Carnegie Mellon University
The Robotics Institute

Joint Object Detection and Multi-Object Tracking with Graph Neural Networks

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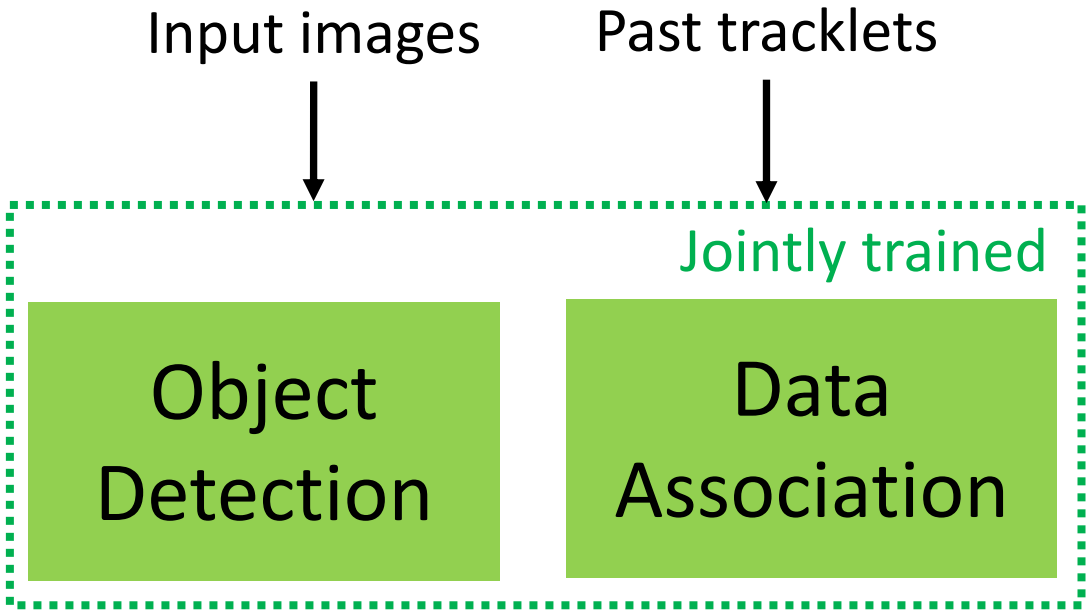
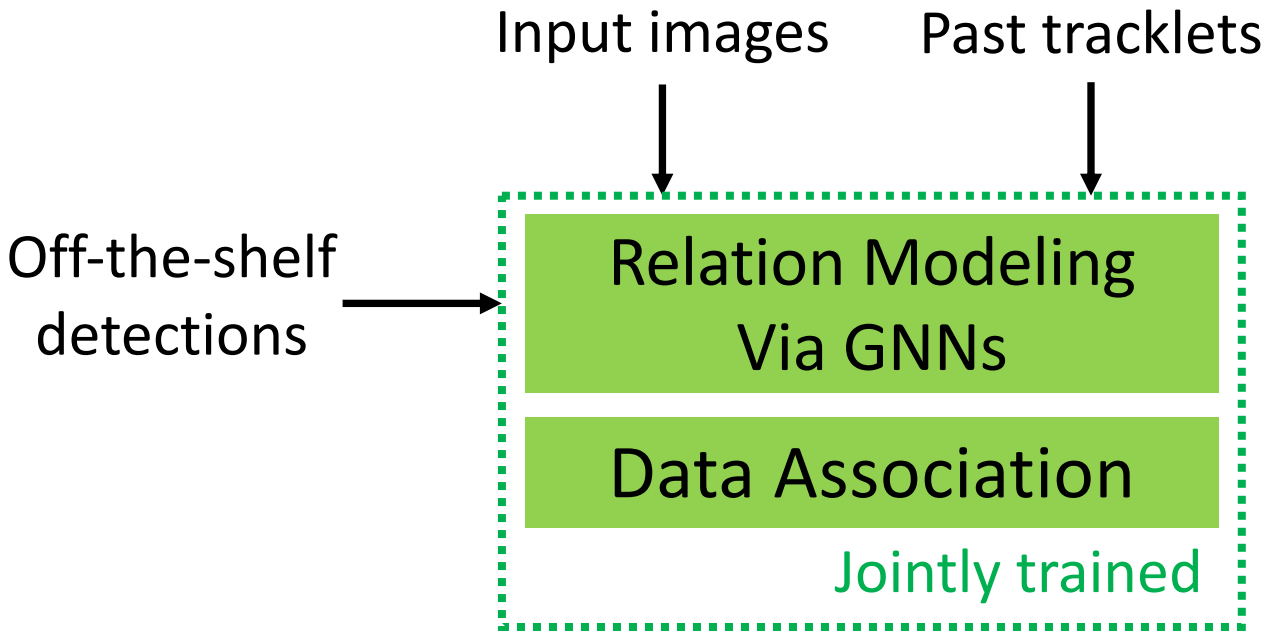
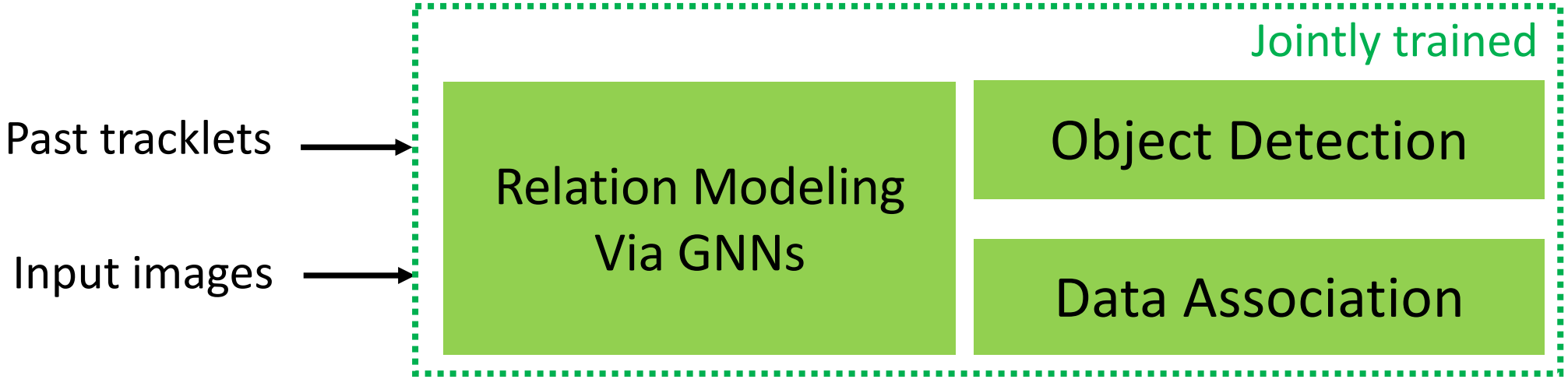
Prior Work: Joint MOT without Relation Modeling



