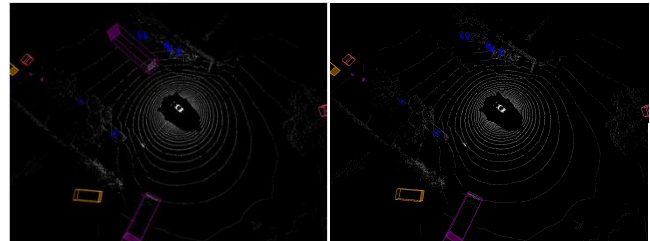
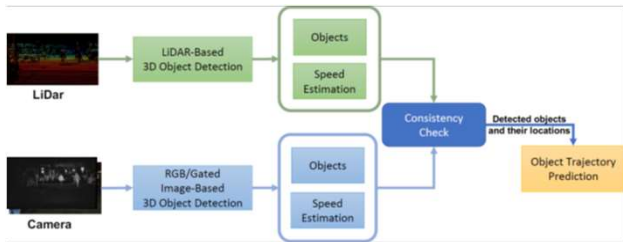


Robust Efficient Perception System for Autonomous Vehicles (REPAVE)

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<http://www.cse.Lehigh.edu/~chuah/repave.html>



This project aims to build a robust and efficient perception system for autonomous vehicles (AVs) under dynamic environments and attacks.

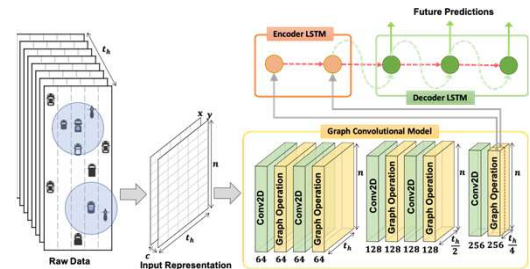
- Various sensors behave differently under adverse weather conditions;
- Predict behaviors of different traffic agents for safe operations of AVs;
- Ensure resilience of AV sensors against adversarial attacks.

Applicability to other CPS systems

- Robust autonomous agents in warehouses
- Robust mobile robots used in surveillance
- Robust robots deployed in hospitals and homes.

Potential Technical Contributions

- Robust, efficient multisensor-based perception system
- Efficient context-aware trajectory prediction scheme
- Robust sensors that are more resilient against adversarial attacks.



Graph-Based Interaction Aware Trajectory Scheme

- 30% improvement over state of the art methods
- Runs 5x faster
- ITSC 2019 paper; journal paper under preparation

TABLE I: Root Mean Square Error (RMSE) for trajectory prediction on NGSIM I-80 and I-101 datasets. Data are converted into the meter unit. All results except ours are extracted from [11]. The smaller the value, the better.

Prediction Horizon (s)	CV	V-LSTM	C-VGMM + VIM [10]	GAIL-GRU [15]	CS-LSTM(M) [11]	CS-LSTM [11]	GRIP (Δ CS-LSTM)	GRIP (ALL)
1	0.73	0.68	0.66	0.69	0.62	0.61	0.37 (40% \uparrow -0.24)	0.64
2	1.78	1.65	1.56	1.51	1.29	1.27	0.96 (32% \uparrow -0.41)	1.13
3	3.13	2.91	2.75	2.55	2.13	2.09	1.45 (31% \uparrow -0.64)	1.80
4	4.78	4.46	4.24	3.65	3.20	3.10	2.21 (29% \uparrow -0.89)	2.62
5	6.68	6.27	5.99	4.71	4.52	4.37	3.16 (28% \uparrow -1.21)	3.60

Broader Impact (Society)

- Advance the algorithmic development of computer vision;
- Safer operations of autonomous vehicles under adverse conditions;
- Potential technology transfer to AV related industries

Broader Impact (Education)

- Train future CPS scientists & engineers
- Increase number of minority students in CS programs at Lehigh via REU-site projects and revived Robotic Club activities
- Provide outreach activities that benefit minority students by organizing tutorials or summer training workshops.

Broader Impact

- Sensor data models for stress testing perception system under adverse weather conditions
- Framework for evaluating robustness of DL-based perception systems for AVs
- Open-source low cost AV testbed