Online multi-target tracking with strong and weak detections

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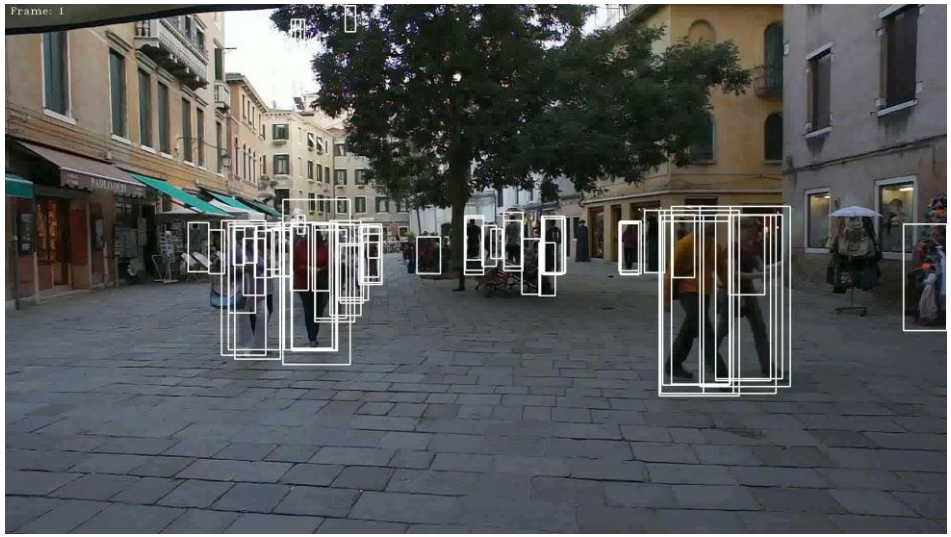
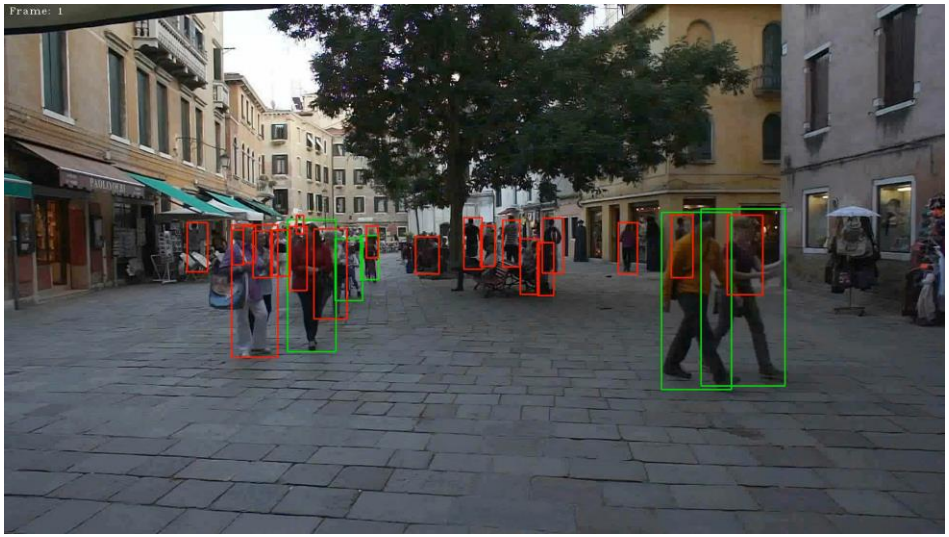
Strong and weak detections

