Flow-Assisted Motion Learning Network (Flaming-Net) for Weakly-Supervised Group Activity Recognition

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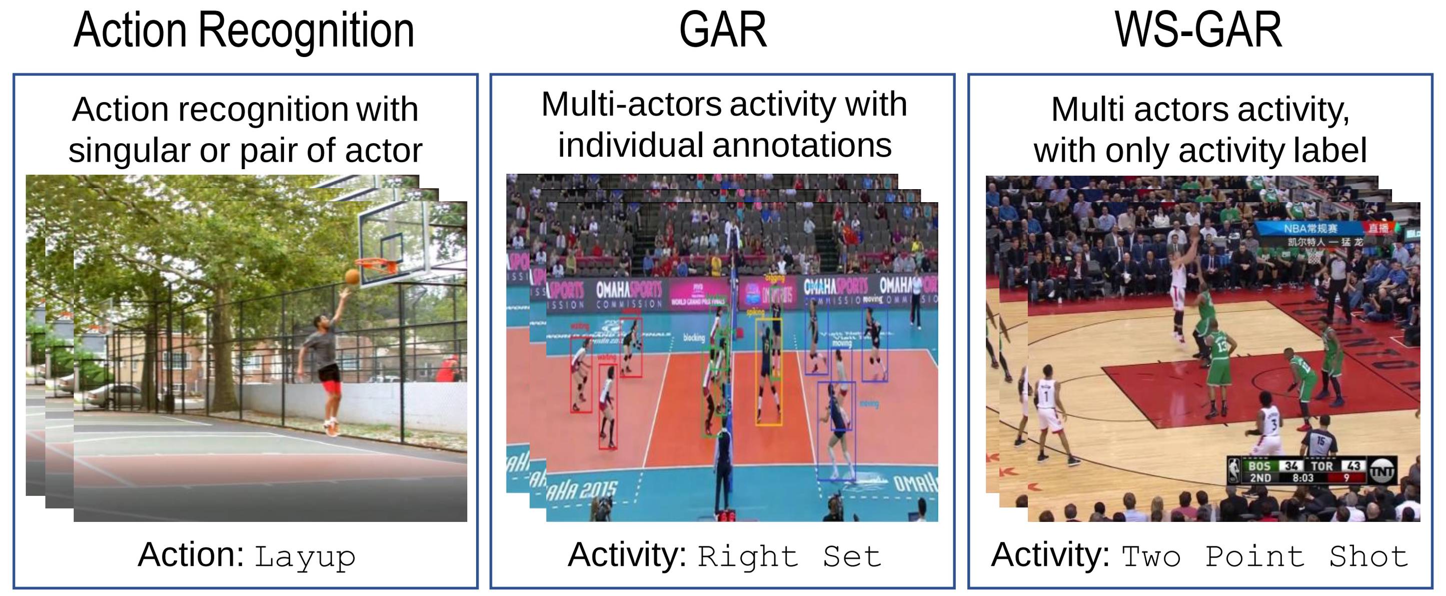
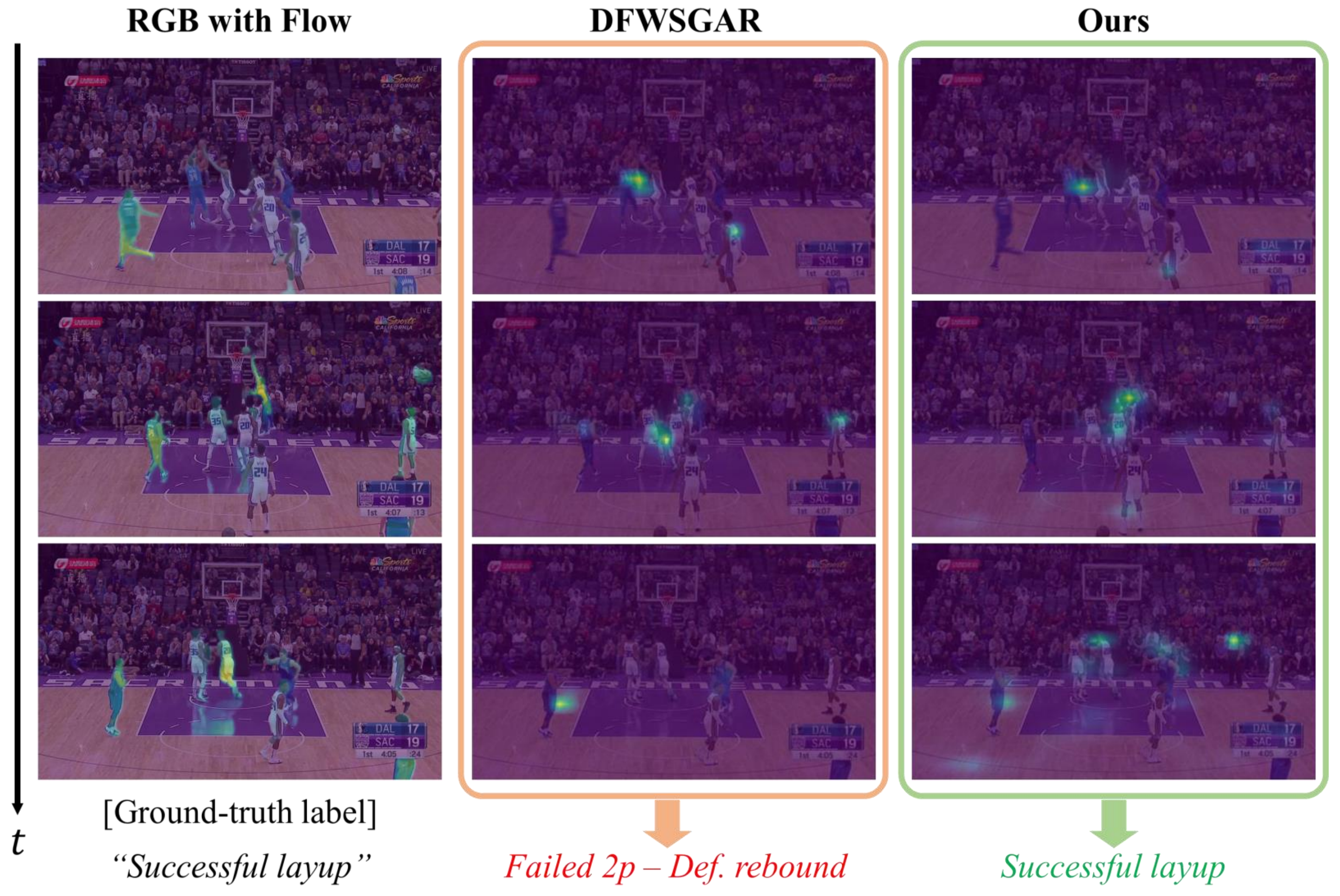
EUROPEAN CONFERENCE ON COMPUTER VISION
MILANO 2024

