GPGait: Generalized Pose-based Gait Recognition
Paper Review 05/02

Bo Han, Chen

National Yang Ming Chiao Tung University, Taiwan
bhchen312551074.cs12@nycu.edu.tw

May 2, 2024

Info

- Title: GPGait: Generalized Pose-based Gait Recognition
- Authors: Yang Fu, Shibei Meng, Saihui Hou, Xuecai Hu, Yongzhen Huang
- Conference: IEEE/CVF International Conference on Computer Vision
- Year: 2023

Motivation

- Poor generalization ability of pose-based methods
- Performance degradation from unseen environments
- Cross-domain factors
  - Scale variation (distance from camera)
  - Tilt view (deployment of camera)

Proposed Method

- Human-Oriented Transformation (HOT)
  - Obtain unified representation
- Human-Oriented Descriptors (HOD)
  - Generate invariant features of bone and angle
  - Capture body structure and gait motion
- Part-Aware Graph Convolutional Network (PAGCN)
  - Graph partitioning based on body structure
  - Capture local and global information with different masks

Proposed Method

Human-Oriented Transformation (HOT)

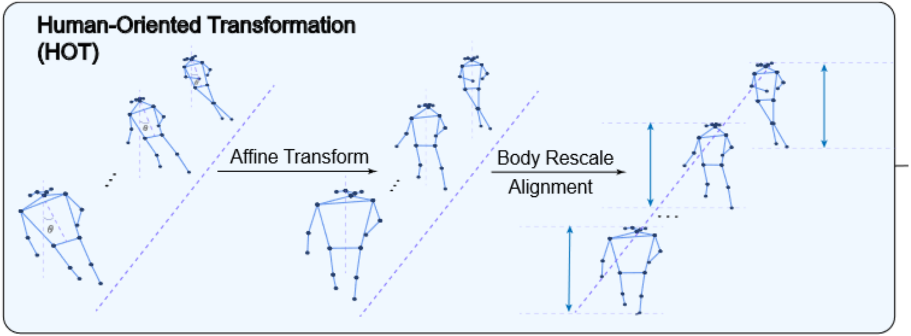

Figure 1: HOT Overview

Proposed Method

Human-Oriented Transformation (HOT)

- Affine transformation
  - Take spine angle as reference
  - neck position & hip joint
  - Applied if angle θ is larger than threshold
- Rescale
  - Height normalization
- Alignment
  - Subtract neck joint coordinate
  - Remove offsets from camera positioning

Proposed Method

Human-Oriented Descriptors (HOD)

- Bone features
  - Calculated by adjacent joints
- Angle features
  - Inner angle
    - Angular changes inside body
  - Peripheral angle
    - Movement of skeleton edge

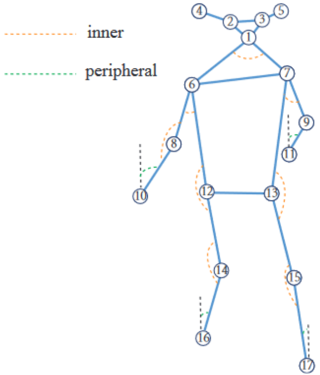

Figure 2: HOD Overview

Proposed Method

Part-Aware Graph Convolutional Network (PAGCN)

- Three parameter branches
  - joint
  - Bone
  - Angle
- Local PAGCN
  - Partition mask
  - Capture fine-grained body information
- Global PAGCN
  - Capture global spatial keypoint relationship

Proposed Method

Part-Aware Graph Convolutional Network (PAGCN)

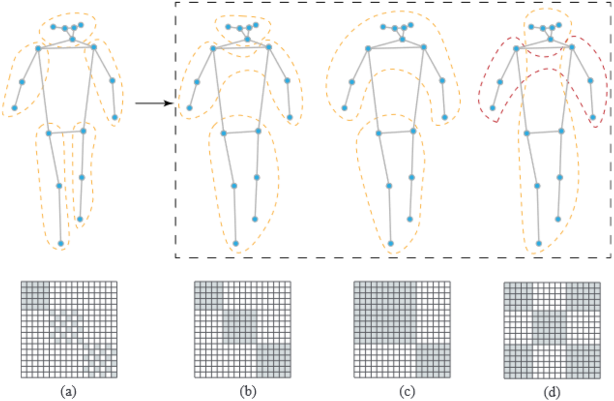

Figure 3: Mask Partition

Experiments

Result

Source Dataset	Method	Target Dataset						
		CASIA-B				OUMVLP-Pose	GREW	Gait3D
		NM	BG	CL	Mean			
CASIA-B	GaitGraph [36]	86.37	76.5	65.24	76.04	0.07	0.45	0.90
	GaitGraph2 [35]	80.29	71.40	63.80	71.83	0.07	0.48	1.10
	GaitTR [42]	**94.72**	**89.29**	**86.65**	**90.22**	0.07	0.62	1.10
	GPGait(ours)	93.60	80.15	69.29	81.01	**2.84**	**9.97**	**8.90**
OUMVLP-Pose	GaitGraph [36]	4.85	4.84	3.90	4.53	4.24	0.67	1.50
	GaitGraph2 [35]	8.83	7.62	5.13	7.19	**70.68**	0.85	1.40
	GaitTR [42]	10.10	8.26	5.17	7.84	39.77	1.06	2.60
	GPGait(ours)	**44.36**	**31.97**	**22.35**	**32.90**	59.11	**11.13**	**9.00**
GREW	GaitGraph [36]	10.54	7.73	5.73	8.00	0.17	10.18	4.40
	GaitGraph2 [35]	8.85	7.18	5.13	7.05	0.22	34.78	8.30
	GaitTR [42]	7.60	6.36	6.40	6.79	0.06	48.58	7.30
	GPGait(ours)	**57.87**	**45.98**	**24.23**	**42.69**	**4.25**	**57.04**	**18.50**
Gait3D	GaitGraph [36]	16.47	12.18	8.29	12.31	0.27	3.14	8.60
	GaitGraph2 [35]	12.32	9.93	5.43	9.23	0.09	2.39	11.20
	GaitTR [42]	4.50	3.90	3.96	4.12	0.06	4.38	7.20
	GPGait(ours)	**48.83**	**40.26**	**19.43**	**36.17**	**2.79**	**11.02**	**22.40**

Experiments
Ablation Study

Method	CASIA-B→Gait3D		Gait3D→CASIA-B	
	Source	Target	Source	Target
HOT(ours)	81.01	**8.90**	22.40	**36.17**
Spine-Unit [2, 23]	74.53	5.50	14.50	15.74
Dataset-Independent [29]	87.03	1.50	9.90	11.54

Experiments
Ablation Study

Method(w/wo)	CASIA-B→Gait3D		Gait3D→CASIA-B	
	Source	Target	Source	Target
GaitGraph	40.91	1.96	11.00	29.24
GaitGraph2	45.66	3.20	12.20	24.49
GaitTR	64.37	2.40	8.10	21.74
GPGait	81.01	**8.90**	22.40	**36.17**
GaitGraph	76.04	0.90	8.60	12.31
GaitGraph2	71.83	1.10	11.20	9.23
GaitTR	90.22	1.10	7.20	4.12
GPGait	86.15	**2.70**	16.00	**20.30**

- Multi-Branch vs. Single-Branch
  - Focus on different type of features
- With mask partition vs. Without mask partition
  - Able to capture fine-grained features

Conclusion

- Performance on source-domain
- vs. silhouette-based methods
  - Keypoint vs. Body shape
  - Robustness to wearing and carrying, etc
- Compared to last reviewed paper
  - temporal information
  - computational cost

Thanks for Listening

Q & A