MFST: Multi-Features Siamese Tracker

ICPR 2020

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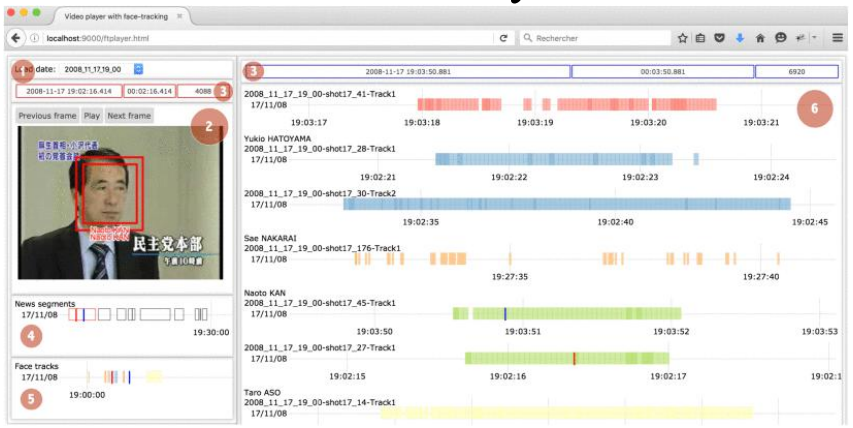
Introduction

Applications

Visual Analysis



Renoust et al, IEEE Transaction on Multimedia, 2016

Pose Estimation

Iqbal et al, CVPR, 2017

Automatic Driving

Lee et al, IEEE Transaction on Multimedia, 2015

Robot Navigation

https://www.youtube.com/watch?v=oIiQPvzwNws

Objectives

Challenges in VOT

- Many disturbing factors during tracking
  - Object motion, changes in viewpoint, lighting variation, etc.

- Different videos have completely different characteristics
  - Representations learned offline are general but not always discriminative;
  - Online adaptation is time consuming.

Objectives

- To discover a robust and efficient feature representation
- To investigate the combination of various features

Contributions

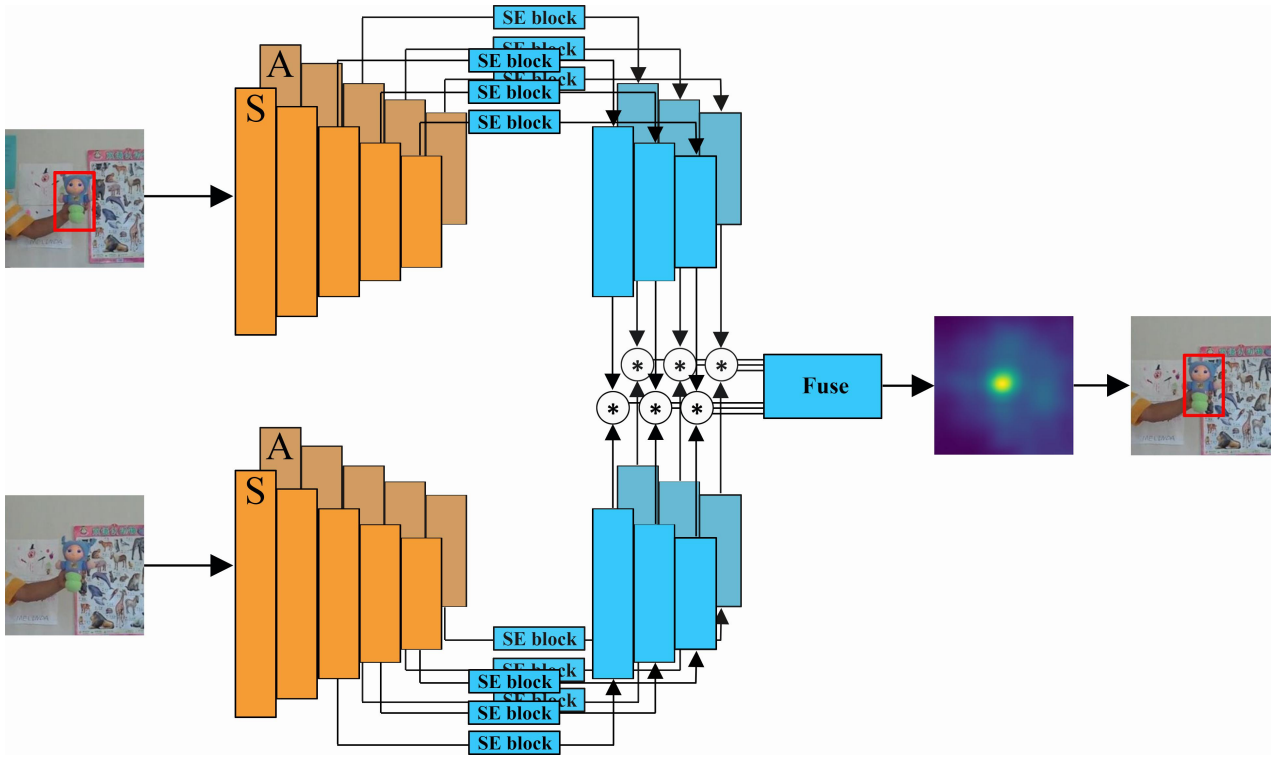
- Explore feature fusing strategies
- Feature representations from hierarchical convolutional layers and different models
- A novel deep similarity network based tracker, MFST