Introduction

- WSGAR (Weakly Supervised Group Activity Recognition) requires the model to find actors and their complex spatio-temporal relations with no individual actor annotations provided.

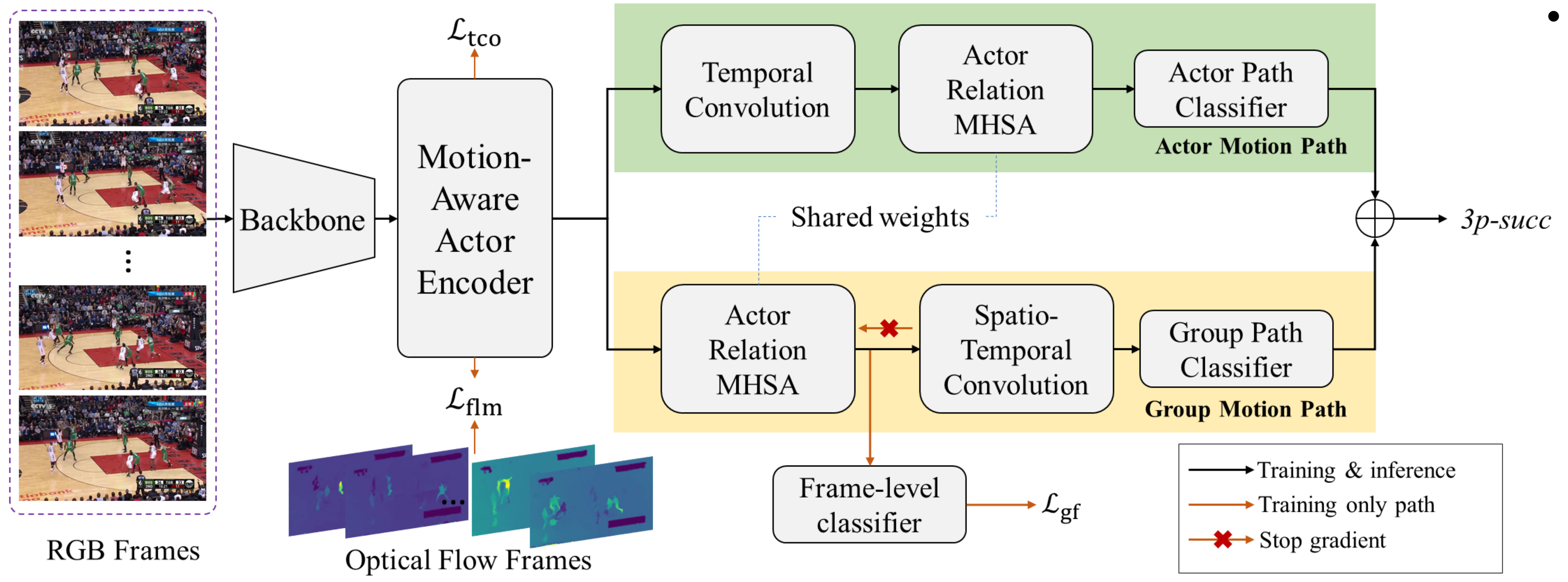


- Flaming-Net selectively highlights key actors, those who play important roles in the activity.
- Utilize optical flow as learning guidance to be more aware of actively moving actors.

