

# Recovery from Tracking Failure



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## Introduction

Tracking failure is inevitable in complex environment, so it is necessary to verify whether the object being followed by the tracker is really the target and recovery after tracking failure. The object model that constructed in the first frame is not polluted by occlusion or deformation at all. We take the initial model to correct the tracker over time. And the number of matched key-points is explored to verify whether the tracker fails to locate the target. A larger search window will be employed to re-detect object and a group of key-points will be used to predict object location after tracking failure.

## The Proposed Method

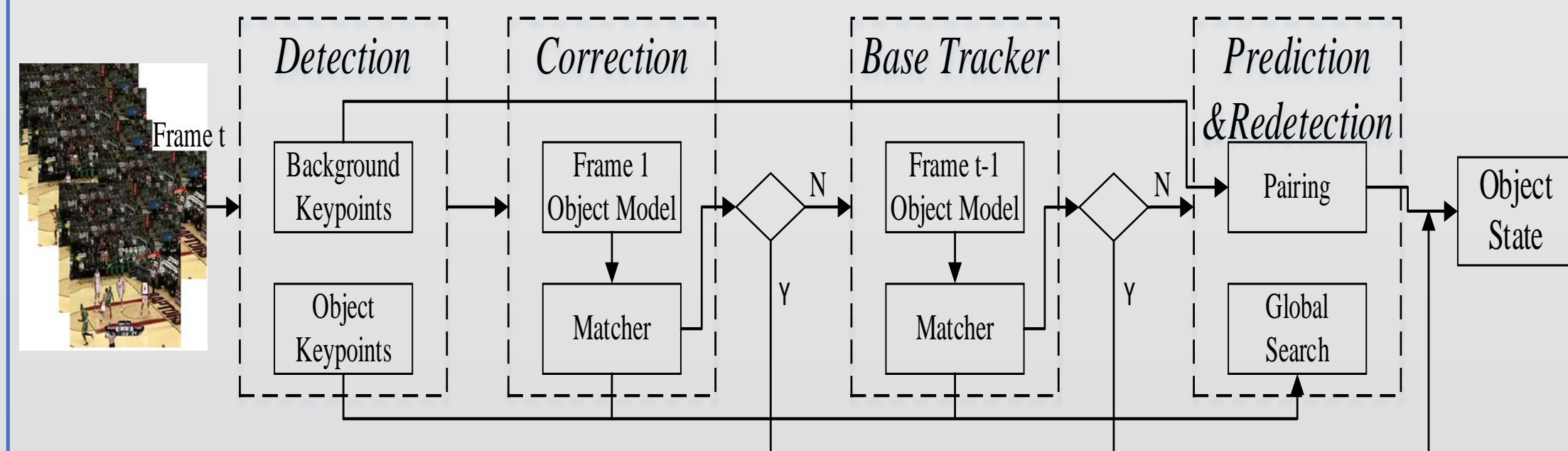


Fig.1. Framework of the Proposed Method

The framework of the proposed method is illustrated in Figure 1. First, a robust tracker based on key-points matching is employed. The location  $l^t$  and scale  $s^t$  of the object are determined by matched key-points between frame  $t$  and frame  $t-1$ . Then, the object model constructed in the first frame is used to correct the tracker for the reason that it is not polluted by model updating at all. The number of matched key-points is exploited to detect whether the tracker fails to

locate the object. If  $N_{m_1}^t < \alpha_1 N^1$  and  $N_m^t < \alpha_2 N^{t-1}$ , then the tracker fails to locate the object.

Once tracking failure has been confirmed, a group of key-points around the object in a rectangular annular region is used to predict the object location, and the object scale is updated with the previous frame  $s^t = s^{t-1}$ . In the meantime, we detect key-points in the whole image to recapture the object after tracking failure.

## Experiments & Results

Our tracker is evaluated on 30 challenging sequences with two widely used evaluation criteria: the center location error(CLE) and Pascal VOC Overlap Ratio(VOR). And the proposed tracker is compared to the other 6 trackers. The results of 7 trackers on all sequences are listed Table 1.

