OBJECTNESS-AWARE TRACKING VIA DOUBLE-LAYER MODEL

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Motivation

➢ The prediction drifts to the non-object backgrounds is a critical issue in conversional correlation filter (CF) based trackers.

➢ The negative samples generated by cyclic shift are not real. Hence, the CF trackers are poorly capable of judging whether the predicted target is an object.

➢ The key insight is to propose a **double-layer model** to address this problem.

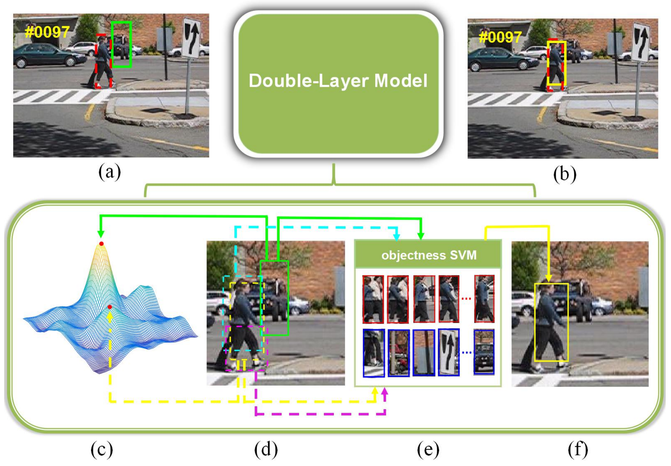
Contributions

➢ The **first layer** is a **CF tracker**, which is employed to predict a rough position of the target.

➢ The **second layer** is an **objectness layer**, which is utilized to reveal the object characteristics of the predicted target.

➢ A simple strategy involving spatio-temporal constraints, is presented to obtain **target-related proposals**.

Framework



Method

Target-Related Proposal Generation

➢Some target-related object proposals are obtained involving **both the spatial and temporal constraints,** i.e., constraints of size, aspect ratio, variance and distance.

Proposals

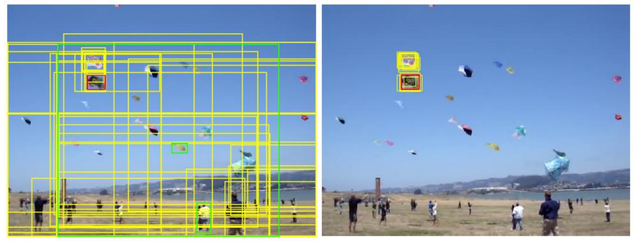
$$\Gamma_t = \begin{cases} \Gamma_t \cup \{\mathbf{b}_t^i\} & \left|\frac{H_t^i/W_t^i}{H_{t-1}^*/W_{t-1}^*} - 1\right| \le \tau_2 \\ \Gamma_t & \text{otherwise} \end{cases} \qquad \Gamma_t = \begin{cases} \Gamma_t \cup \{\mathbf{b}_t^i\} & \left|\frac{H_t^i W_t^i}{H_{t-1}^* W_{t-1}^*} - 1\right| \le \tau_1 \\ \Gamma_t & \text{otherwise} \end{cases}$$

$$\Gamma_t = \begin{cases} \Gamma_t \cup \{\mathbf{b}_t^i\} & var(\mathbf{b}_t^i) \ge var(\mathbf{B}_{t-1}^*)/2 \\ \Gamma_t & \text{otherwise} \end{cases} \qquad c(\mathbf{b}_t^i, \mathbf{B}_t^{\mathbf{f}}) = \frac{1}{2\pi\sigma^2}\exp\left(-\frac{\|c_0(\mathbf{b}_t^i) - c_0(\mathbf{B}_t^{\mathbf{f}})\|^2}{2\sigma^2}\right)$$

ranked by:

$$S(\mathbf{b}_t^i) = f_s(\mathbf{b}_t^i) + c(\mathbf{b}_t^i, \mathbf{B}_t^{\mathbf{f}})$$

Target-Related Proposals



(a) (b)

Objectness Classifier

➢An objectness classifier is trained with reliable samples, and tested to best distinguish target object from noise background proposals.

