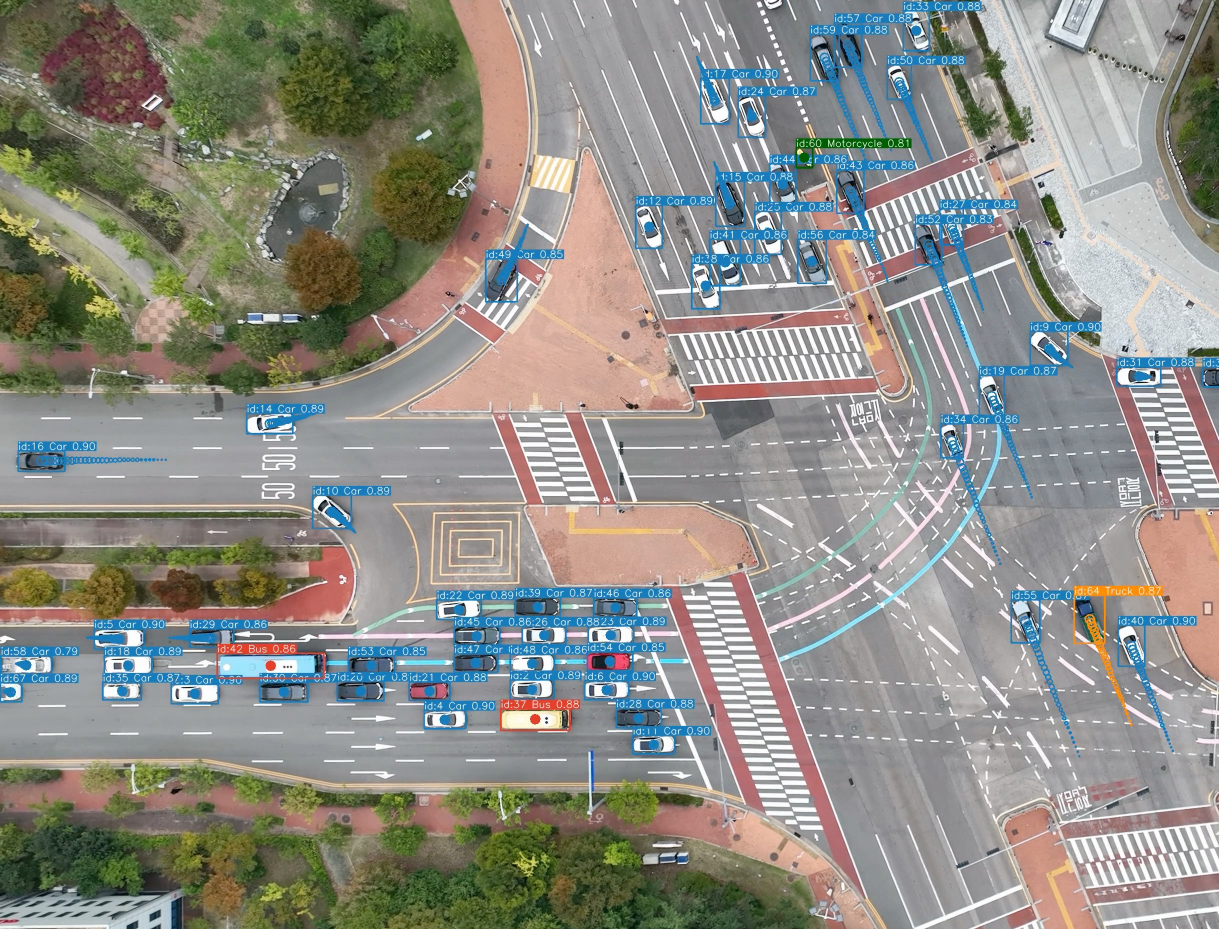




High-Precision Georeferenced Trajectory Extraction Using Advanced Computer Vision From a Multi-Drone Experiment