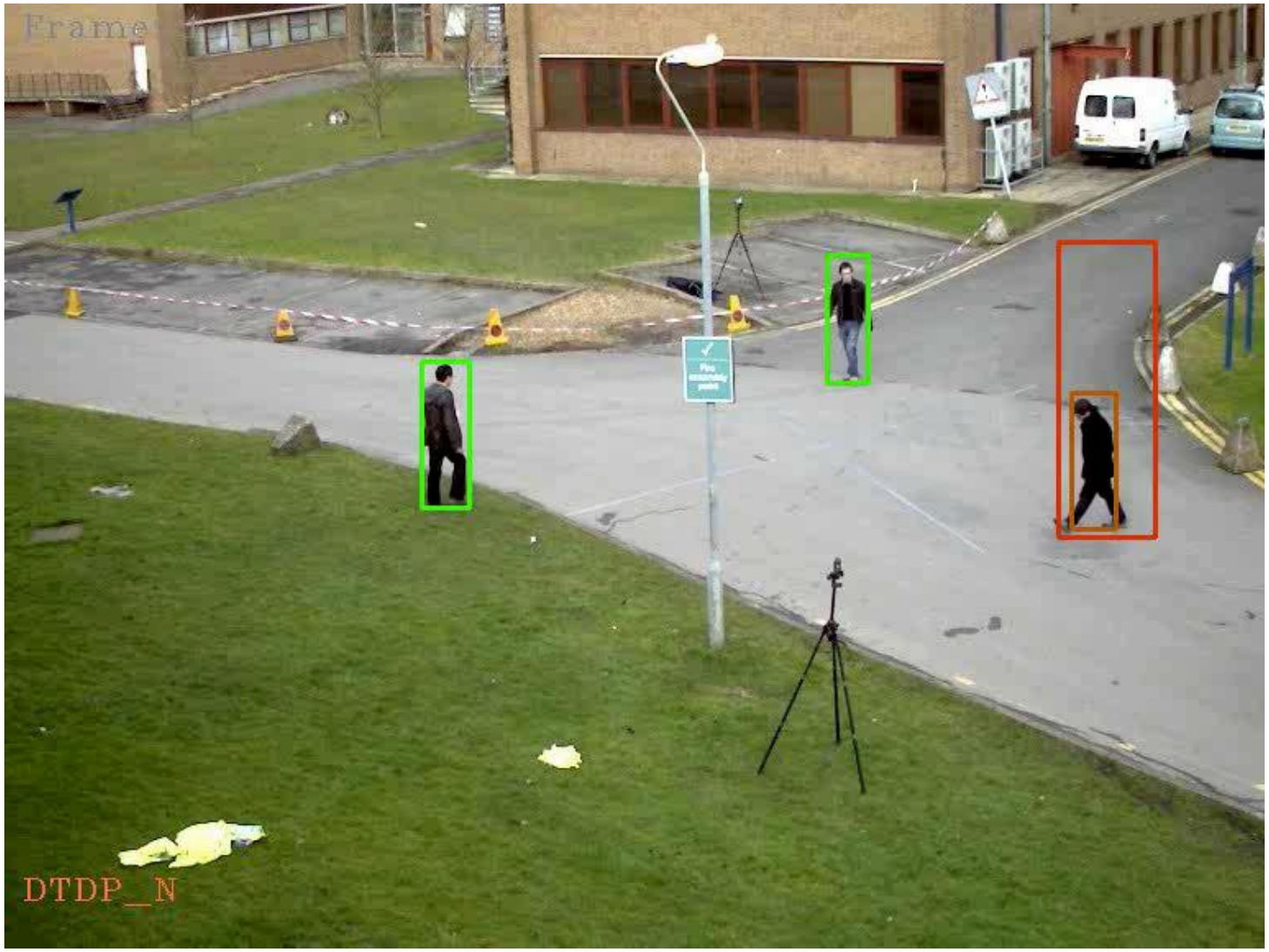


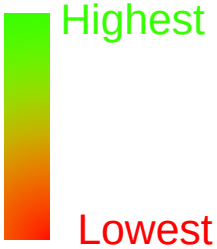
Detections



Z_k^+: strong detections
Z_k^-: weak detections

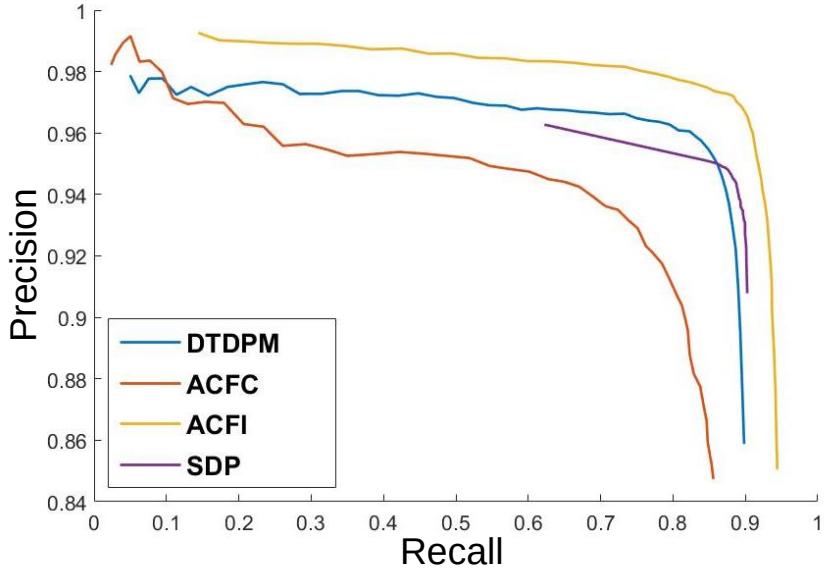
Confidence score



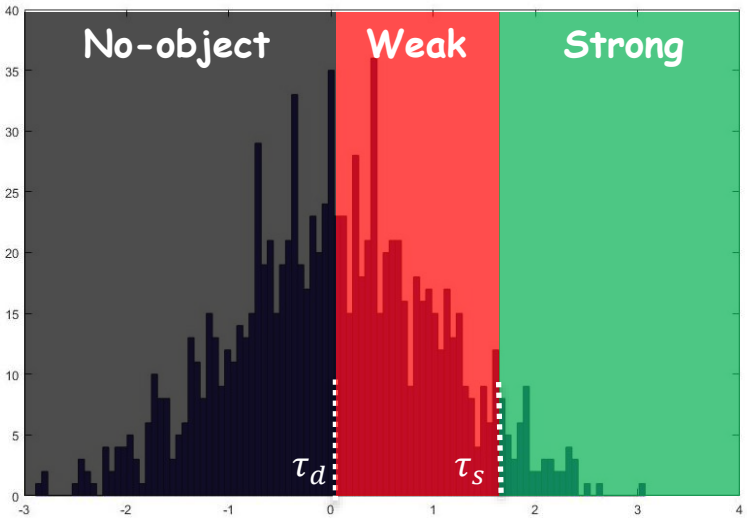


Confidence score