Prior Work: Relation Modeling for Data Association only



Ours: Relation Modeling for Joint MOT



Quantitative Evaluation on the MOT Challenges

	Method	MOTA(%)↑	IDF1(%)↑	MT(%)↑	ML(%)↓	IDS↓
2DMOT2015	DMT [27]	44.5	49.2	34.7	22.1	684
	Lif_TsimInt [81]	47.2	57.6	27.0	29.8	554
	MDP_SubCNN [11]	47.5	55.7	30.0	18.6	628
	CDA_DDAL [82]	51.3	54.1	36.3	22.2	544
	MPNTrack [40]	51.5	58.6	31.2	25.9	**375**
	EAMTT [83]	53.0	54.0	35.9	19.6	776
	AP_HWDPL [84]	53.0	52.0	29.1	20.2	708
	NOMTwSDP [85]	55.5	59.1	39.0	25.8	427
	RAR15 [86]	56.5	61.3	45.1	14.6	428
	Tube_TK [35]	58.4	53.1	39.3	18.0	854
	GSDT (Ours)	**60.7**	**64.6**	**47.0**	**10.5**	477

	Method	MOTA(%)↑	IDF1(%)↑	MT(%)↑	ML(%)↓	IDS↓
MOT16	DeepSORT_2 [13]	61.4	62.2	32.8	18.2	1,423
	NOMTwSDP16 [85]	62.2	62.6	32.5	31.1	**406**
	VMaxx [87]	62.6	49.2	32.7	21.1	1,389
	RAR16wVGG [86]	63.0	63.8	**39.9**	22.1	482
	TAP [88]	64.8	**73.5**	38.5	21.6	571
	CNNMTT [89]	65.2	62.2	32.5	21.3	946
	POI [90]	66.1	65.1	34.0	20.8	3,093
	Tube_TK_POI [35]	66.9	62.2	39.0	**16.1**	1,236
	CTracker_V1 [34]	**67.6**	57.2	32.9	23.1	1,897
	GSDT (Ours)	66.7	69.2	38.6	19.0	959

