

All-In-One Drive (AIODrive) Trajectory Forecasting Challenge

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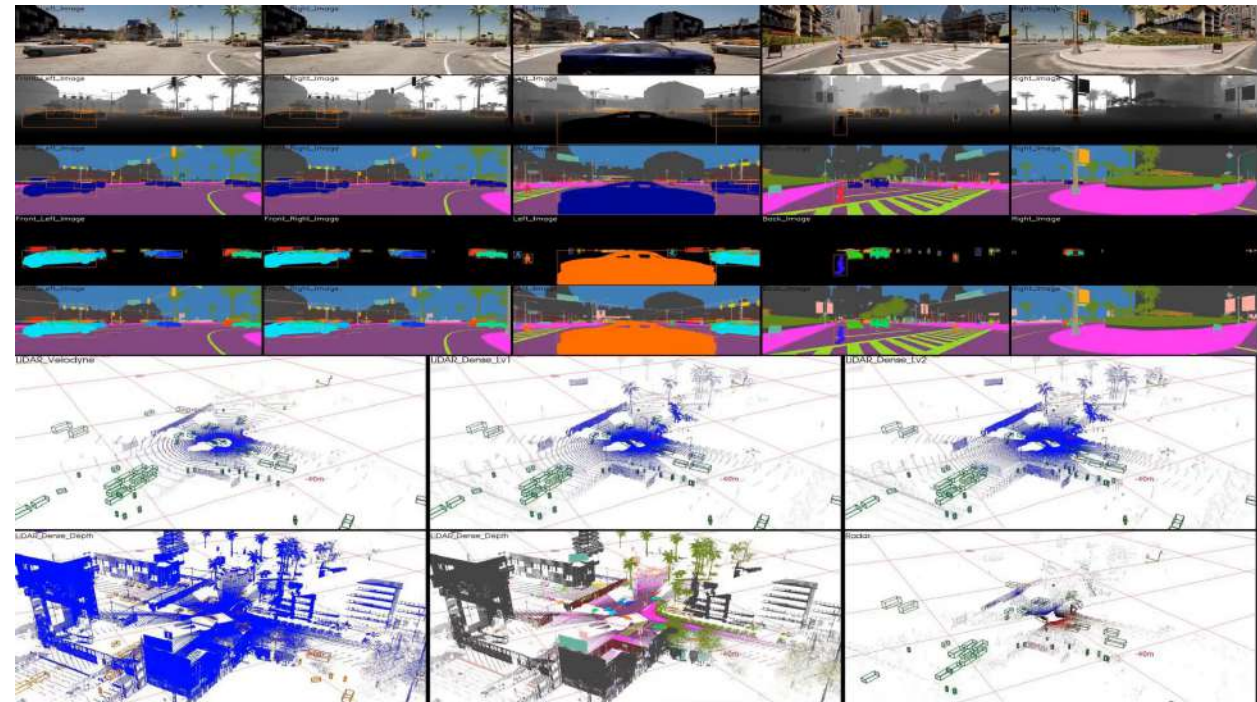
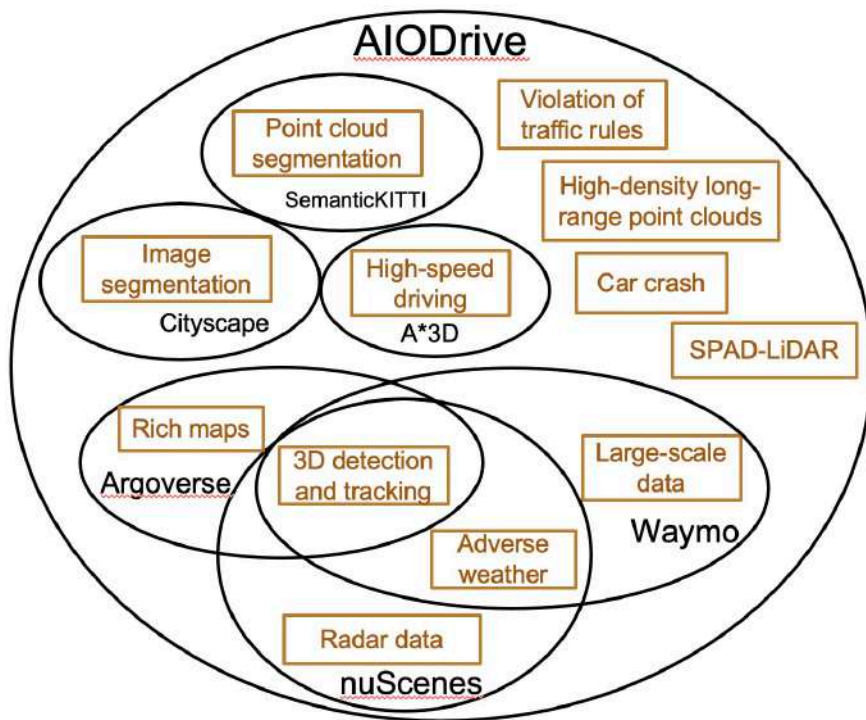
Robotics Institute, Carnegie Mellon University