$$\min_{\mathbf{w}} \frac{1}{2}\|\mathbf{w}\|^2 + C\sum_{m=1}^{V}\xi_m$$

$$\text{s.t. } \forall m: \xi_m \ge 0$$

$$\forall m, \forall \mathbf{B}_t^{\mathbf{s},j} \ne \mathbf{B}_t^*: \langle \mathbf{w}, \delta\Phi_m(\mathbf{B}_t^{\mathbf{s},j})\rangle \ge \Delta(\mathbf{B}_t^{\mathbf{s},j}, \mathbf{B}_t^*) - \xi_m$$

$$\delta\Phi_m(\mathbf{B}_t^{\mathbf{s},j}) = \Phi(\mathbf{B}_t^*) - \Phi(\mathbf{B}_t^{\mathbf{s},j})$$

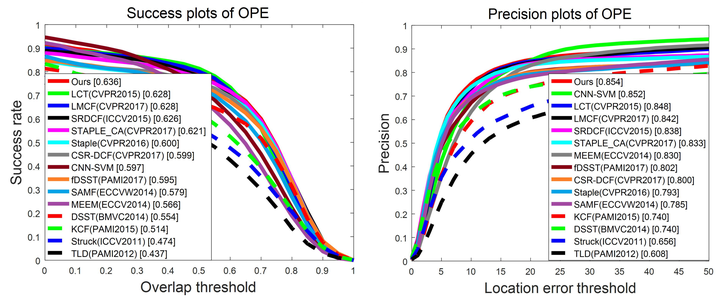
$$\Delta(\mathbf{B}_t^{\mathbf{s},j}, \mathbf{B}_t^*) = 1 - U(\mathbf{B}_t^{\mathbf{s},j}, \mathbf{B}_t^*)$$

$$g_{t+1}(sv_t, \mathbf{B}_{t+1}^{\mathbf{s},j}) = \sum_{l_t^v \in sv_t} w_t^v \kappa(l_t^v, \mathbf{B}_{t+1}^{\mathbf{s},j})$$

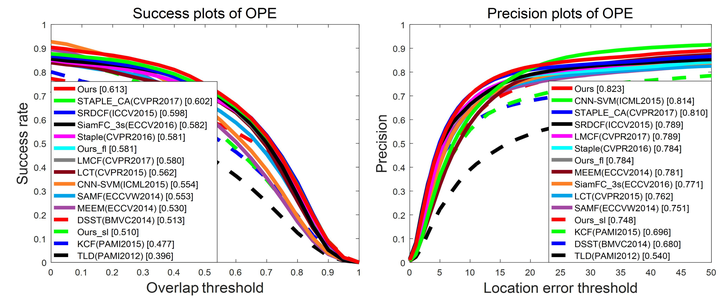
(a) (b)

Experiments

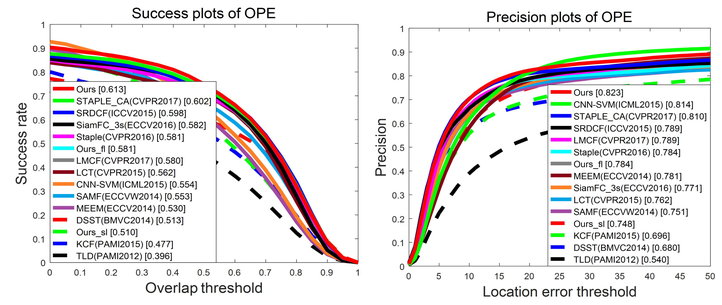
➢ Evaluation on OTB50 Benchmark



➢ Evaluation on OTB100 Benchmark



➢ Evaluation on TC128 Benchmark



➢ SR/PR on some attributes on OTB100

Attributes	**Ours**	STAPLE_CA[16]	SRDCF[17]	LMCF[18]	Staple[8]
FM(39)	**59.6**/**77.8**	58.9/75.8	**59.7**/**76.9**	55.1/73.0	53.7/69.7
DE(44)	**59.1**/**80.1**	**56.7**/**76.4**	54.4/73.4	52.8/73.3	55.4/74.8
OC(49)	**58.1**/**75.9**	**56.4**/74.0	54.8/72.6	55.6/74.0	50.4/**74.1**