Table 1. The results of 7 trackers on 30 sequences

Sequence	ours	CMT	Struck	TLD	CXT	Frag	STC
basketball	0.66/0.64	0.04/0.03	0.117/0.11	0.03/0.02	0.03/0.02	0.75/0.78	0.08/0.04
biker	0.51/0.46	0.94/0.79	0.94/0.56	0.49/0.42	0.74/0.46	0.49/0.31	0.51/0.21
bird2	0.49/0.59	0.78/0.81	0.52/0.56	0.41/0.43	0.19/0.11	0.22/0.22	0.52/0.54
blurbody	0.46/0.60	0.97/1.00	0.72/0.94	0.03/0.13	0.32/0.52	0.05/0.30	0.38/0.06
bolt	0.35/0.19	0.02/0.01	0.02/0.02	0.30/0.20	0.03/0.02	0.27/0.13	0.02/0.02
box	0.30/0.34	0.75/0.80	0.85/0.85	0.74/0.50	0.32/0.34	0.25/0.29	0.36/0.19
boy	1.00/1.00	1.00/0.97	1.00/0.98	1.00/0.98	0.93/0.54	0.48/0.47	0.67/0.64
clifbar	0.50/0.32	0.69/0.60	0.65/0.35	0.60/0.44	0.48/0.48	0.24/0.11	0.47/0.24
coke	0.91/0.88	0.22/0.14	0.95/0.95	0.62/0.47	0.64/0.63	0.08/0.08	0.81/0.45
david	1.00/0.97	1.00/0.84	0.33/0.25	1.00/1.00	1.00/0.97	0.16/0.15	1.00/0.54
deer	0.59/0.51	0.94/0.86	1.00/1.00	0.73/0.73	1.00/0.94	0.21/0.23	0.04/0.04
doll	0.95/0.96	0.95/0.95	0.91/0.79	0.98/0.77	0.99/0.99	0.88/0.74	0.22/0.11
dragonbaby	0.27/0.28	0.28/0.24	0.32/0.27	0.21/0.14	0.53/0.27	0.25/0.26	0.06/0.06
dudek	0.88/1.00	0.82/1.00	0.88/0.98	0.57/0.89	0.80/0.95	0.49/0.63	0.55/0.76
fleetface	0.64/0.84	0.59/0.64	0.63/0.79	0.47/0.63	0.56/0.65	0.33/0.52	0.45/0.48
human6	0.59/0.59	0.27/0.21	0.28/0.22	0.49/0.55	0.24/0.20	0.32/0.23	0.29/0.22
human7	0.68/0.54	1.00/0.92	1.00/0.53	1.00/0.96	1.00/0.36	0.47/0.26	0.32/0.32
ironman	0.13/0.12	0.04/0.04	0.08/0.06	0.12/0.08	0.04/0.03	0.04/0.04	0.13/0.13
jump	0.06/0.10	0.07/0.07	0.08/0.10	0.05/0.05	0.07/0.07	0.09/0.05	0.07/0.10
lemming	0.62/0.63	0.54/0.56	0.61/0.68	0.85/0.66	0.73/0.66	0.40/0.41	0.29/0.15
liquor	0.81/0.92	0.82/0.86	0.39/0.41	0.58/0.61	0.21/0.21	0.34/0.38	0.40/0.25
panda	0.86/0.31	0.62/0.46	1.00/0.42	0.99/0.73	0.24/0.21	0.98/0.57	0.19/0.13
shaking	0.80/0.97	0.04/0.04	0.18/0.20	0.39/0.42	0.12/0.13	0.08/0.10	0.77/0.84
skiing	0.14/0.11	0.07/0.07	0.04/0.04	0.12/0.07	0.15/0.14	0.04/0.04	0.14/0.11
singer2	0.11/0.17	0.13/0.06	0.04/0.04	0.06/0.15	0.06/0.04	0.18/0.20	0.03/0.03
soccer	0.17/0.17	0.18/0.16	0.24/0.17	0.11/0.13	0.22/0.13	0.19/0.21	0.14/0.11
surfer	1.00/0.99	0.99/0.98	0.98/0.21	1.00/0.95	1.00/1.00	0.26/0.09	0.04/0.04
tiger1	0.88/0.77	0.65/0.66	0.17/0.20	0.44/0.48	0.36/0.33	0.27/0.34	0.34/0.14
tiger2	0.91/0.90	0.16/0.17	0.60/0.73	0.34/0.24	0.31/0.38	0.12/0.14	0.11/0.11
trellis	0.81/0.80	0.55/0.40	0.86/0.81	0.51/0.52	0.96/0.86	0.39/0.38	0.73/0.49

Tracking examples are shown in Figure 3 (more examples are presented in our paper). The sequence *human6* suffers from occlusion, scale variation, out of view and fast motion, all trackers except ours fail to estimate the object position and scale soon after the object is occluded or distracted by other objects.

