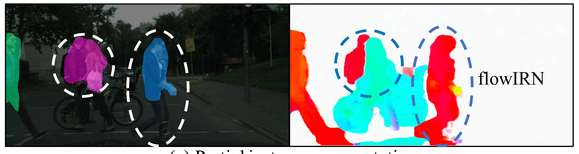
Weakly Supervised Instance Segmentation for Videos with Temporal Mask Consistency

Qing Liu[1] Vignesh Ramanathan[2] Dhruv Mahajan[2] Alan Yuille[1] Zhenheng Yang[2]
[1] Johns Hopkins University [2] Facebook

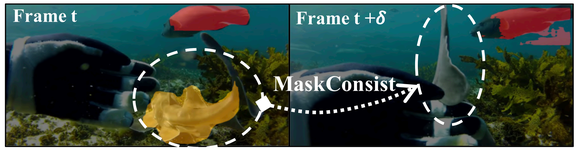
CVPR VIRTUAL JUNE 19-25

Motivation

➢ Problems with existing works where video signals can help:



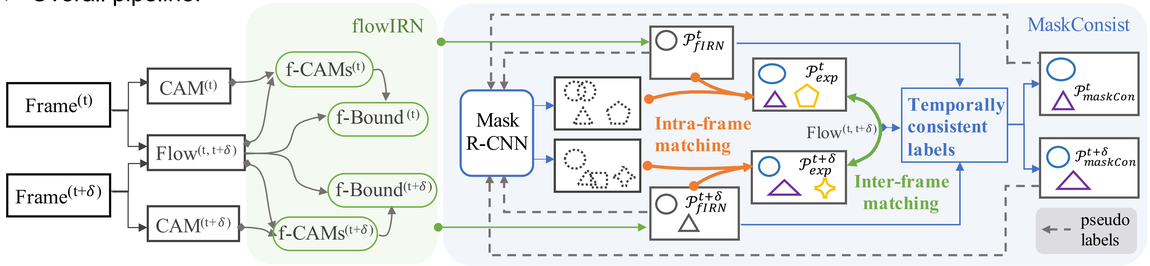
(a) Partial instance segmentation



(b) Missing object instance

Framework

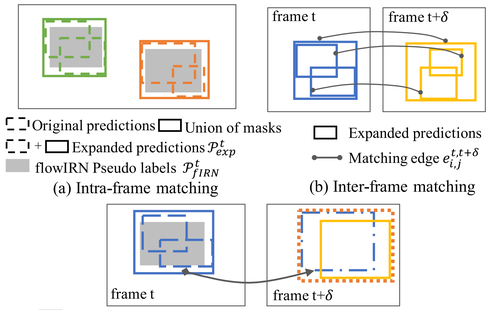
➢ Overall pipeline:



➢ Incorporating optical flow in flowIRN module:

- Flow-amplified CAMs: $\text{f-CAM}_c(x) = \text{CAM}_c(x) \times A^{\mathbb{I}(||\mathcal{F}(x)||_2 > T)}$
- Flow-boundary loss: $\mathcal{L}^{\mathcal{B}}_{\mathcal{F}} = \sum_{j \in \mathcal{N}_i} ||\mathcal{F}'(i) - \mathcal{F}'(j)|| \alpha_{i,j} + \lambda |1 - \alpha_{i,j}|$

➢ Three steps of MaskConsist module:



Frame Instance Segmentation Results

Methods	Video Info	Supervision	AP_{50}
Mask R-CNN [17]	✗	Mask	78.24
WSIS-BBTP [20]	✗	Bbox	46.80
WISE [27]	✗	Class	24.54
F2F [29]+MCG [41]	✓	Class	26.31
IRN [6]	✗	Class	29.64
IRN [6]+F2F[29]	✓	Class	30.27
Ours	✓	Class	34.66
Ours (self-training)	✓	Class	**36.00**

Table 1. Frame-level instance segmentation performance (AP_{50}) on YTVIS train_val split.

Methods	Supervision	Instance seg	Semantic seg
Mask R-CNN [17]	Mask	38.73	79.23
WISE [27]	Class	10.51	35.82
F2F [29]+MCG [41]	Class	10.73	33.26
IRN [6]	Class	12.33	33.48
IRN [6]+F2F[29]	Class	12.53	34.17
Ours	Class	16.05	39.88
Ours (self-training)	Class	**16.82**	**41.31**

Table 2. Frame-level instance segmentation (AP_{50}) and semantic segmentation (IoU) on Cityscapes validation split.

Video Instance Segmentation Results

Methods		Train_Val Split					Validation Split				
		mAP	AP_{50}	AP_{75}	AR_1	AR_{10}	mAP	AP_{50}	AP_{75}	AR_1	AR_{10}
Fully supervised learning methods	IoUTracker+ [58]	-	-	-	-	-	23.6	39.2	25.5	26.2	30.9
	DeepSORT [57]	-	-	-	-	-	26.1	42.9	26.1	27.8	31.3
	MaskTrack [58]	-	-	-	-	-	30.3	51.1	32.6	31.0	35.5
Weakly supervised learning methods	WISE [27]	8.7	22.1	5.5	9.8	10.7	6.3	17.5	3.5	7.1	7.8
	IRN [6]	10.8	26.4	7.7	12.6	14.4	7.3	18.0	3.0	9.0	10.7
	Ours	14.1	34.4	9.4	16.0	17.9	10.5	27.2	6.2	12.3	13.6

Table 3. Video instance segmentation results on Youtube-VIS dataset.

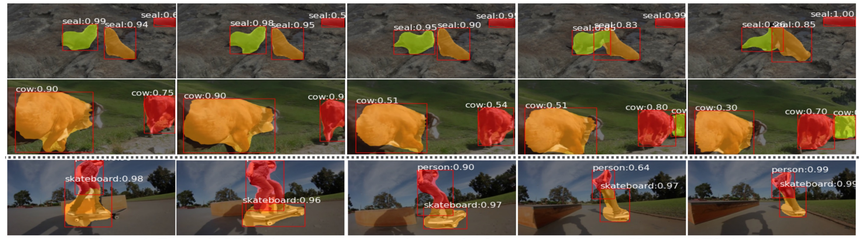
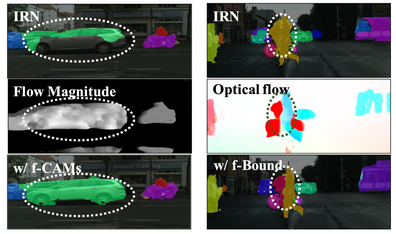


Figure 4. Example Video instance segmentation results from our method on Youtube-VIS dataset.

Ablations

➢ Effect of flowIRN:

	YTVIS	Cityscapes
IRN [6]	25.42	8.46
IRN+f-Bound	26.60	9.51
IRN+f-CAMs	27.47	10.55
flowIRN	**28.45**	**10.75**



➢ Effect of MaskConsist:

MaskConsist Components			AP_{50}	
Intra-F	Inter-F	IoM-NMS	YTVIS	Cityscapes
✗	✗	✗	31.43	14.66
✗	✓	✓	33.75	14.92
✓	✗	✓	31.08	14.43
✓	✓	✗	33.65	15.27
✓	✓	✓	**34.66**	**16.05**

Methods	w/ MC	AP_{50}		TC
		YTVIS	Cityscapes	
WISE [27]	✗	24.54	10.51	72.08
	✓	27.03	12.26	76.27
IRN [6]	✗	29.64	12.33	80.98
	✓	31.51	14.72	82.04
Ours	✗	31.43	14.66	80.43
	✓	34.66	16.05	84.36