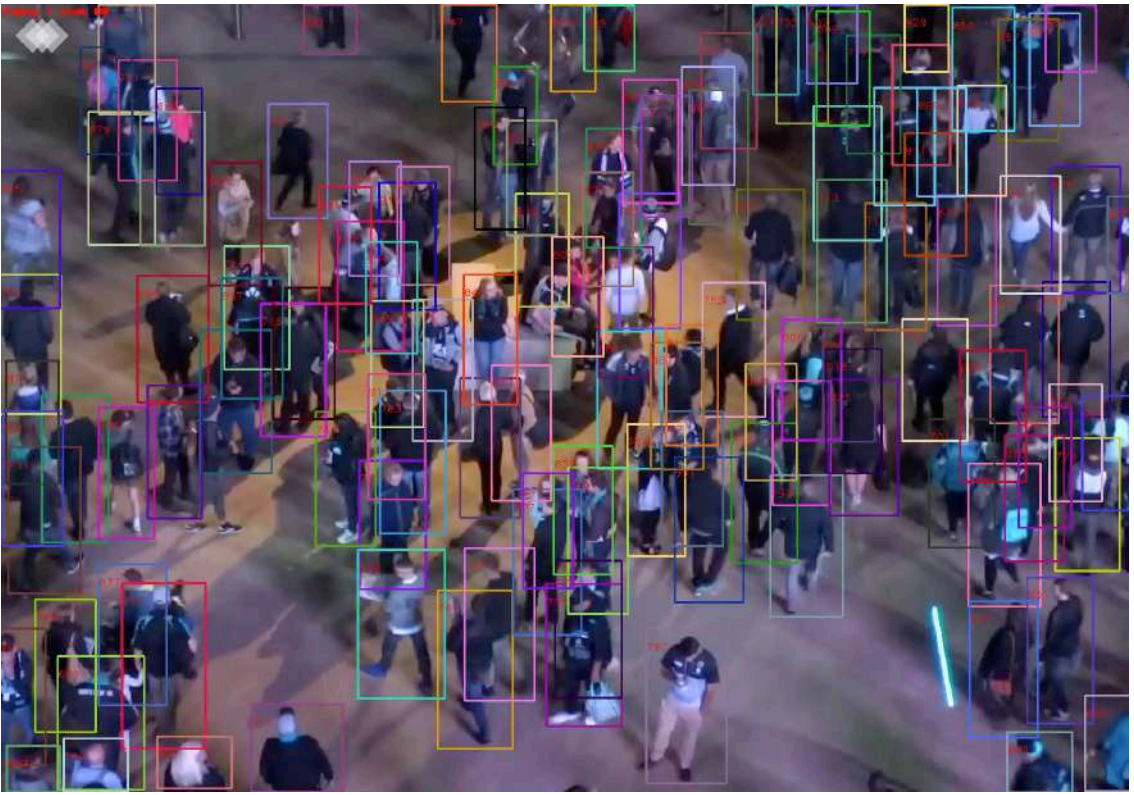
	Method	MOTA(%)↑	IDF1(%)↑	MT(%)↑	ML(%)↓	IDS↓
MOT17	MPNTrack [40]	58.8	61.7	28.8	33.5	**1,185**
	Lif_T [81]	60.5	65.6	27.0	33.6	1,189
	Tube_TK [35]	63.0	58.6	31.2	19.9	4,137
	CTrackerV1 [34]	66.6	57.4	32.2	24.2	5,529
	CTTrack17 [30]	**67.8**	64.7	34.6	24.6	3,039
	GSDT (Ours)	66.2	**68.7**	**40.8**	**18.3**	3,318

	Method	MOTA(%)↑	IDF1(%)↑	MT(%)↑	ML(%)↓	IDS↓
MOT20	SORT20 [12]	42.7	45.1	16.7	26.2	4,334
	GSDT (Ours)	**67.1**	**67.5**	**53.1**	**13.2**	**3,133**