Presented at the 3rd Precognition Workshop, CVPR 2021

June 19, 2021

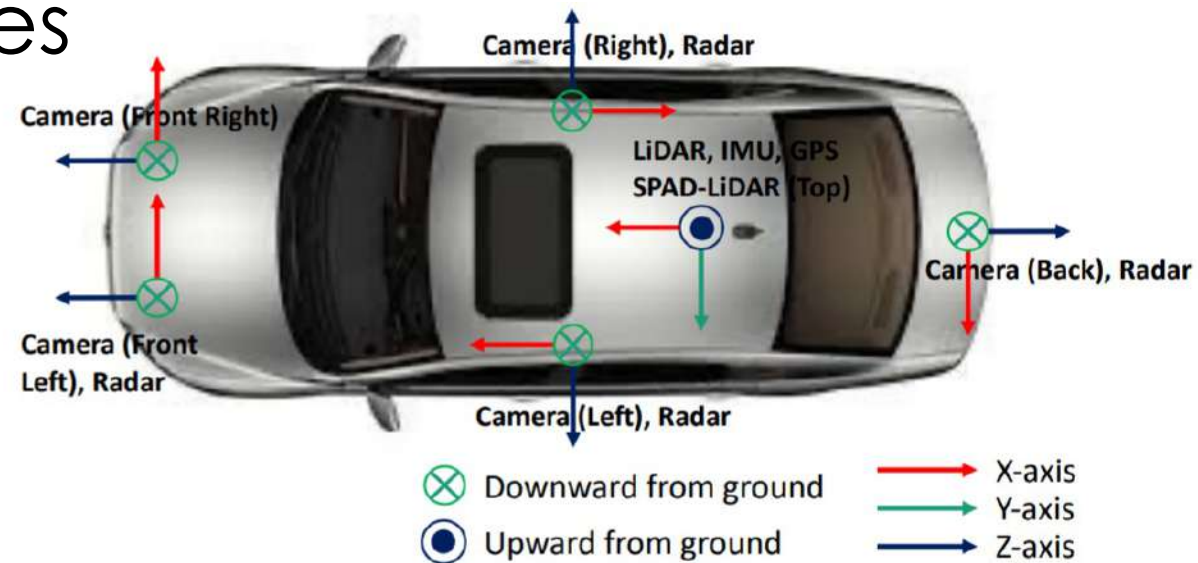
All-Inclusive Perception Dataset: AIODrive

- Complete annotations for all mainstream perception tasks
- Comprehensive sensor modalities (SPAD, high-density long-range LiDAR)
- Diverse environmental variations (out of distribution data)
- Built with Carla, state-of-the-art high-fidelity simulator



Comprehensive Sensor Modalities

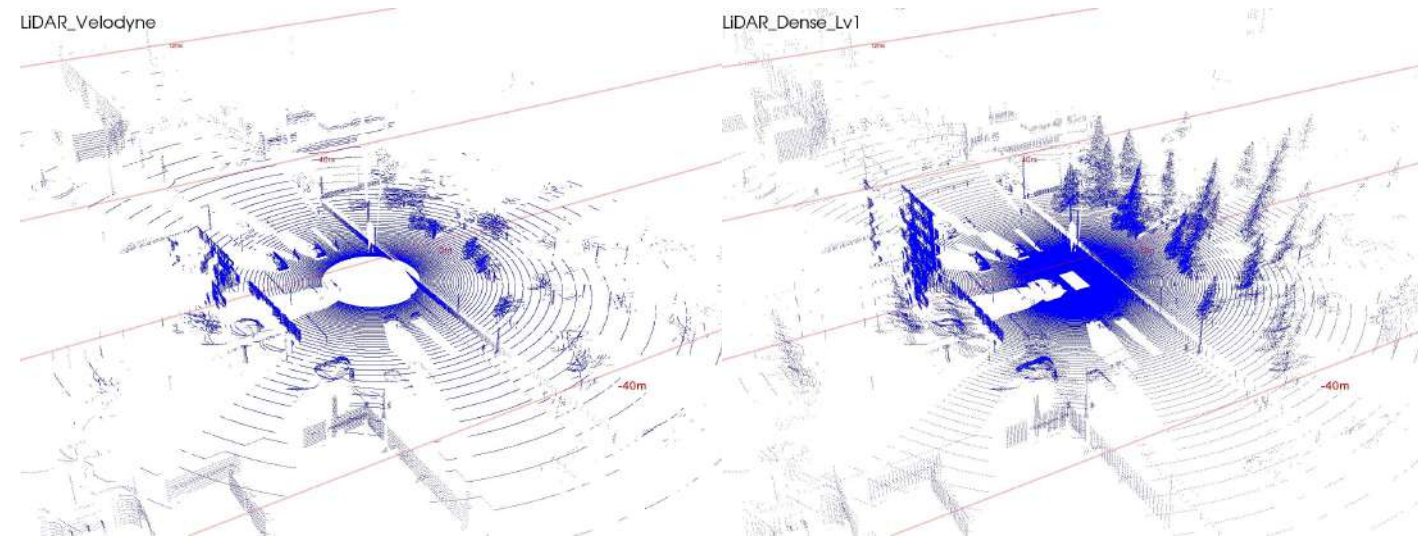
- The most comprehensive sensor suite
 - 5x RGB/depth camera (LRFB + stereo)
 - 4x Radar (LRFB)
 - 3x LiDAR (different resolutions)
 - 1x SPAD-LiDAR
 - 1x IMU/GPS