Methodology - MFST

Multiple Features-Siamese Tracker (MFST)

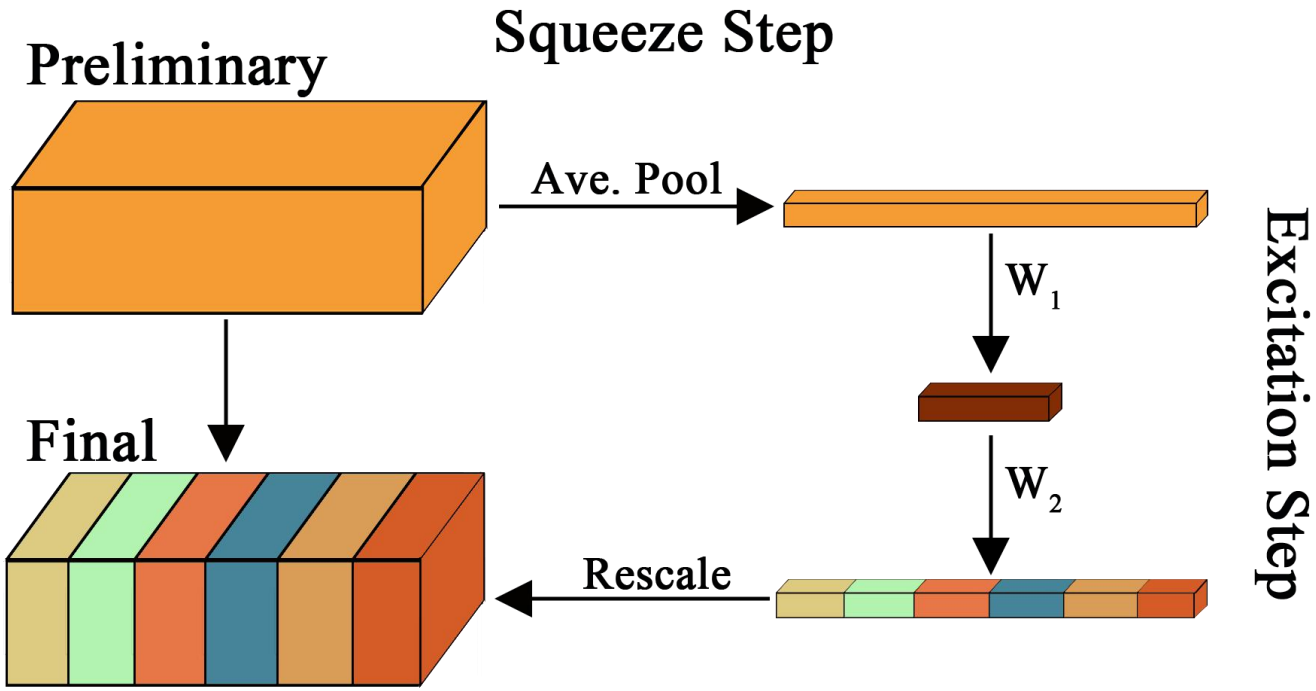
A-AlexNet

S-SiamFC



Methodology - MFST

Feature Recalibration (SE-block)