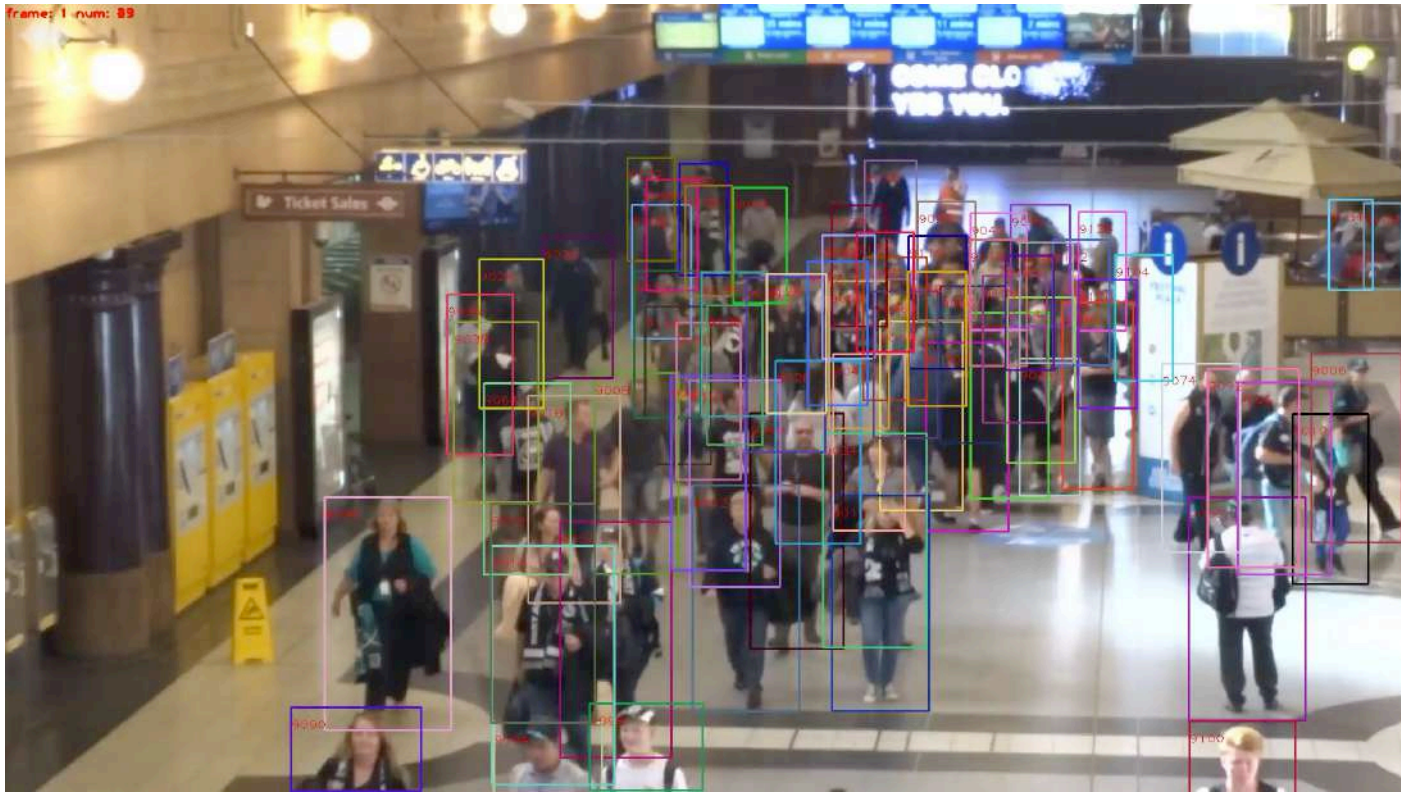
Qualitative Analysis

Visualization on MOT20 test sequences

MOT20-04

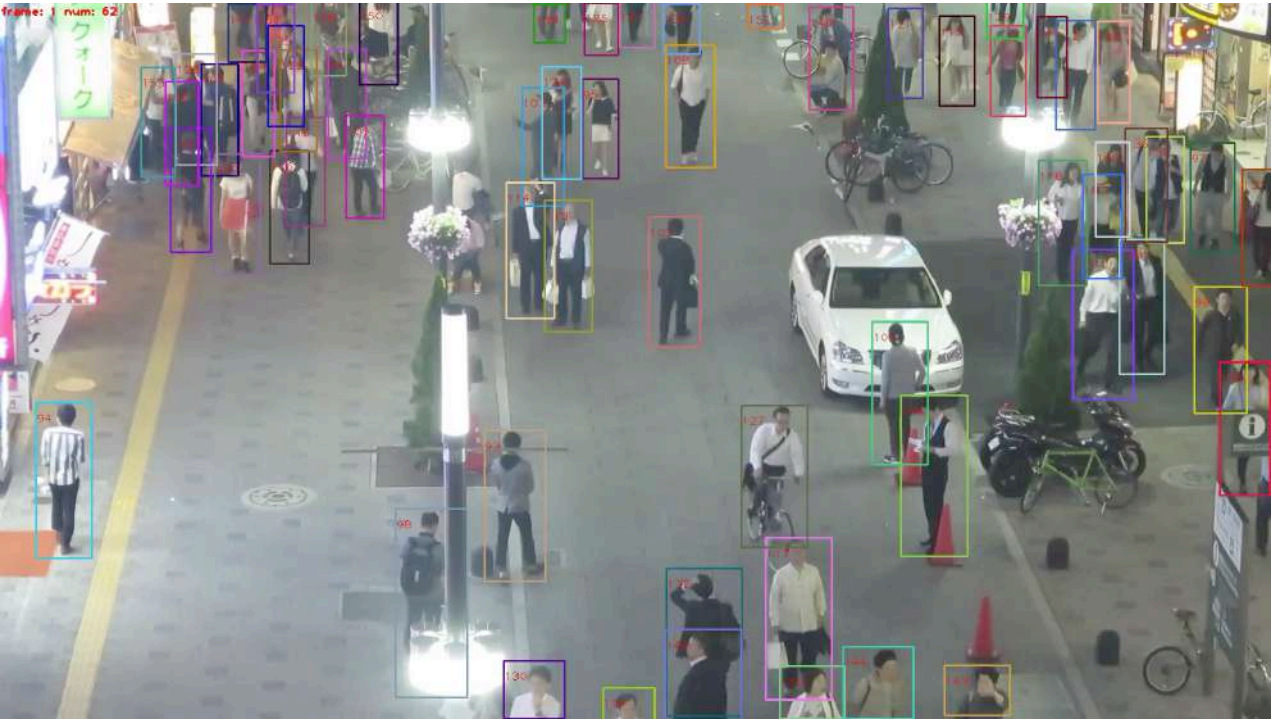


MOT20-07



Visualization on MOT17 test sequences

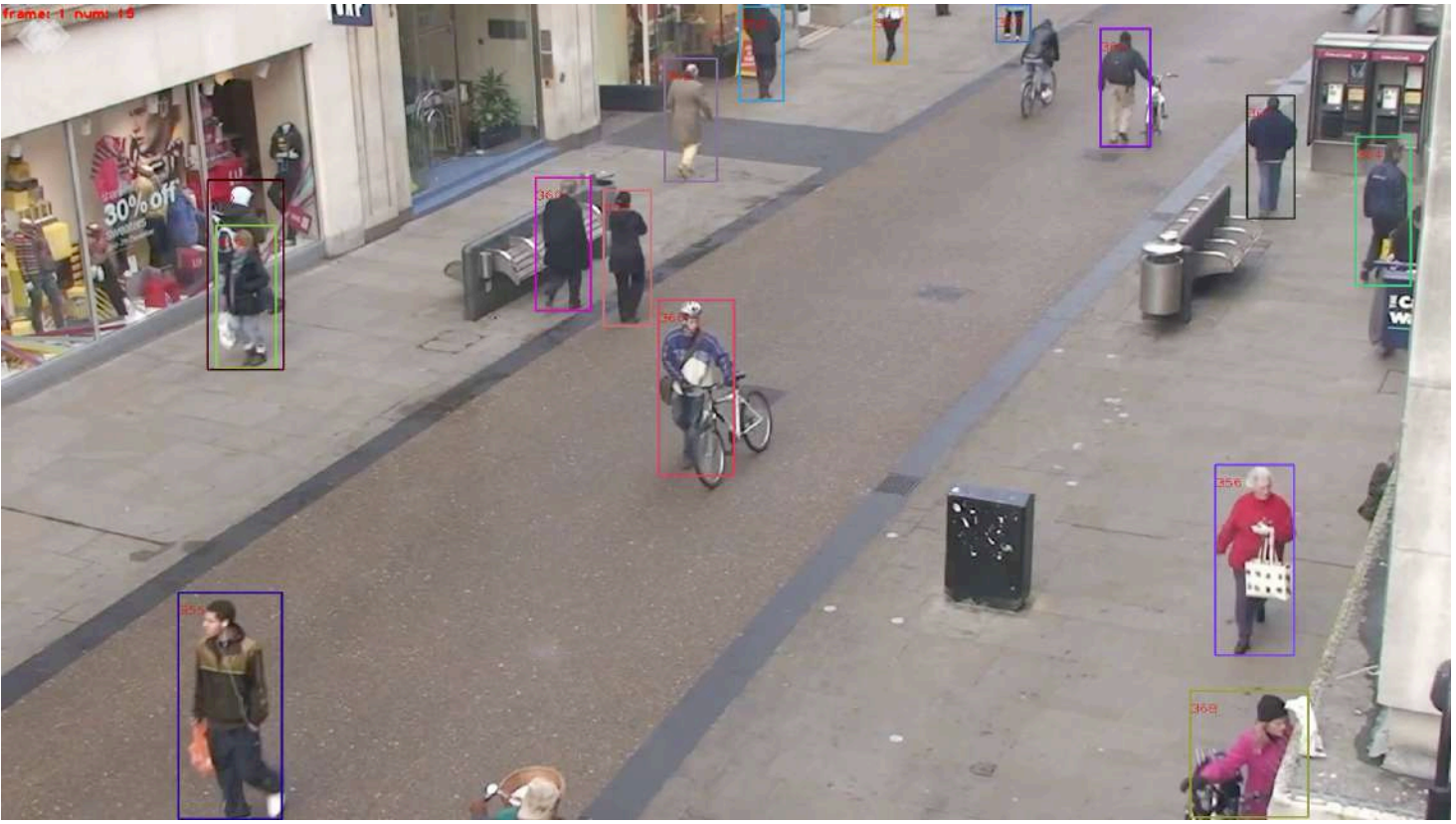
MOT17-03



MOT17-07

Visualization on 2DMOT2015 test sequences

2DMOT2015 – AVG-TownCentre



2DMOT2015 – PETS09-S2L2

Our Method with/without GNNs

Our method with GNNs

Our method without GNNs

*Objects that are detected in one video but are missing in the other are marked with **bold** bounding boxes*

Our method with GNNs

Our method without GNNs

*Objects that are detected in one video but are missing in the other are marked with **bold** bounding boxes*

Our method with GNNs

Our method without GNNs

*Objects that are detected in one video but are missing in the other are marked with **bold** bounding boxes*

Our Joint MOT Method with GNNs

vs.