Strong vs weak detections: classification

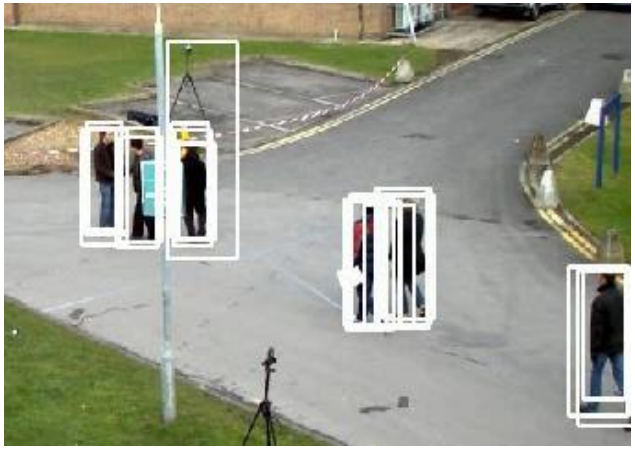


Detection results on PETS09-S2L1



Confidence score histogram

Strong and weak detections



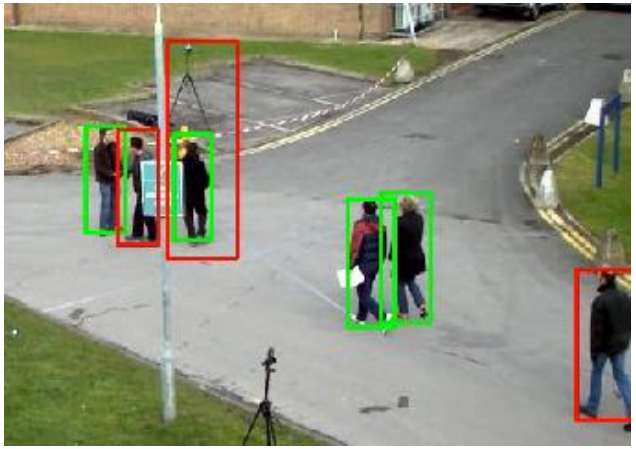
Assumption:
large set of
object detections Z_k^*