Dataset	# cities	# hours	# sequences	# annotated images	Stereo	Depth	LiDAR	Radar	SPAD-LiDAR	IMU/GPS	All 360°
KITTI [12]	1	1.5	22	15k	✓	✓	✓			✓	
Cityscape [9]	27	2.5	0	5k	✓					✓	
Mapillary Vistas [35]	30	-	-	25k							
ApolloScape [17, 55]	4	-	-	140k	✓		✓			✓	
SYNTIA [44]	1	2.2	4	200k		✓					✓
H3D [38]	4	0.8	160	27k			✓			✓	
SemanticKITTI [1]	1	1.2	22	43k			✓			✓	
DrivingStereo [52]	-	5	42	180k	✓	✓	✓			✓	
Argoverse [8]	2	0.6	113	22k	✓		✓			✓	✓
EuroCity [4]	31	0.4	-	47k						✓	
CADC [41]	1	0.6	75	7k			✓			✓	
Audi [13]	3	0.3	3	12k	✓	✓	✓			✓	✓
nuScenes [7]	2	5.5	1k	40k			✓	✓			✓
A*3D [40]	1	55	-	39k	✓		✓				
Waymo Open [53]	3	6.4	1150	230k			✓				
Ours (AIODrive)	8	2.8	100	100k	✓	✓	✓	✓	✓	✓	✓

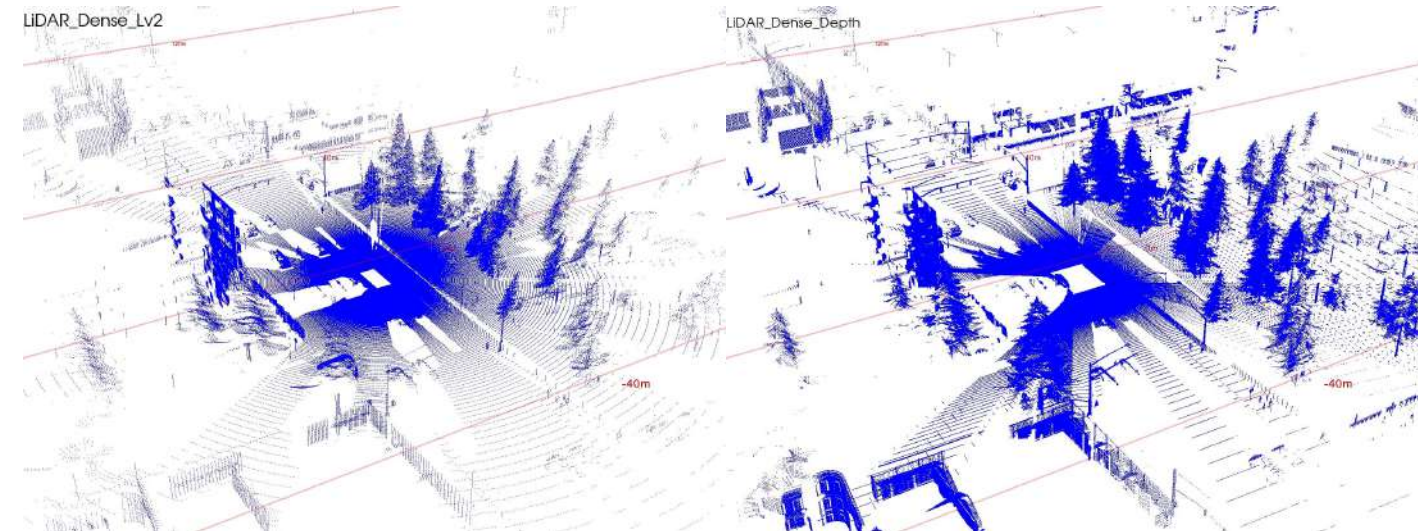
Various Density of Point Clouds

- 3x LiDAR point clouds
 - 100k points (velodyne-64) per frame
 - 600k points
 - 1M points
- 1x Depth point cloud
 - Aggregated points from 5 depth cameras
 - 4M points per frame
- 1x SPAD-LiDAR point cloud
 - Multi-echo every beam
 - 1M points per frame