Existing Joint MOT Methods without GNNs

Ours – Joint detection and data association **with GNNs**

FairMOT[1] – Joint detection and data association **without GNNs**

*Objects that are detected in one video but are missing in the other are marked with **bold** bounding boxes*

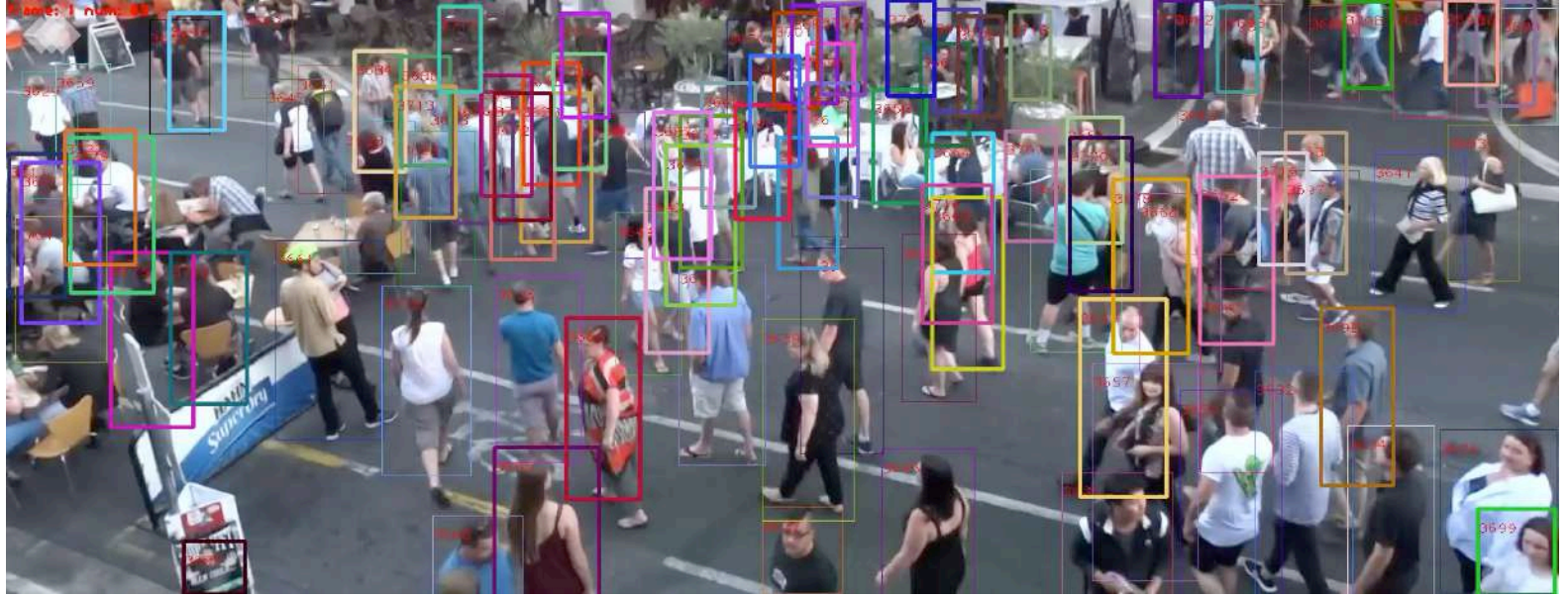
[1] Y. Zhang, C. Wang, X. Wang, W. Zeng, W. Liu. A Simple Baseline for Multi-Object Tracking. In arXiv preprint arXiv:2004.01888, 2020.