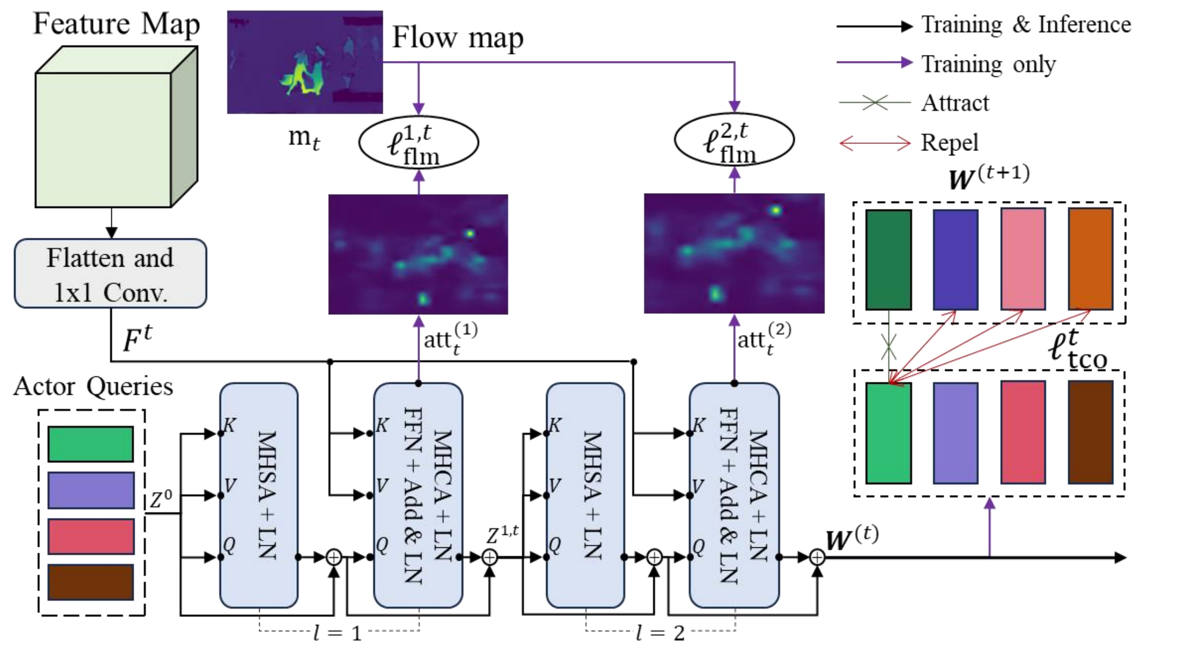


Method

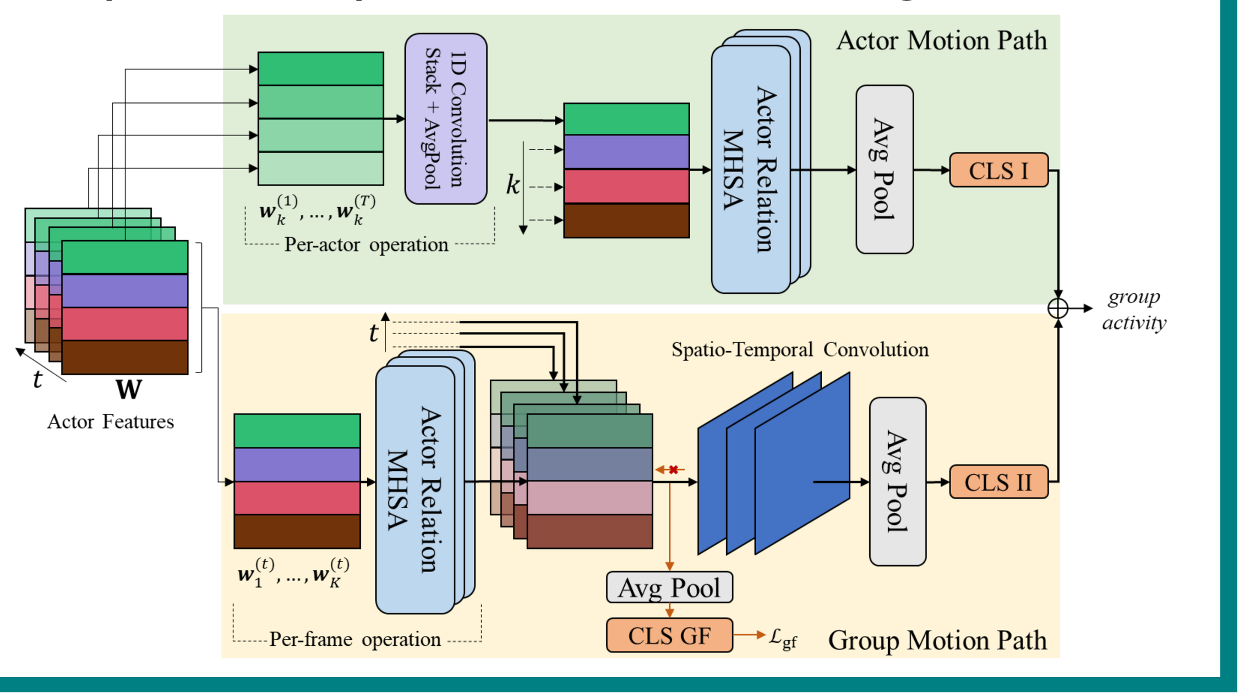
- Motion-aware actor encoder generates actor features by transforming a set of actor queries into features representing key actors.
- The actor relation module learns relations between actors to infer activity.
- Maintain efficiency by utilizing only the RGB frames in the inference stage.