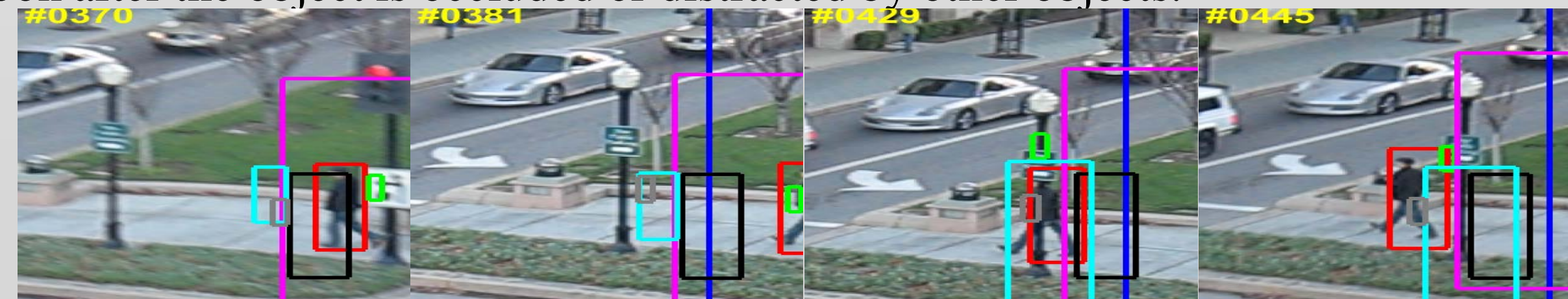


Fig.2. Tracking examples

## Conclusion

we proposed a framework to correct tracker, verify failure, predict object position and re-detect object. But the proposed method cannot cope with the situation that just few key-points are detected. And if the object reappears with quite different appearance, then the tracker cannot recognize the object.

To analyze the effectiveness of each part of our method, we present the results of base tracker (BT), base tracker with correction (BTC) and base tracker with correction, prediction and re-detection (BTCPR) in Figure 3.

