Game4Loc: A UAV Geo-Localization Benchmark from Game Data

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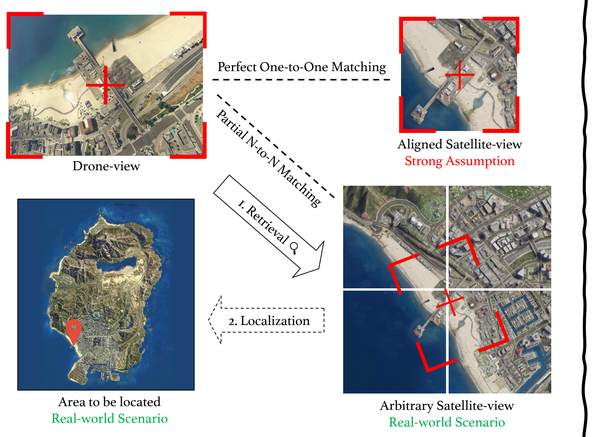
Project | Paper

AAAI-25 / IAAI-25 / EAAI-25

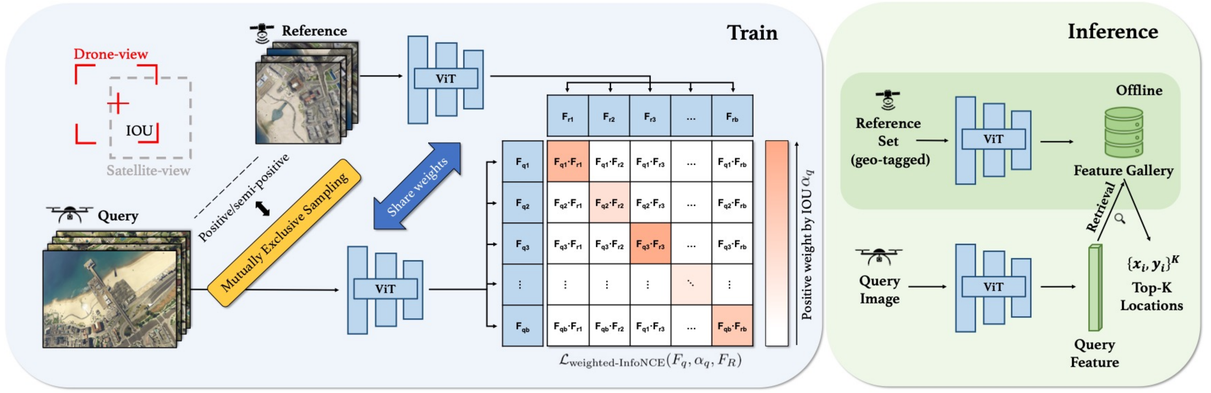
Motivation



Dataset Highlight

- Large continuous area ($81.3km^2$)
- 33,763 **drone-view** images
  - Multiple altitudes (80~$650m$)
  - Multiple attitudes
  - Multiple scenes (urban, coast, etc.)
  - 6-DoF meta-data
- 14,640 **satellite-view** tiles
  - Multiple zoom levels
- Arbitrarily **partial matching** pairs
  - Overlap (in IOU)

Pipeline Overview



- Training on the proposed weighted-InfoNCE. (based on overlapping IOU)