100k-points LiDAR

600k-points LiDAR



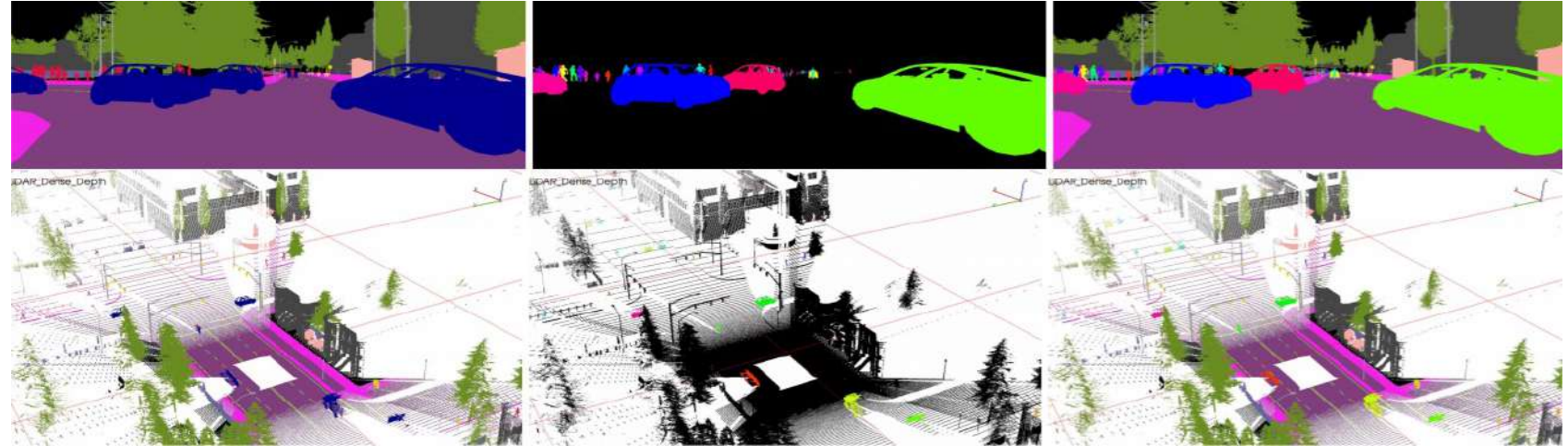
1M-points LiDAR

4M-points depth
point cloud ⁴

Complete Annotations for Perception

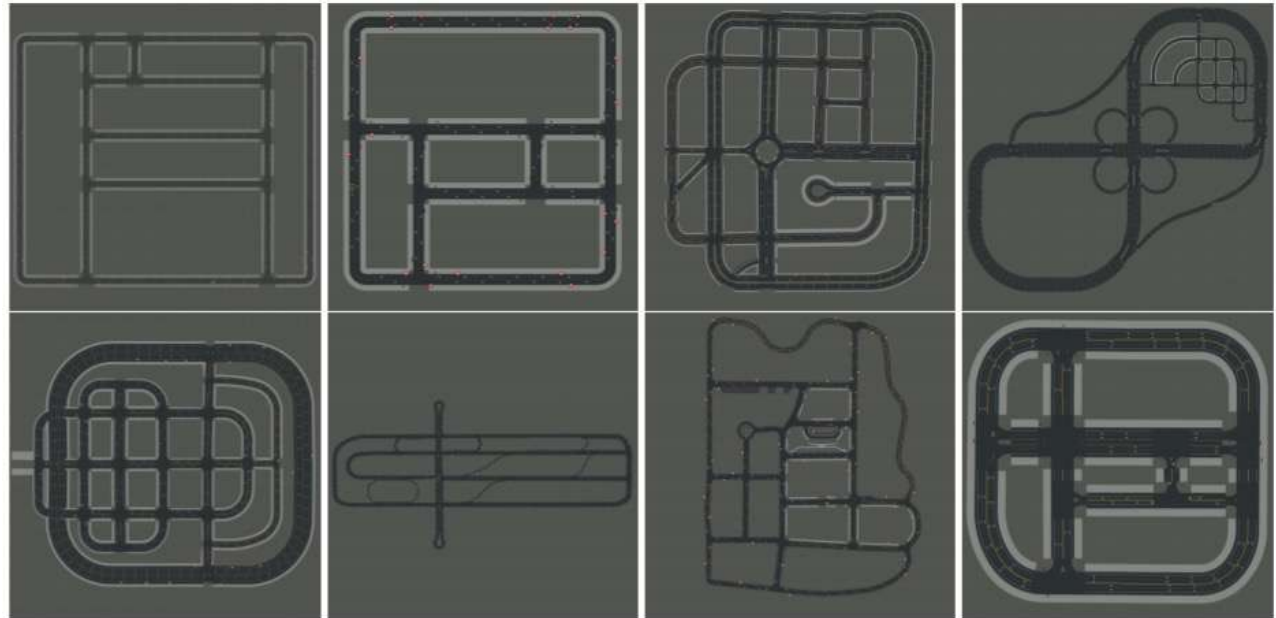
- Support both **scene-level** and object-level annotations