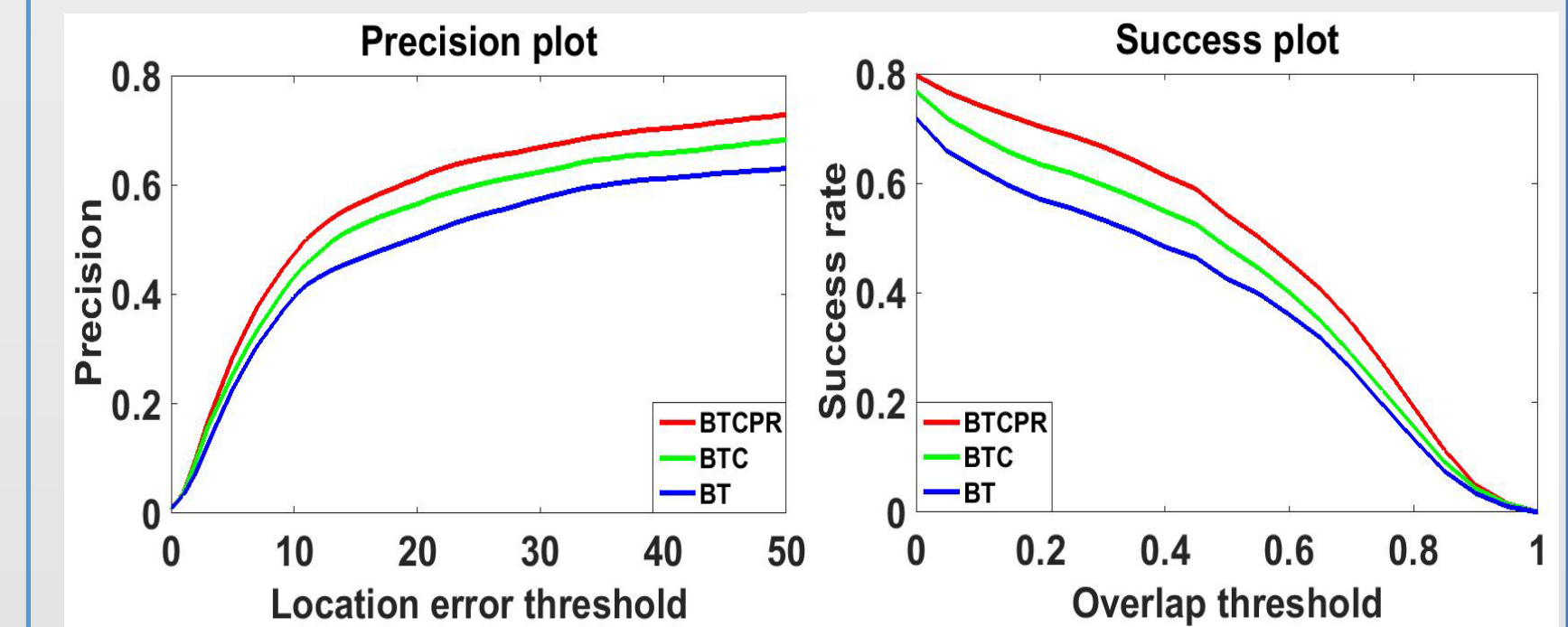


Fig.3. The performance of the proposed base tracker(BT), base tracker with correction(BTC) and base tracker with correction, prediction and re-detection(BTCPR).

In Figure 4, we present the results of our tracker against other trackers, and our tracker rank first both in precision and success plots.

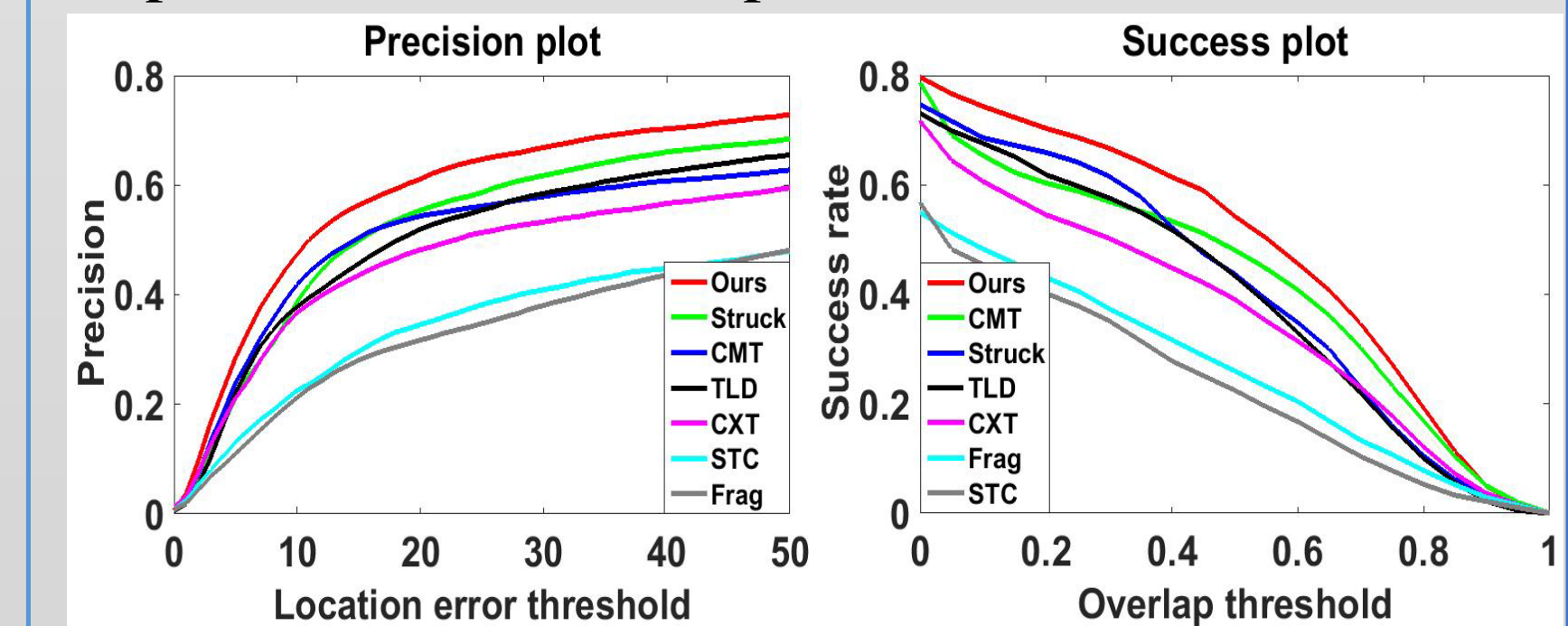


Fig. 4. Precision and success plots of all trackers

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