Methodology - MFST

Response Maps Combination

Hard weight: $$r^* = \sum_{t=1}^{N} w_t r_t \qquad \text{(HW)}$$

Soft mean: $$r^* = \sum_{t=1}^{N} \frac{r_t}{\max(r_t)} \qquad \text{(SM)}$$

Soft weight: $$r^* = \sum_{t=1}^{N} \frac{w_t r_t}{\max(r_t)} \qquad \text{(SW)}$$

Methodology - MFST

Ablation Study

A-AlexNet

S-SiamFC

Model	Conv3	Conv4	Conv5	Fusion	SE	OTB-2013 AUC	OTB-2013 Prec.	OTB-50 AUC	OTB-50 Prec.	OTB-100 AUC	OTB-100 Prec.
A	✓					0.587	0.740	0.474	0.618	0.559	0.712
A	✓				✓	0.603	0.755	0.504	0.642	0.587	0.747
A		✓				0.632	0.789	0.536	0.692	0.614	0.778
A		✓			✓	**0.637**	0.801	0.544	0.707	0.623	0.795
A			✓			0.582	0.763	0.496	0.665	0.557	0.735
A			✓		✓	0.573	0.762	0.507	0.696	0.575	0.769
A	✓	✓	✓	HW		0.623	0.774	0.515	0.657	0.605	0.763
A	✓	✓	✓	SM		0.633	0.797	0.542	0.705	0.616	0.784
A	✓	✓	✓	SW		0.630	0.795	0.538	0.699	0.616	0.786
A	✓	✓	✓	HW	✓	0.627	0.798	0.537	0.700	0.617	0.790
A	✓	✓	✓	SM	✓	0.631	0.799	0.542	0.706	0.621	0.792
A	✓	✓	✓	SW	✓	0.635	**0.811**	**0.545**	**0.716**	**0.627**	**0.803**
S	✓					0.510	0.661	0.439	0.574	0.512	0.656
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S			✓			0.600	0.791	0.519	0.698	0.586	0.766
S			✓		✓	0.606	0.801	0.535	**0.722**	0.588	0.777
S	✓	✓	✓	HW		0.614	0.794	0.532	0.692	0.602	0.776
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S	✓	✓	✓	SM	✓	0.591	0.761	0.501	0.649	0.575	0.736
S	✓	✓	✓	SW	✓	0.603	0.780	0.518	0.673	0.590	0.759