Video semantic / instance /
panoptic segmentation



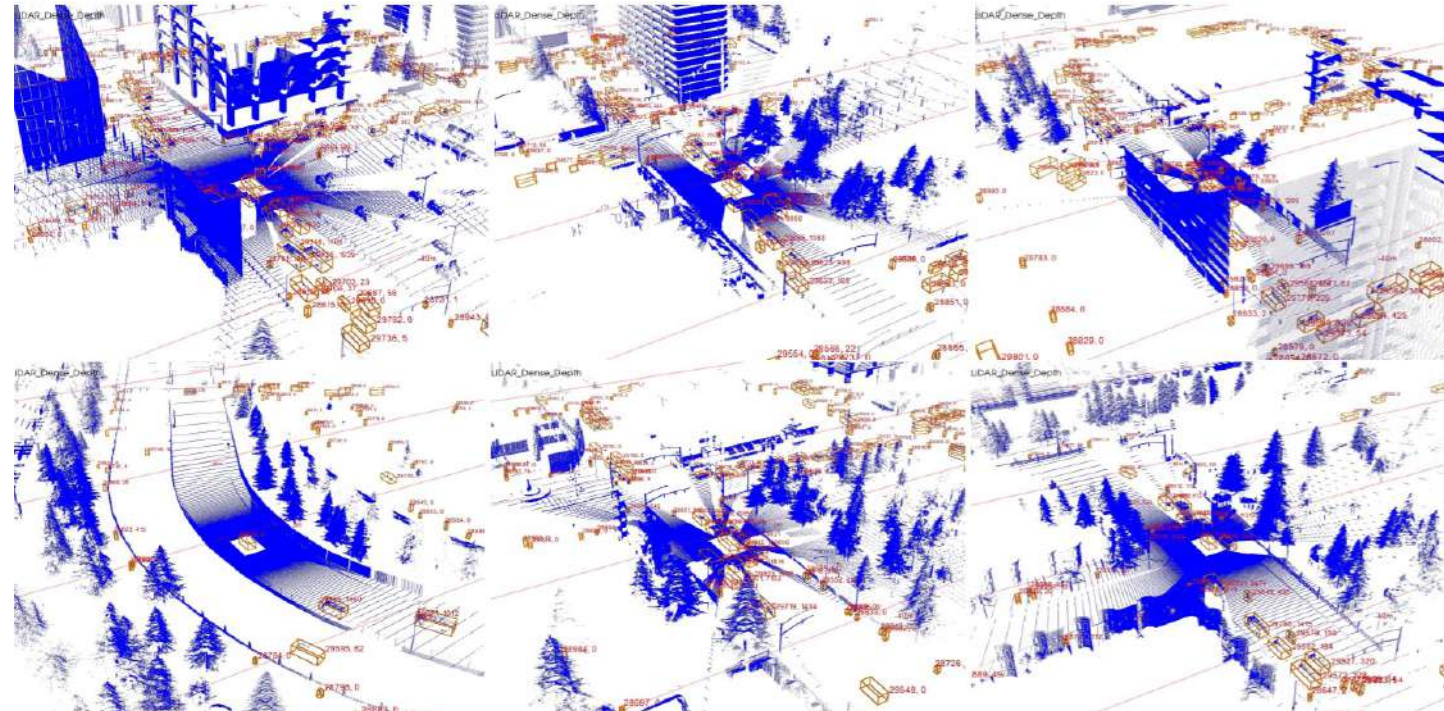
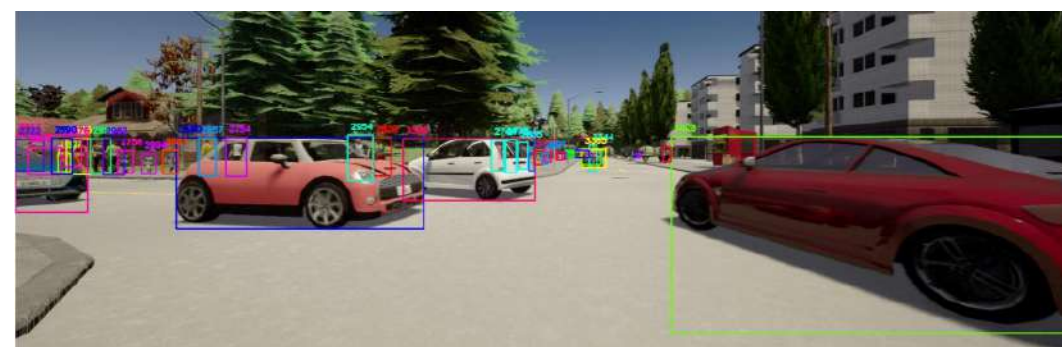
Point cloud semantic /
instance / panoptic
segmentation