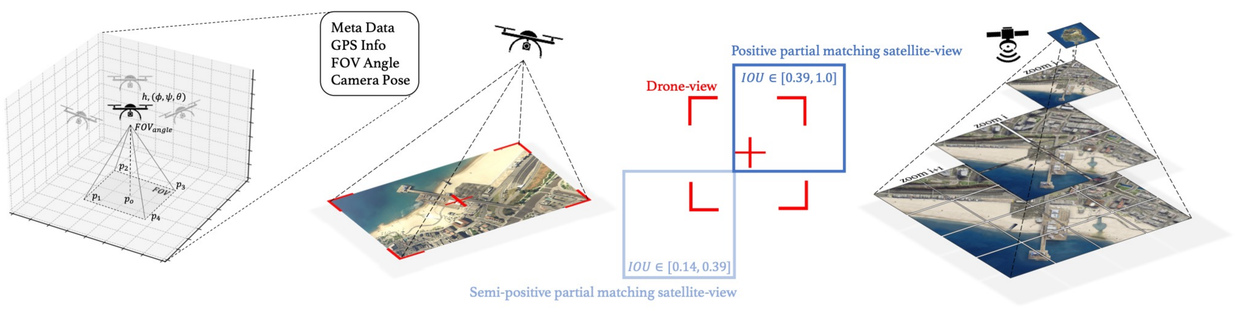
Comparison to Other Dataset

	University	SUES-200	DenseUAV	UAV-VisLoc	GTA-UAV (proposed)
Drone images	37,854	24,210	18,198	6,742	33,763
Drone-view GPS locations	Aligned	Aligned	Aligned	-	Arbitrary
Altitude range	$\sim 50m$	$150m \sim 300m$	$80m \sim 100m$	$400m \sim 840m$	$80m \sim 650m$
Contiguous area	×	×	✓	✓	✓
Evaluation in terms of meters	×	×	×	✓	✓
Multiple attitudes	✓	×	×	×	✓
Multiple scenes	×	×	×	✓	✓
Multiple scales satellite images	×	×	×	-	✓

Performance

Methods	Cross-Area					Same-Area				
	R@1↑	R@5↑	AP↑	SDM@3↑	Dis@1↓	R@1↑	R@5↑	AP↑	SDM@3↑	Dis@1↓
Positive-only										
Triplet Loss ($\mathcal{L}_{\text{triplet}}$)	43.41%	66.70%	53.56%	61.26%	756.95m	68.22%	87.99%	76.73%	79.17%	438.38m
InfoNCE Loss ($\mathcal{L}_{\text{InfoNCE}}$)	49.57%	72.84%	59.68%	65.53%	612.22m	72.99%	90.64%	80.76%	80.40%	363.67m
InfoNCE Loss ($\mathcal{L}_{\text{InfoNCE}}$, w/. MES)	52.64%	74.63%	62.40%	67.64%	552.90m	72.34%	91.42%	80.86%	81.57%	369.59m
Ours ($\mathcal{L}_{\text{weighted-InfoNCE}}$, w/. MES)	**57.52%**	80.10%	**67.24%**	72.33%	444.13m	75.97%	94.53%	83.35%	82.80%	325.61m
Positive + Semi-positive										
Triplet Loss ($\mathcal{L}_{\text{triplet}}$)	24.78%	46.99%	35.13%	58.79%	879.06m	46.55%	85.07%	62.95%	83.63%	252.88m
InfoNCE Loss ($\mathcal{L}_{\text{InfoNCE}}$)	35.83%	63.79%	48.08%	68.15%	576.41m	52.67%	90.75%	67.74%	85.35%	204.08m
InfoNCE Loss ($\mathcal{L}_{\text{InfoNCE}}$, w/. MES)	45.97%	71.43%	57.19%	71.48%	460.08m	65.89%	93.09%	77.84%	86.52%	196.59m
Ours ($\mathcal{L}_{\text{weighted-InfoNCE}}$, w/. MES)	55.91%	**81.07%**	66.56%	**76.35%**	**342.05m**	**84.95%**	**97.59%**	**90.15%**	**88.03%**	**149.07m**

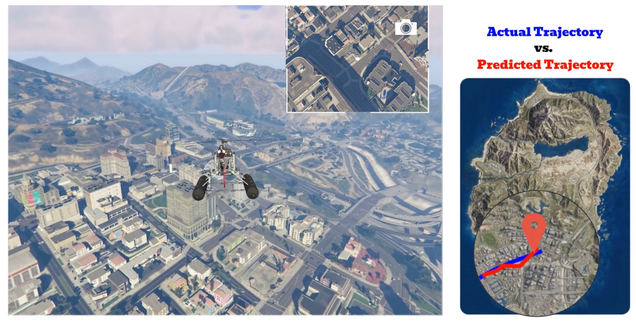
Dataset Construction



- Arbitrarily paired by IOU (between FOV from drone-view and satellite-view)
- Divided into positive and semi-positive pairs according to the IOU value
- Applicable to **real world** scenarios!

Localization Demo

Demo
Scan for Video



Localization in Flight Trajectory

- Transferability to **real-world data**. More details on our project page.