Robert Fonod, Haechan Cho,
Hwasoo Yeo, Nikolas Geroliminis,



Emergence of Drones for Traffic Monitoring

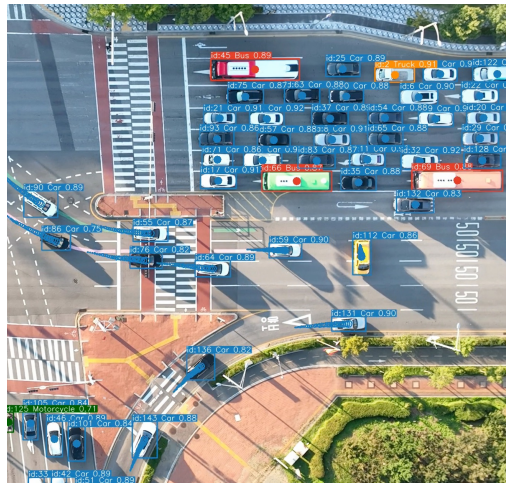
Drones

- Tech revolution in traffic data collection
- Versatile, rapid deployment, enlarged coverage, ...



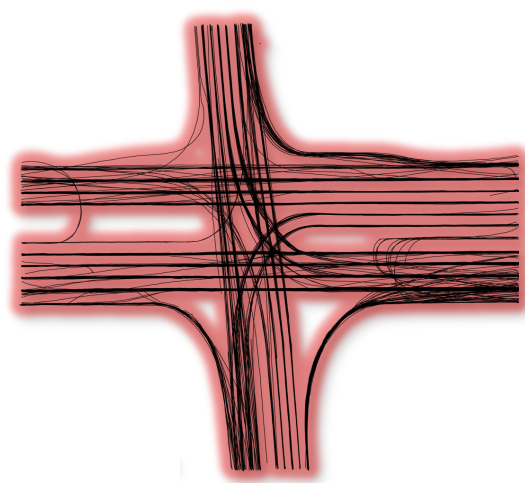
CV/ML Advancements

- Driven by the rapid rise of Deep Learning methods
- Enhanced accuracy and new features at higher frequencies



Traffic Implications

- New drone datasets for research and practice
- Analyzing flow, congestion, safety, emissions, ...



The Experiment Location – Songdo IBD (“smart” city)

■ High-Precision Georeferenced Trajectory Extraction Using Advanced Computer Vision From a Multi-Drone Experiment



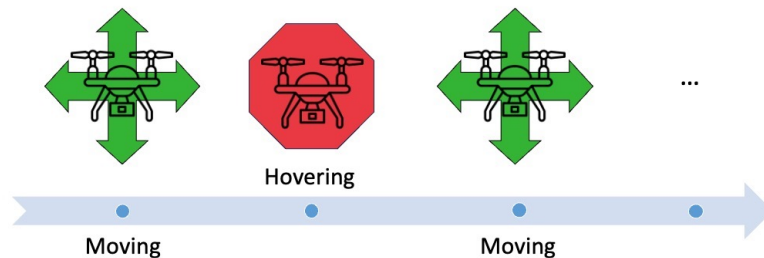
Experiment Details

Key Idea: A fleet of **10 drones** dynamically monitors 2-3 intersections, alternating between **hovering/recording** at each intersection before **moving** to the next.

Enlarged spatial coverage!