- The encoder consists of multi-head attention modules with learnable actor queries.
- The attentions are guided by the optical flow using aux. loss $\mathcal{L}_{flm}$ to highlight active actors.
- Temporal contrastive loss helps to create consistent actor representation across time.

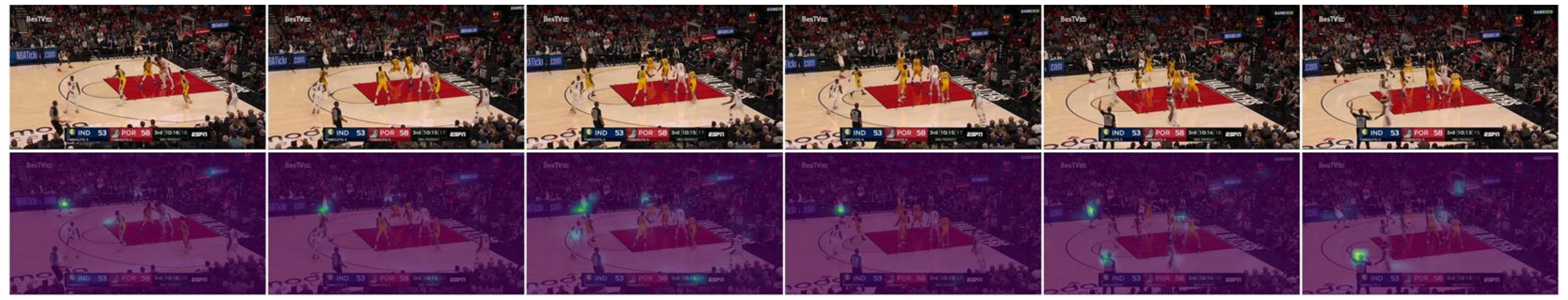


- The actor relation module consists of actor motion and group motion path.
- The actor motion path focuses on the temporal evolution of individual actors.
- The group motion path focuses on local spatio-temporal relations among actors.



Results

High attention to important players on crucial moments



In **3p-success**, Flaming-Net first highlights the shooter, then the def. players and referee

In **failed 2p - def. reb.**, Flaming-Net highlights the scrimmage and the rebound action

Performance in NBA dataset containing complex spatial and long temporal actor relationships.

Method	Pub.	F	#Params	FLOPs	MCA	MPCA
SAM	ECCV'20	✗	25.5M	304 G	44.2%	59.3%
Dual-AI	CVPR'22	✓	-	-	58.1%	50.2%
DFWSGAR	CVPR'22	✗	17.5M	313G	75.8%	71.2%
LRMM+GCM	ImaVis'23	✗	14.2M	306G	77.8%	73.2%
Flaming-Net	ECCV'24	Tr	13.8M	307G	**79.1%**	**76.0%**

Performance in WS-Volleyball dataset.

Method	Pub.	F	Backbone	MCA	MPCA
SAM	ECCV'20	✗	ResNet-18	86.3%	93.1%
Dual-AI	CVPR'22	✓	Inception-v3	-	**96.5%**
DFWSGAR	CVPR'22	✗	ResNet-18	90.5%	94.4%
LRMM+GCM	ImaVis'23	✗	ResNet-18	92.8%	95.6%
Flaming-Net	ECCV'24	Tr	Inception-v3	**93.3%**	95.2%

F = Optical Flow, Tr = Use optical flow only in training

Efficacy of auxiliary losses

$\mathcal{L}_{gf}$	$\mathcal{L}_{tco}$	$\mathcal{L}_{flm}$	MCA	MPCA
✗	✗	✗	75.3%	70.1%
✓	✗	✗	78.3%	72.3%
✓	✓	✗	77.5%	73.0%
✓	✗	✓	77.5%	73.0%
✓	✓	✓	79.1%	76.0%

Effect of actor relation module

Actor Relation	MCA	MPCA
Actor Motion Path (AMP)	74.3%	73.9%
AMP + Losses	77.1%	71.7%
S.T Transformer Dual Path	77.0%	70.7%
Flaming-Net	79.1%	76.0%

More results and analysis on our paper

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