Methodology - MFST

Ablation Study

A-AlexNet

S-SiamFC

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Methodology - MFST

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Methodology - MFST

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A			✓		✓	0.573	0.762	0.507	0.696	0.575	0.769
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A	✓	✓	✓	SM		0.633	0.797	0.542	0.705	0.616	0.784
A	✓	✓	✓	SW		0.630	0.795	0.538	0.699	0.616	0.786
A	✓	✓	✓	HW	✓	0.627	0.798	0.537	0.700	0.617	0.790
A	✓	✓	✓	SM	✓	0.631	0.799	0.542	0.706	0.621	0.792
A	✓	✓	✓	SW	✓	0.635	**0.811**	**0.545**	**0.716**	**0.627**	**0.803**
S	✓					0.510	0.661	0.439	0.574	0.512	0.656
S	✓				✓	0.545	0.709	0.465	0.608	0.532	0.687
S		✓				0.584	0.757	0.507	0.666	0.570	0.742
S		✓			✓	0.592	0.772	0.518	0.686	0.581	0.758
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S			✓		✓	0.606	0.801	0.535	**0.722**	0.588	0.777
S	✓	✓	✓	HW		0.614	0.794	0.532	0.692	0.602	0.776
S	✓	✓	✓	SM		0.612	0.787	0.539	0.697	0.607	0.777
S	✓	✓	✓	SW		0.615	0.808	0.534	0.705	0.600	0.780
S	✓	✓	✓	HW	✓	**0.627**	**0.823**	**0.542**	0.716	**0.606**	**0.787**
S	✓	✓	✓	SM	✓	0.591	0.761	0.501	0.649	0.575	0.736
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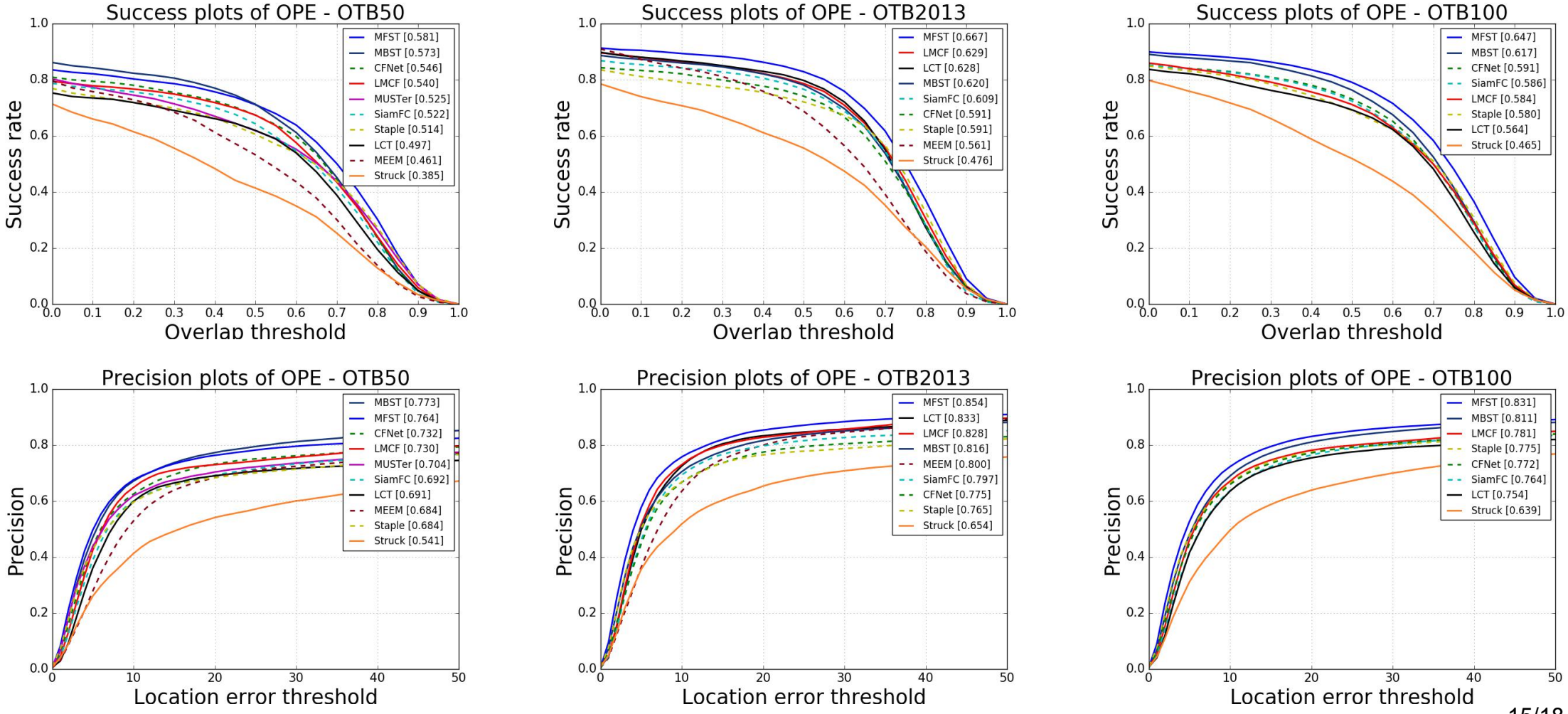
Methodology - MFST

Ablation Study

				OTB-2013		OTB-50		OTB-100	
A	S	Fusion	SE	AUC	Prec.	AUC	Prec.	AUC	Prec.
A_{conv5}				0.582	0.763	0.496	0.665	0.557	0.735
A_{com}				0.630	0.795	0.538	0.699	0.616	0.786
A_{com}			✓	0.635	0.811	0.545	0.716	0.627	0.803
	S_{conv5}			0.661	0.854	0.581	0.764	0.647	0.831
	S_{com}			0.614	0.794	0.532	0.692	0.602	0.776
	S_{com}		✓	0.627	0.823	0.542	0.716	0.606	0.787
A_{com}	S_{com}	HW		0.637	0.815	0.555	0.720	0.625	0.801
A_{com}	S_{com}	SM		0.647	0.819	0.560	0.728	0.638	0.816
A_{com}	S_{com}	SW		0.647	0.818	0.564	0.734	0.637	0.813
A_{com}	S_{com}	HW	✓	0.667	0.852	**0.583**	0.761	0.644	0.824
A_{com}	S_{com}	SM	✓	0.640	0.810	0.557	0.718	0.632	0.804
A_{com}	S_{com}	SW	✓	**0.667**	**0.854**	0.581	**0.764**	**0.647**	**0.831**

