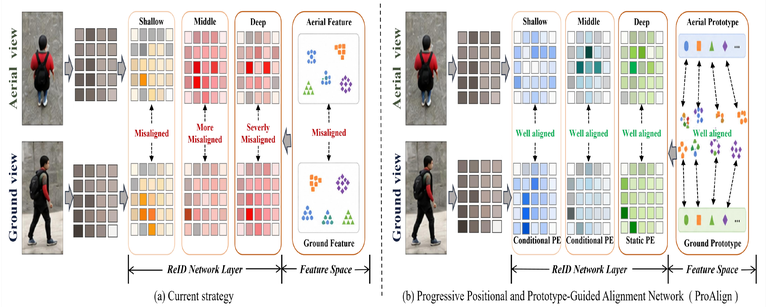
ProAlign: Progressive Positional and Prototype-Guided Alignment for Aerial-Ground Person Re-Identification

Qiao Li[1], Jing Chen[1], Cong Wu[1], Kun He[1], Ruiying Du[1], Lei Tan[2]
[1]School of Cyber Science and Engineering, Wuhan University, Wuhan, China [2]National University of Singapore, Singapore

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Motivation



(a) Prior methods suffer from cumulative positional drift and cross-view distributional gaps.

(b) ProAlign addresses these issues through layer-wise positional calibration (LPPE) and prototype-guided semantic alignment (PCL).

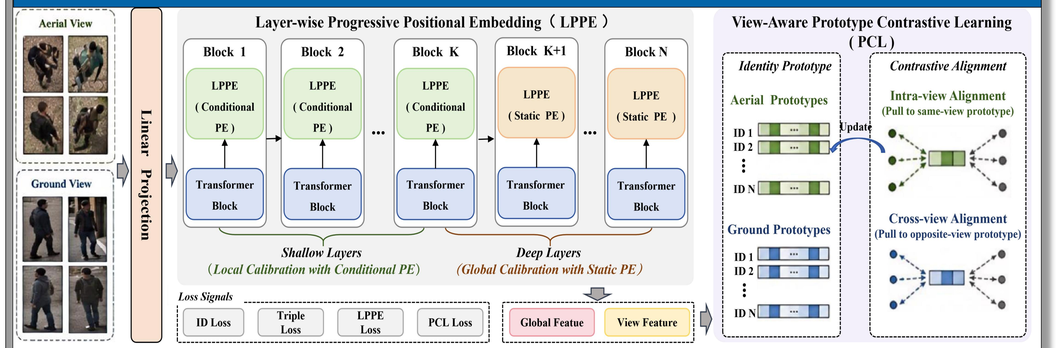
Contribution

(a) We propose ProAlign, a unified framework for aerial-ground person re-identification that jointly addresses hierarchical positional drift and cross-view semantic inconsistency under extreme viewpoint variations.

(b) We introduce a Layer-wise Progressive Positional Embedding (LPPE) module and a View-Aware Prototype Contrastive Learning (PCL) module. LPPE progressively calibrates spatial representations across transformer layers, while PCL performs prototype-guided population-level semantic alignment across views.

(c) Extensive experiments on multiple AG-ReID benchmarks demonstrate that ProAlign achieves state-of-the-art overall performance and exhibits strong robustness under challenging aerial-ground matching scenarios.

The Proposed GSAlign



Given aerial or ground-view inputs, ProAlign first extracts patch tokens and processes them through transformer layers equipped with LPPE for depth-adaptive spatial correction. In parallel, the PCL module maintains view-specific prototypes to facilitate cross-view identity alignment.