Combination

$$s_k = \frac{U}{D^2} \sum_{j=1}^{U} s_j \ , s_k \in [0,1]$$

D: # detectors

U: # detectors contributing to an specific combined detection

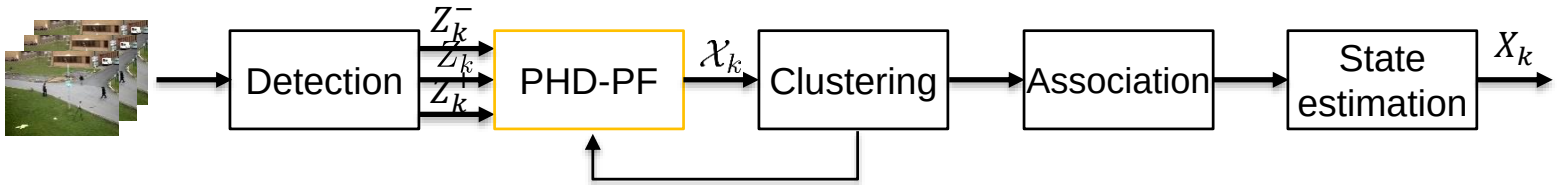


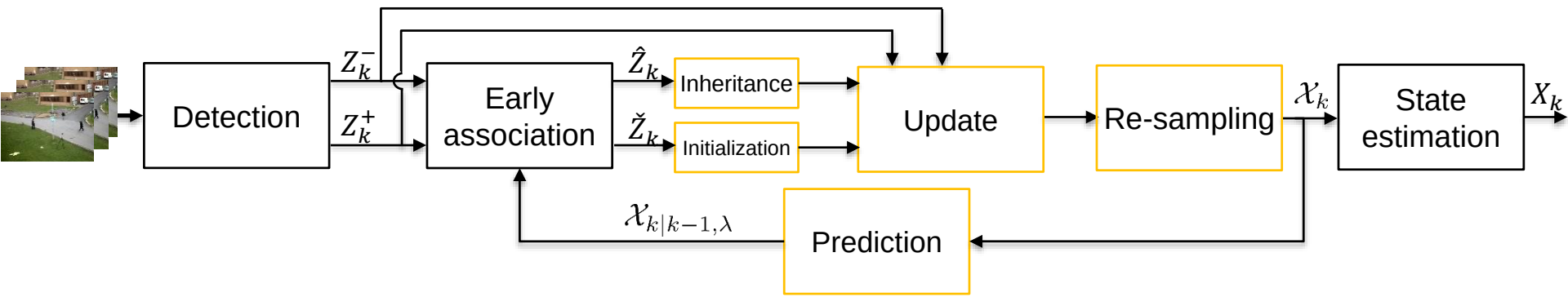
Classification