Characteristics:

- 4(5) days in October 2022
- 10 drones (DJI Mavic 3)
- 20 busy intersections
- 4K (3840x2160) @ 29.97fps
- **Bird's-eye view** perspective
- **140m – 150m** altitude



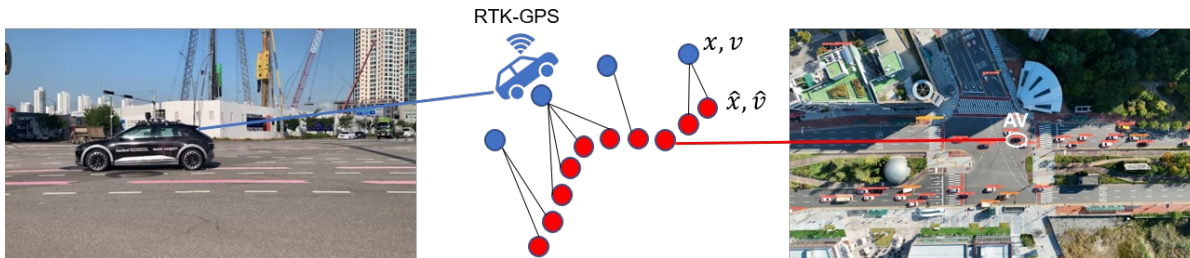
	# Flight Sessions	Recording Period	Session Duration	Battery Swap
Morning (AM)	5	07:00 – 10:10	Peak ±30 min	≤10 min
Afternoon (PM)	5	15:00 – 18:10	hours ±30 min	≤10 min

Stanford AV-based Validation

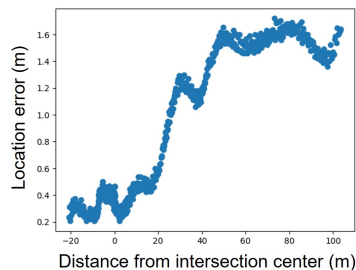
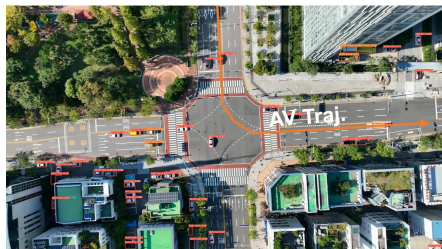
6

Robert Fonod

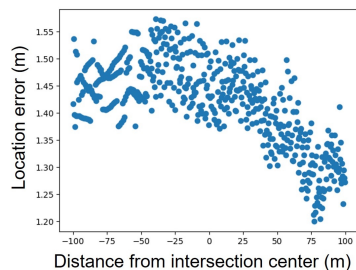
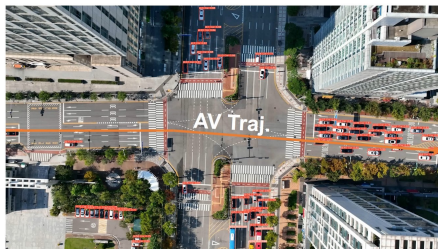
High-Precision Georeferenced Trajectory Extraction Using Advanced Computer Vision From a Multi-Drone Experiment



Intersection P



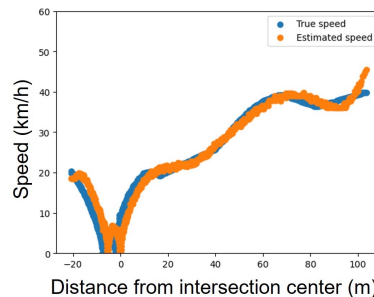
Intersection L



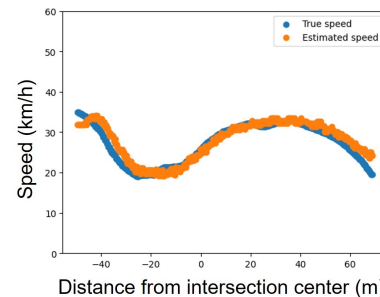
Location and Speed Error of the Estimated AV Trajectories

Error type	Mean error per intersection		Error std. dev. per intersection	
	P	L	P	L
Location error (m)	0.687	1.421	0.489	0.079
Speed error (km/h)	3.276	0.676	2.632	0.604

Intersection P



Intersection L



Traffic State Estimation

High-Precision Georeferenced Trajectory Extraction Using Advanced Computer Vision From a Multi-Drone Experiment