Map (lane, traffic signal)



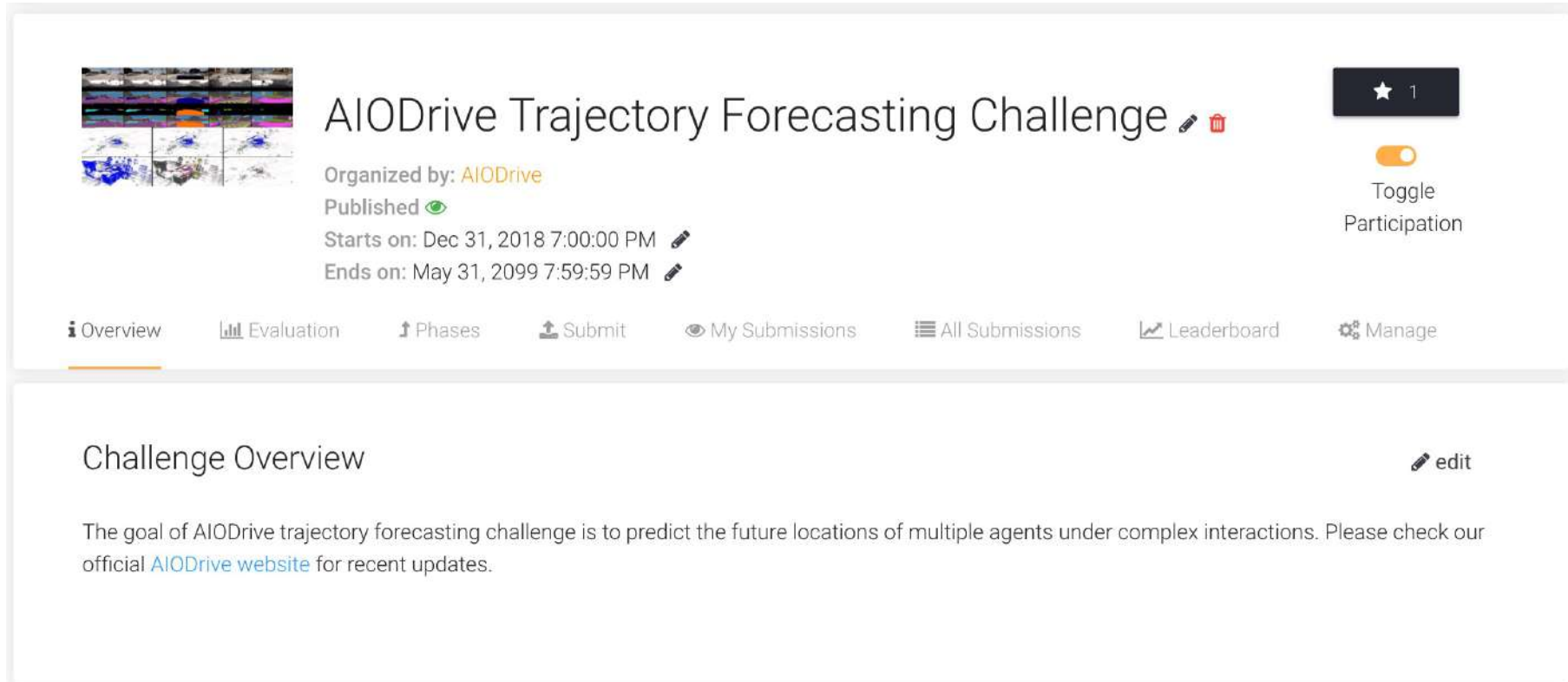
Complete Annotations for Perception

- Support both scene-level and **object-level** annotations
 - 2D/3D object bounding boxes
 - 2D/3D object identities, i.e., trajectories
 - Object classes and vehicle models
 - Object motion log including velocity and acceleration
 - Object control signal including brake, steer, throttle, reverse, etc





AIODrive Trajectory Forecasting Challenge


- Hosted on EvalAI: <https://eval.ai/web/challenges/challenge-page/1052>
- Evaluation and starter code on GitHub: <https://github.com/xinshuoweng/AIODrive>
- Train / validation / test data hosted on Dropbox, with test GT preserved
- Detailed instructions: <http://www.aiodrive.org/forecasting.html>





The screenshot shows the challenge page for 'AIODrive Trajectory Forecasting Challenge' on EvalAI. The page features a header with the challenge title, organized by 'AIODrive', and a 'Toggle Participation' switch. Below the header is a navigation bar with tabs for Overview, Evaluation, Phases, Submit, My Submissions, All Submissions, Leaderboard, and Manage. The main content area is titled 'Challenge Overview' and contains a paragraph describing the goal of the challenge: 'The goal of AIODrive trajectory forecasting challenge is to predict the future locations of multiple agents under complex interactions. Please check our official AIODrive website for recent updates.'