Z_k^+: strong detections
Z_k^-: weak detections

$$Z_k^+ = \{z_k^+ : s_k \geq \tau_s\}$$
$$Z_k^- = \{z_k^- : s_k < \tau_s\}$$

The framework





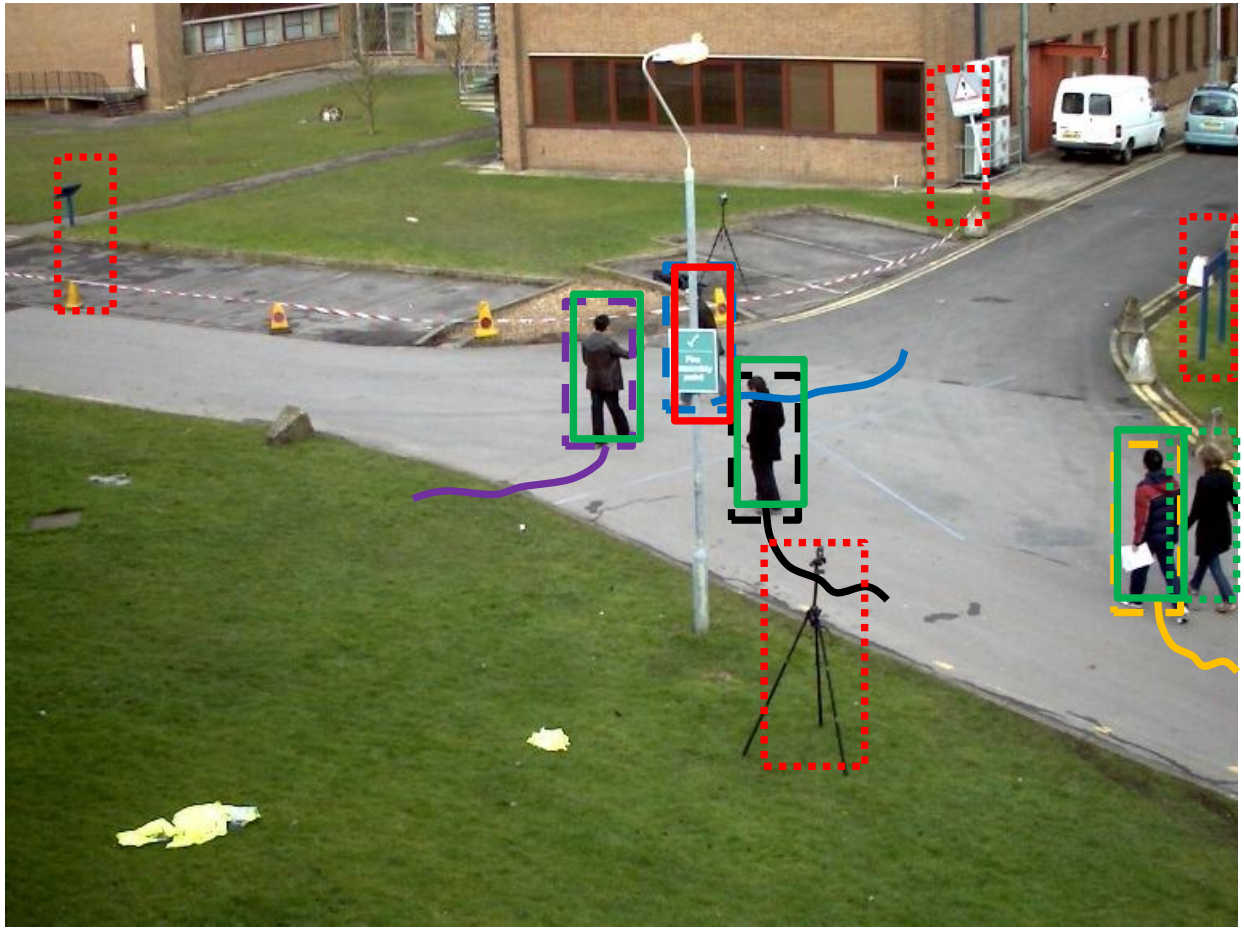
Z_k : detections
Z_k^+: strong detections
Z_k^-: weak detections