Experimental Results

Success plots and precision plots on OTB benchmarks



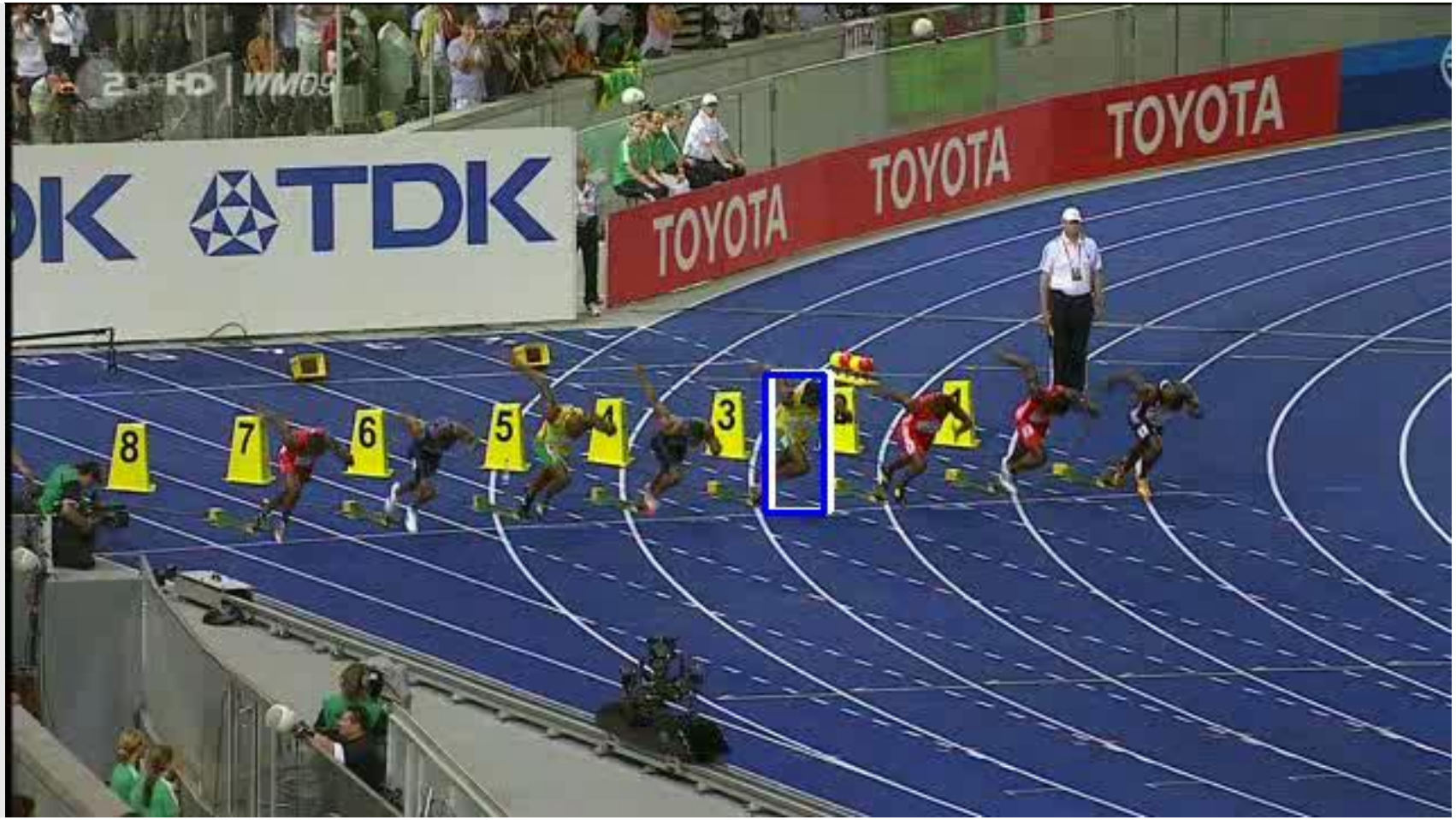
Experimental Results

Ground Truth

SiamFC (Baseline)

MBST

MFST (Ours)



Experimental Results

Ground Truth

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Thanks