AIODrive Trajectory Forecasting Challenge  

Organized by: [AIODrive](#)

Published 

Starts on: Dec 31, 2018 7:00:00 PM 

Ends on: May 31, 2099 7:59:59 PM 

1

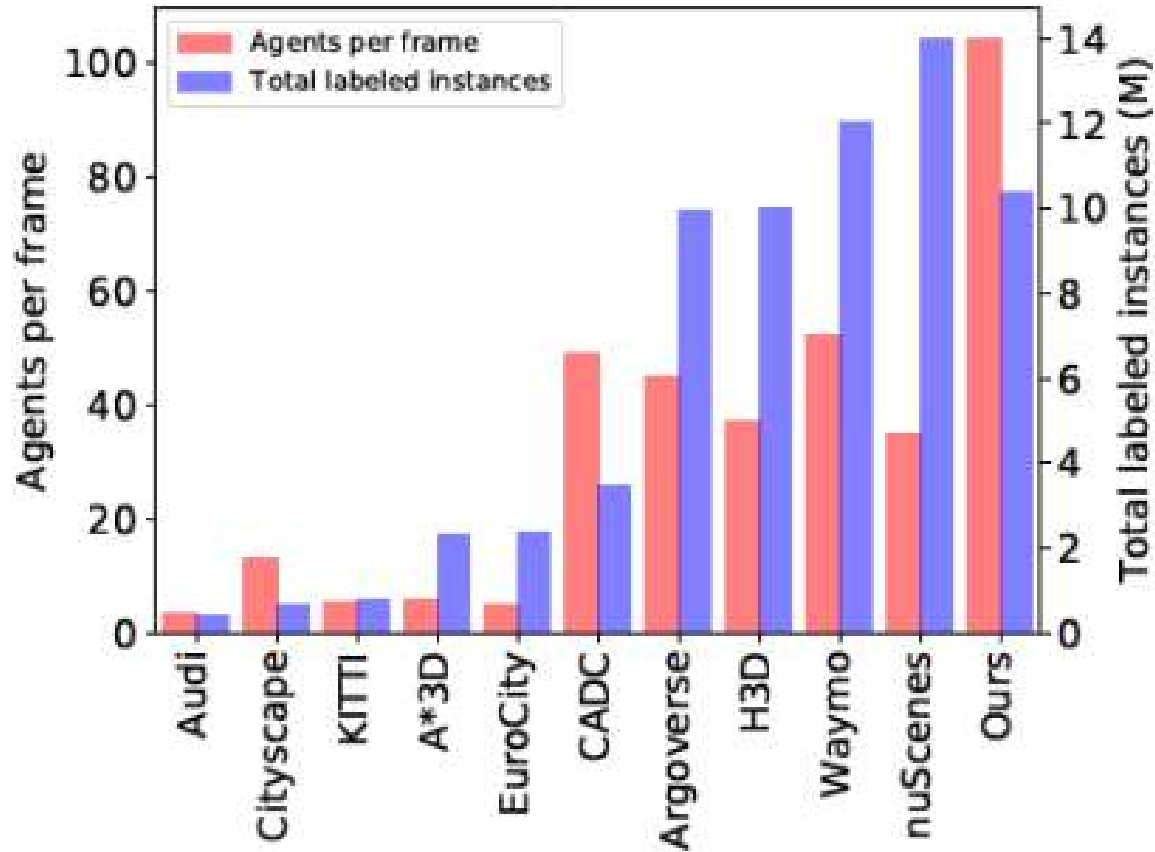
Toggle Participation

[Overview](#) [Evaluation](#) [Phases](#) [Submit](#) [My Submissions](#) [All Submissions](#) [Leaderboard](#) [Manage](#)