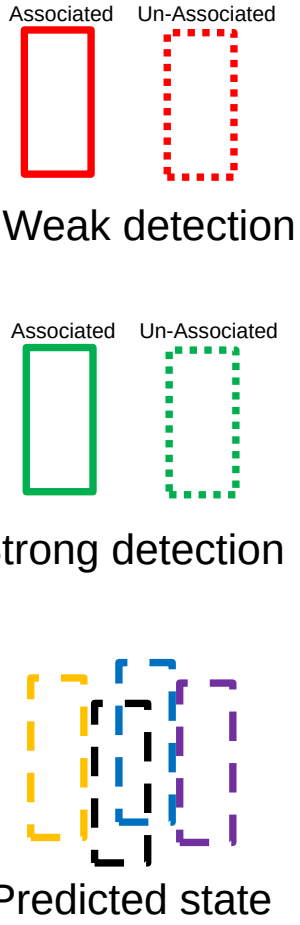
$\hat{Z}_k$: associated strong and weak detections
$\check{Z}_k$: un-associated strong detections

$\chi_{k,\lambda}$: particles
X_k: estimated states

Early Association + Inheritance

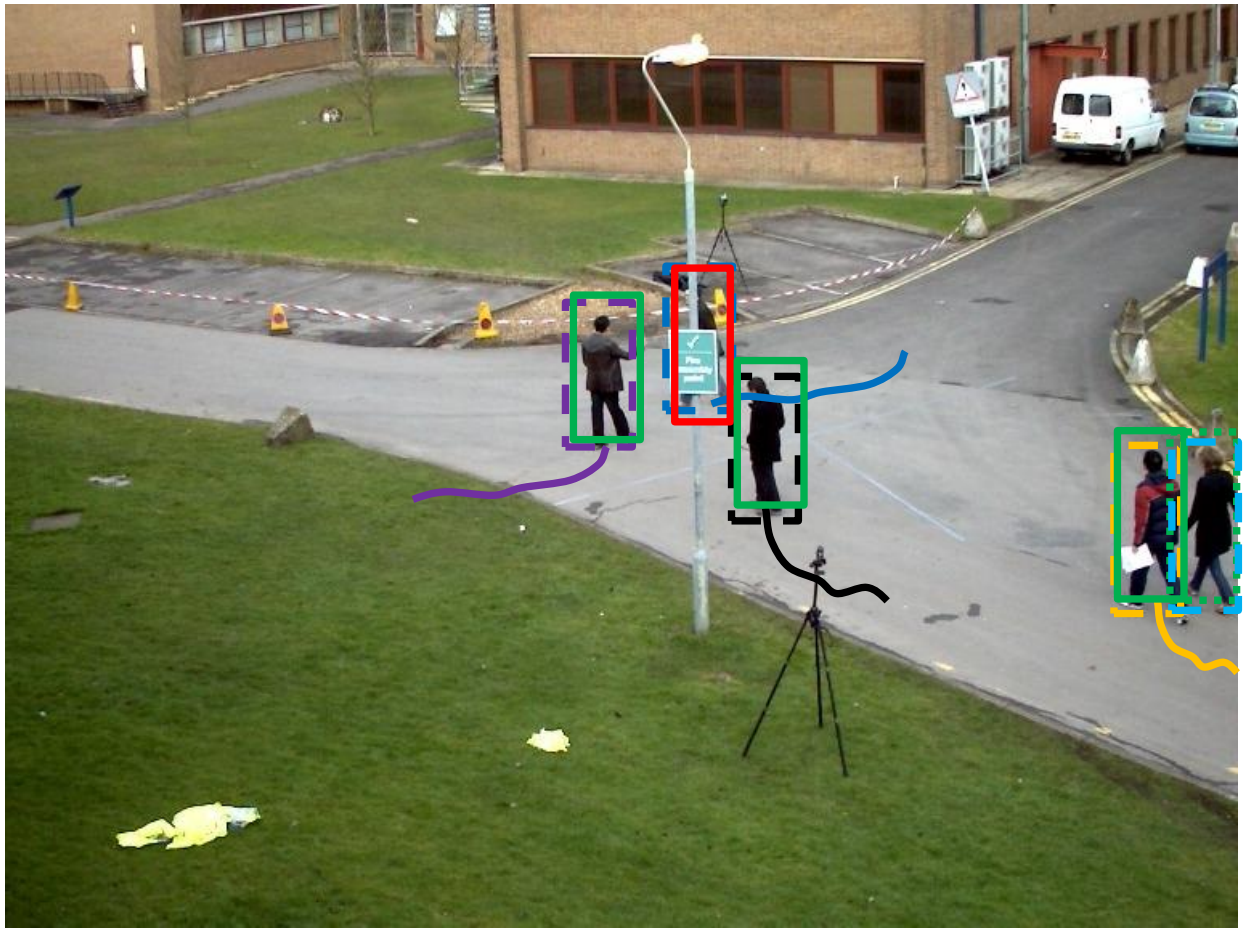
- New-Born particles are generated from associated strong & weak detections
  - **Inheriting** existing label