Our Joint MOT Method with GNNs

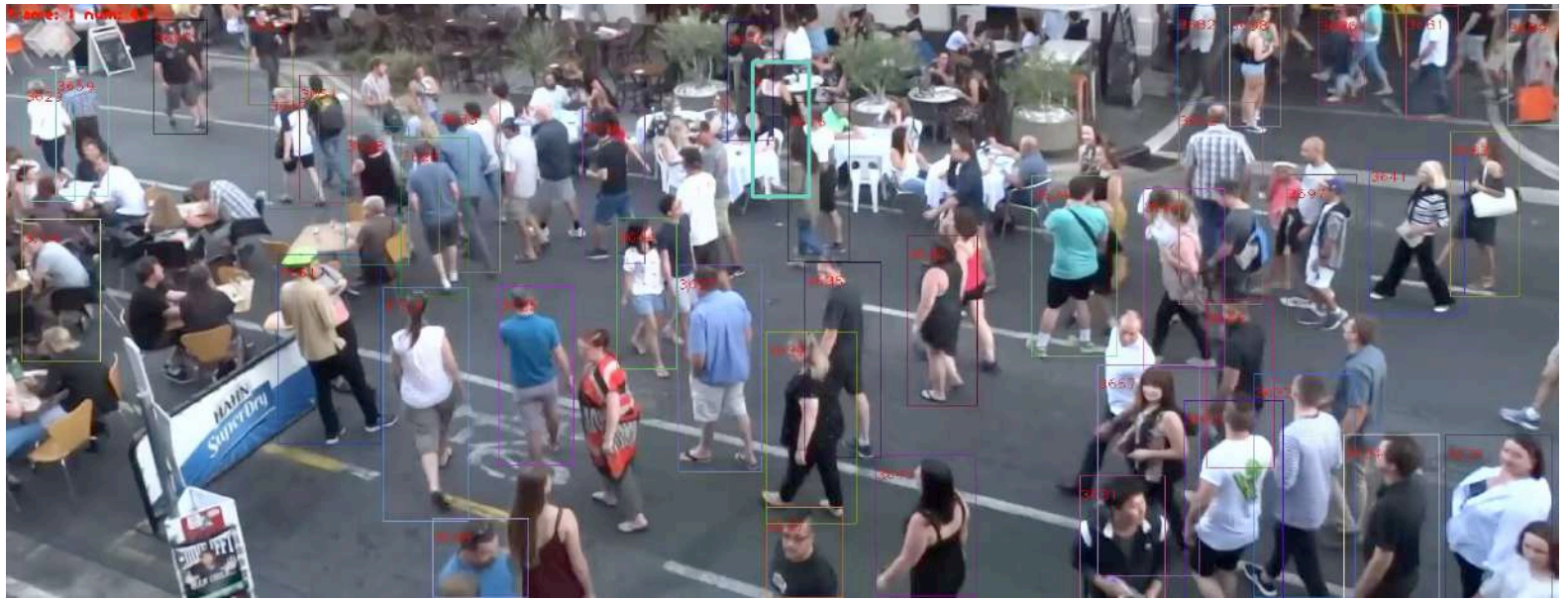
vs.

Existing Methods using GNNs for Data Association only

Ours – **Joint detection and data association** with GNNs



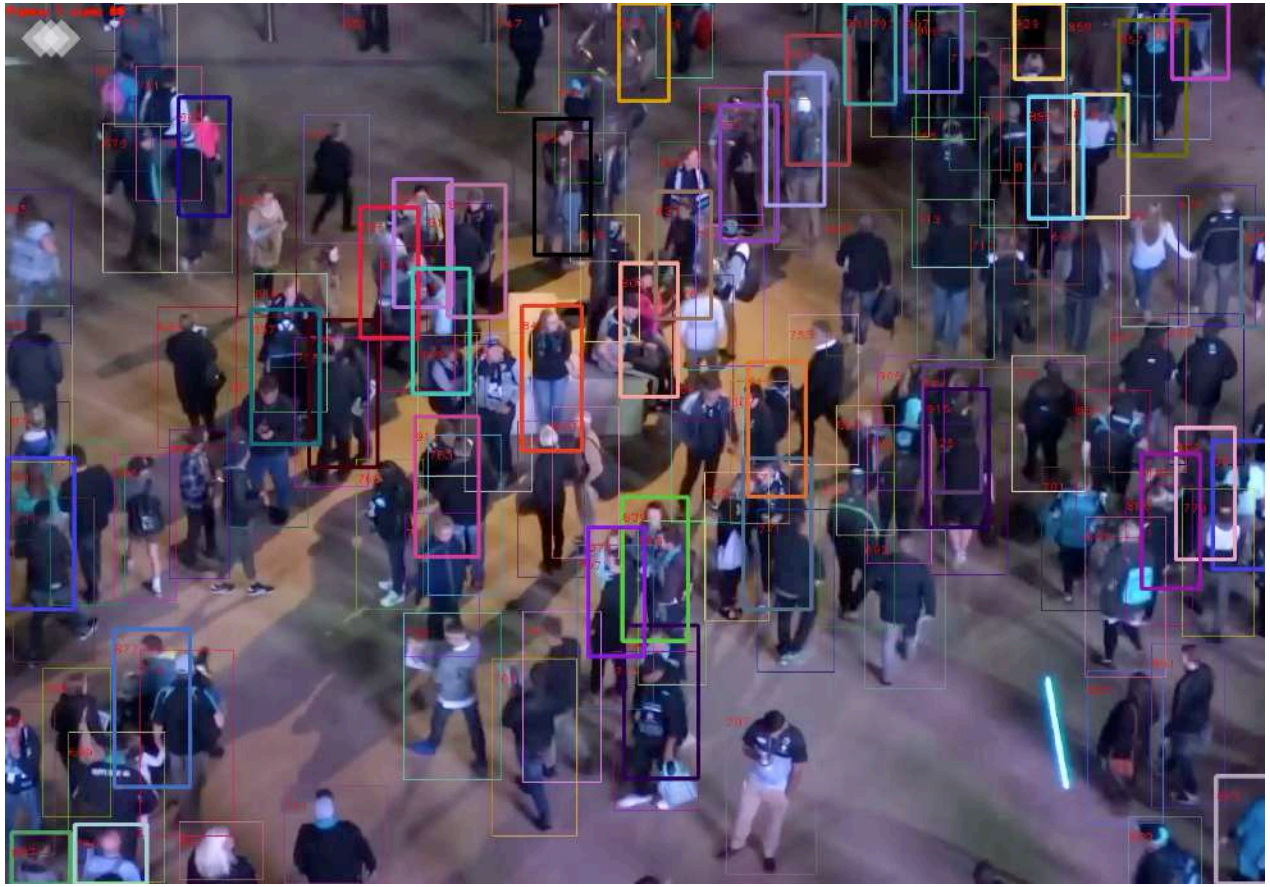
MPNTrack[2] – **Data association only** with GNNs