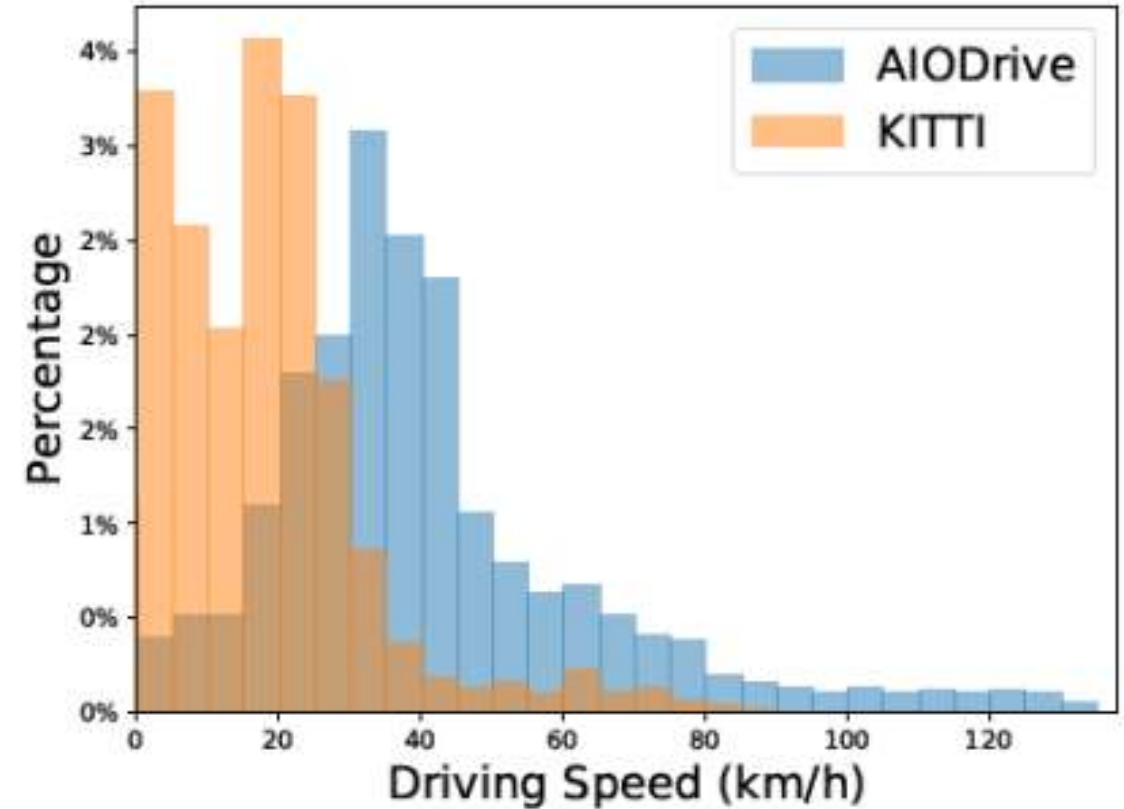
Challenge Overview

The goal of AIODrive trajectory forecasting challenge is to predict the future locations of multiple agents under complex interactions. Please check our official [AIODrive website](#) for recent updates.

Challenge: Dense Agents and Wide Speed Distribution



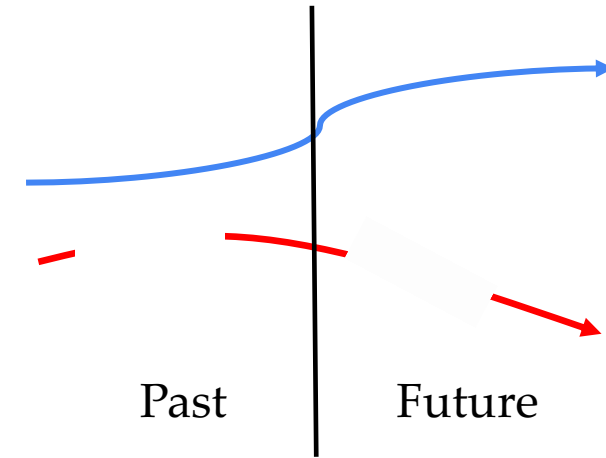
Dense agents lead to more complex agent-agent interactions



Larger variation of speed -> more difficult to be predicted

Challenge: Prediction with Incomplete Trajectories

- Standard practice
 - Only **keep** complete trajectories for evaluation
 - **Throw away** incomplete yet important trajectories
 - Due to occlusion
 - Newly appeared objects
 - Fragments from real-world tracking results
- Our evaluation
 - Keep a trajectory if there is ≥ 1 frame of past and ≥ 1 frame of future data
 - Add masking for invalid future frames during ADE evaluation
 - Select the valid last frame of future data during FDE evaluation



Important Dates

- Dataset release: April 6
- Evaluation setup: May 25
- Challenge announced: June 3
- ~~• Challenge closing: June 17 (planned)~~
- Challenge closing: July 16 (one more month)
- Winner announcement: July 23

Winner and Award

- Winner will be selected based on the main metric: ADE₂₀ (20 samples, 2 seconds)
- No CVPR workshop presentation, but will be promoted on our website and social media
- Invited as our baseline for the next round of challenge
- Award: iPad

Baseline & Findings on the AIODrive Challenge

- Big thanks to the collaboration with Jiachen Li (Ph.D. candidate at UC Berkeley)
 - Homepage: <https://jiachenli94.github.io/>
 - Research Interests
 - Relational reasoning
 - Graph neural network
 - Multi-agent systems
 - Trajectory forecasting
 - Interactive decision making
- Spatio-Temporal Graph Dual-Attention Network for Multi-Agent Prediction and Tracking. arXiv 2021.