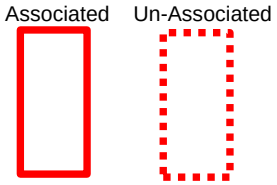




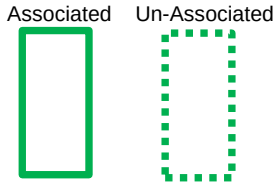
Early Association + Initialization

- New-Born particles are generated from <u>un-associated strong</u> detections
  - **Initializing** new label

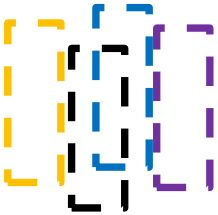




Weak detection



Strong detection



Predicted state

Evaluation

Dataset		Length (frames)	Length (s)	Density (objects/frame)
MOT15	Training	5503	389	7.3
	Test	5783	607	10.6
MOT16	Training	5316	215	20.8
	Test	5919	759	30.8

- The CLEAR MOT Metrics [Bernardin2008]
- Detection set Z_k^* generated with
  - DTDPM [Felzenszwalb2010]
  - ACF trained with Caltech [Dollar2014]
  - ACF trained with INRIA [Dollar2014]
  - SDP [Yang2016]

Online tracking results – submission time

Dataset	Tracker	MOTA	MOTP	FP	FN	IDS	Frag	Hz
MOT15	EAMTT (proposed)	**53.0**	**75.3**	7538	**20590**	776	1269	11.5
	FOMT	53.0	74.8	6974	20776	1143	2043	**16.0**
	AMPL	51.9	75.0	6963	22225	**372**	**1130**	2.8
	LKDAT_CNN	49.3	74.5	**6009**	24550	563	1155	1.2
MOT16	POI	**66.1**	**79.5**	5061	**55914**	805	3093	9.9
	KFILDAwSDP	57.3	77.5	15682	60252	1873	2664	2.2
	EAMTT (proposed)	52.5	78.8	4407	81223	910	1321	**12.2**
	AMPL	50.9	77.0	**3229**	86123	**196**	**639**	1.5

Online tracking results – now

Dataset	Tracker	MOTA	MOTP	FP	FN	IDS	Frag	Hz
MOT15	RAR15	**56.6**	73.0	9386	**16921**	**428**	1364	5.1
	EAMTT (proposed)	53.0	75.3	7538	20590	776	1269	11.5
	CDA_DDAL	51.3	74.2	7110	22271	544	1335	1.3
	LKDAT_CNN	49.3	74.5	**6009**	24550	563	**1155**	1.2
MOT16	FLOW4	**67.7**	79.2	8225	**49178**	1568	3153	**24.7**
	POI	66.1	**79.5**	5061	55914	805	3094	9.9
	EAMTT (proposed)	52.5	78.8	4407	81223	910	1321	12.2
	AMPL	50.9	77.0	**3229**	86123	**196**	**639**	1.5

Q&A

Thank you!