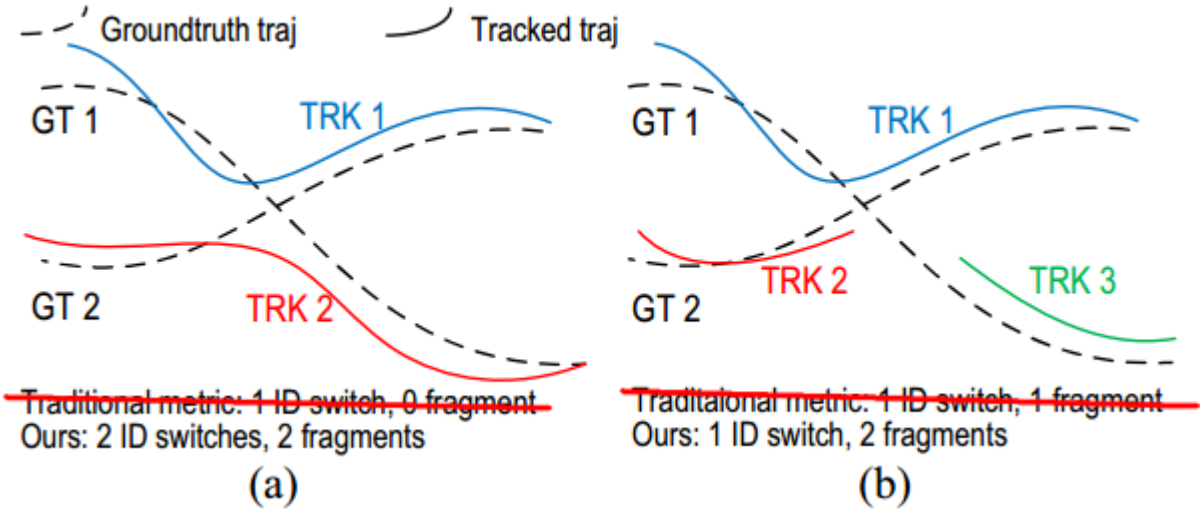
$$MOTA = 1 - \frac{\sum_t (m_t + fp_t + mme_t)}{\sum_t g_t}$$

- m_t, fp_t, and mme_t are the number of **misses**, of **false positives**, and of **mismatches**, respectively, for time frame t, computed over the total number of objects present in all frames.
- The MOTA can be seen as derived from 3 error ratios: the ratio of misses in the sequence, the ratio of false positives, the ratio of mismatches.

> Li Y, Huang C, Nevatia R. **Learning to associate: Hybridboosted multi-target tracker for crowded scene**[C]//Computer Vision and Pattern Recognition, 2009. CVPR 2009. IEEE Conference on. IEEE, 2009: 2953-2960.

Name	Definition
Recall	(Frame-based) correctly matched objects / total groundtruth objects.
Precision	(Frame-based) correctly matched objects / total output objects.
FA/Frm	(Frame-based) No. of false alarms per frame. *The smaller the better.*
GT	No. of groundtruth trajectories.
MT%	Mostly tracked: Percentage of GT trajectories which are covered by tracker output for more than 80% in length.
ML%	Mostly lost: Percentage of GT trajectories which are covered by tracker output for less than 20% in length. *The smaller the better.*
PT%	Partially tracked: 1.0-MT-ML.
Frag	Fragments: The total of No. of times that a groundtruth trajectory is interrupted in tracking result. *The smaller the better.*
IDS	ID switches: The total of No. of times that a tracked trajectory changes its matched GT identity. *The smaller the better.*

ID Switch and Fragment


Groundtruth traj
Tracked traj
GT 1
TRK 1
GT 2
TRK 2
Traditional metric: 1 ID switch, 0 fragment
Ours: 2 ID switches, 2 fragments
(a)
GT 1
TRK 1
TRK 2
TRK 3
GT 2
Traditional metric: 1 ID switch, 1 fragment
Ours: 1 ID switch, 2 fragments
(b)