*Objects that are detected in one video but are missing in the other are marked with **bold** bounding boxes*

[2] G. Brasó, L. Leal-Taixé. Learning a Neural Solver for Multiple Object Tracking. CVPR, 2020.

Ours – **Joint detection and data association** with GNNs



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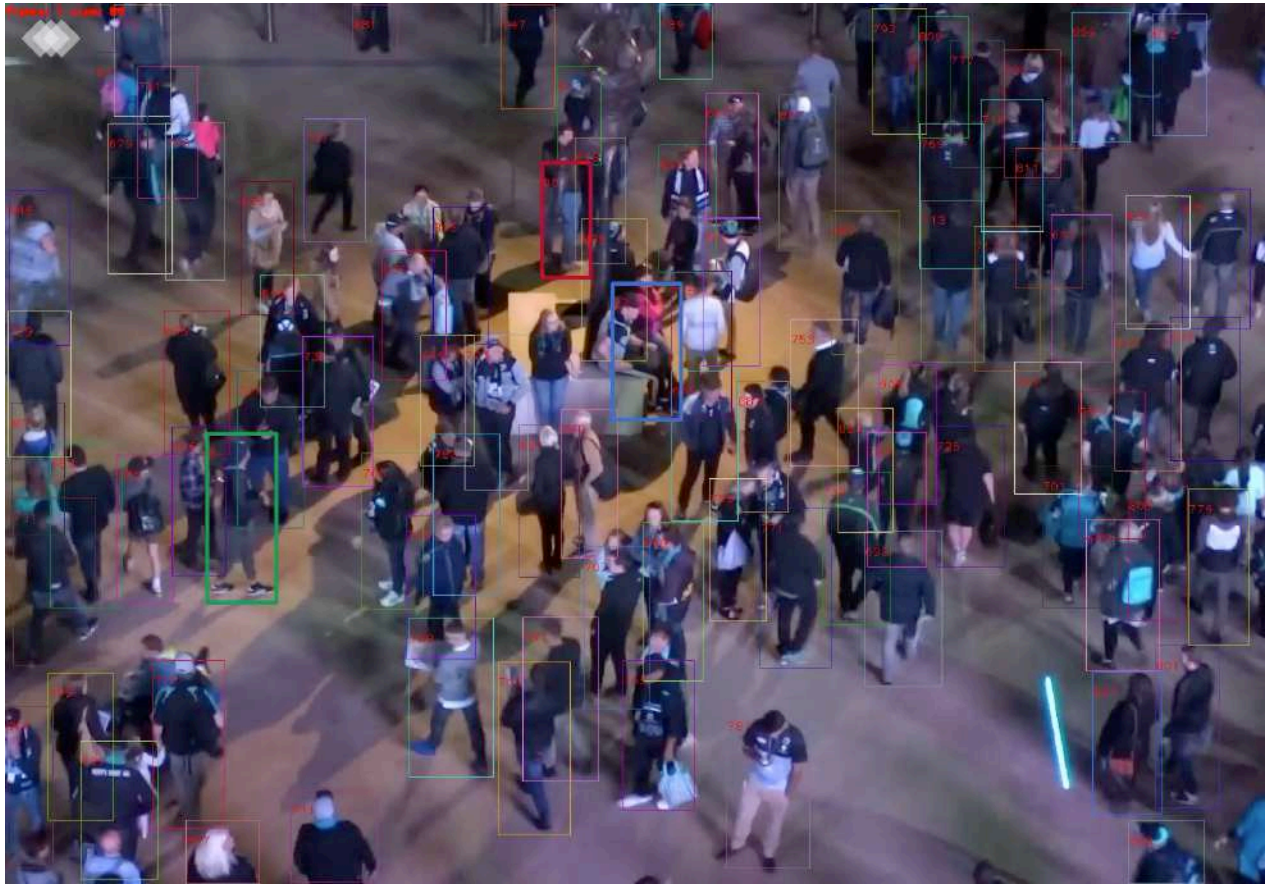

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