Experiments

Method	Protocol 1: ALL			Protocol 2: G↔G			Protocol 3: A↔A			Protocol 4: A↔G		
	Rank1	mAP	mINP	Rank1	mAP	mINP	Rank1	mAP	mINP	Rank1	mAP	mINP
SBS [38]	50.32	43.09	29.76	72.31	62.99	48.24	67.50	49.73	29.32	31.25	29.00	18.71
PCB [33]	51.00	44.50	32.20	74.10	67.60	55.10	55.00	44.60	27.00	34.40	30.40	20.10
BoT [34]	54.81	46.49	32.40	77.68	66.47	51.34	65.00	49.79	29.82	36.25	32.56	21.46
MGN [35]	54.81	49.08	36.52	83.93	71.05	55.20	65.00	52.96	36.78	31.87	33.47	24.64
VV [39, 40]	45.83	38.84	39.57	72.31	62.99	48.24	67.50	49.73	29.32	31.25	29.00	18.71
AGW [32]	60.26	53.44	40.22	81.25	71.66	58.09	67.50	56.48	40.40	43.57	40.90	29.39
ViT [36]	61.54	53.54	39.61	82.14	71.34	57.55	80.00	64.67	47.07	43.13	40.11	28.20
GSAlign [11]	66.67	56.35	41.42	83.04	71.57	57.68	82.50	67.70	51.80	**65.96**	**60.50**	49.32
VDT [6]	64.10	55.20	41.13	82.14	71.59	58.39	82.50	66.83	50.22	48.12	42.75	29.95
VIF [37]	65.71	57.46	44.12	83.93	74.19	62.30	82.50	66.98	51.44	51.25	44.55	31.20
ProAlign	**68.27**	**62.47**	**51.39**	**84.82**	**80.22**	**72.51**	**85.00**	**70.05**	**54.66**	60.64	58.44	**49.86**

Setting	Protocol 1: ALL			Protocol 2: G↔G			Protocol 3: A↔A			Protocol 4: A↔G		
	Rank1	mAP	mINP	Rank1	mAP	mINP	Rank1	mAP	mINP	Rank1	mAP	mINP
Baseline	64.10	55.20	41.13	82.14	71.59	58.39	82.50	66.83	50.22	48.12	42.75	29.95
Baseline + LPPE	60.58	54.92	43.13	79.46	74.10	65.12	75.00	63.62	47.28	53.19	52.63	44.73
Baseline + PCL	65.38	58.55	46.49	79.46	73.99	64.52	82.50	67.66	51.20	58.51	57.65	49.68
Baseline + LPPE + PCL	**68.27**	**62.47**	**51.39**	**84.82**	**80.22**	**72.51**	**85.00**	**70.05**	**54.66**	**60.64**	**58.44**	**49.86**

Setting	Protocol 1: ALL			Protocol 2: G↔G			Protocol 3: A↔A			Protocol 4: A↔G		
	Rank1	mAP	mINP	Rank1	mAP	mINP	Rank1	mAP	mINP	Rank1	mAP	mINP
Depths of CPE												
First 3 layers	**68.59**	60.97	48.7	**85.71**	77.74	67.86	80.00	68.32	53.99	60.64	60.31	52.22
First 6 layers	68.27	**62.47**	**51.39**	84.82	**80.22**	**72.51**	**85.00**	**70.05**	**54.66**	60.64	58.44	49.86
First 9 layers	66.35	60.40	48.43	81.25	76.22	67.17	82.50	68.73	53.71	**62.77**	**61.66**	**53.87**
All layers	67.63	58.87	45.41	83.93	74.92	64.11	80.00	67.58	52.16	61.70	59.60	50.12
Different variants of prototype												
Inner-Batch	62.82	56.12	43.55	77.68	72.57	62.64	77.50	64.44	48.94	60.64	**58.50**	49.49
Global Memory	61.86	55.40	42.71	77.68	71.83	61.10	77.50	64.53	48.89	56.38	55.80	47.80
Classifier Weights	62.82	56.30	43.98	81.25	75.06	65.08	75.00	63.90	47.79	53.19	53.52	45.54
View-Aware PCL	**68.27**	**62.47**	**51.39**	**84.82**	**80.22**	**72.51**	**85.00**	**70.05**	**54.66**	**60.64**	58.44	**49.86**

Setting	Protocol 1: ALL			Protocol 2: G↔G			Protocol 3: A↔A			Protocol 4: A↔G		
	Rank1	mAP	mINP	Rank1	mAP	mINP	Rank1	mAP	mINP	Rank1	mAP	mINP
$\gamma = 0$	66.67	57.24	42.85	82.14	73.79	62.44	80.00	64.44	46.03	**63.83**	57.99	46.82
$\gamma = 0.25$	67.31	58.54	45.12	82.14	75.25	65.02	**85.00**	68.98	51.75	62.77	**60.54**	**51.29**
$\gamma = 0.5$	**68.27**	**62.47**	**51.39**	**84.82**	**80.22**	**72.51**	**85.00**	**70.05**	**54.66**	60.64	58.44	49.86
$\gamma = 0.75$	66.67	58.54	44.67	82.14	73.25	61.65	82.50	68.39	53.43	59.57	58.76	49.85

Visulization

