Augmented Vehicular Reality: Extended Vision for Future Vehicles

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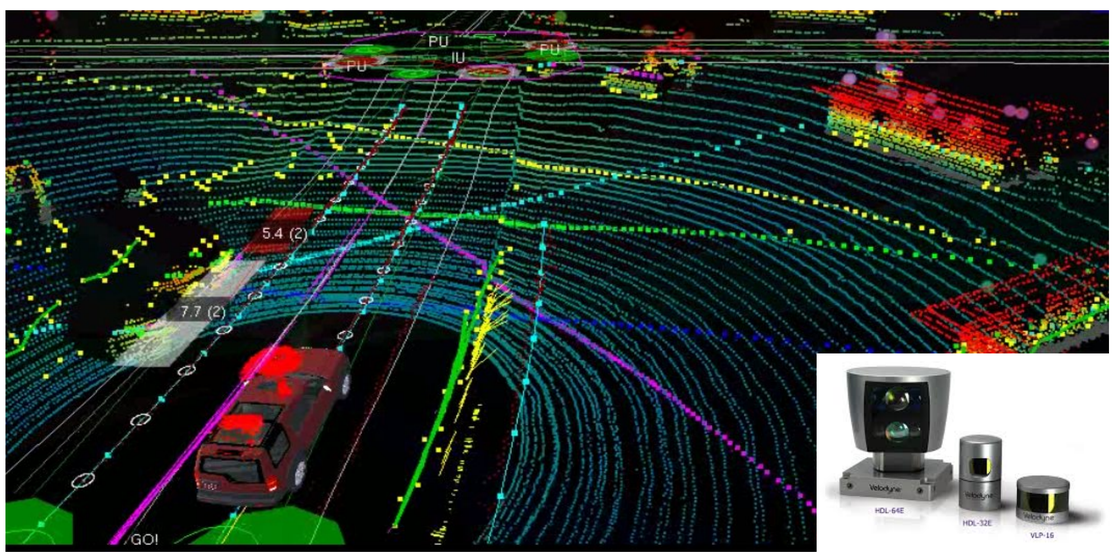
Abstract

Problem:

- rich array of sensors in autonomous vehicles e.g., LiDAR, radar and 3D cameras etc.
- fundamental issue: line-of-sight, occlusion, extreme weather and lightning conditions

Solution: Augmented Vehicular Reality

- leverage wireless communication capabilities to broaden vehicle's horizon
- share visual information with nearby vehicles
- careful alignment of coordinate reference frames and dynamic object detection



Approach

Vehicle Relative Positioning:

- construct and share Crowdsourced HD map

Extended Vision:

- share 3D points cloud using wireless communication
- perspective transformation to get extended vision

Challenges

Construction of Crowdsourced HD Map:

- building a crowdsourced HD map of a region with map segments from different vehicles

Perspective Transformation:

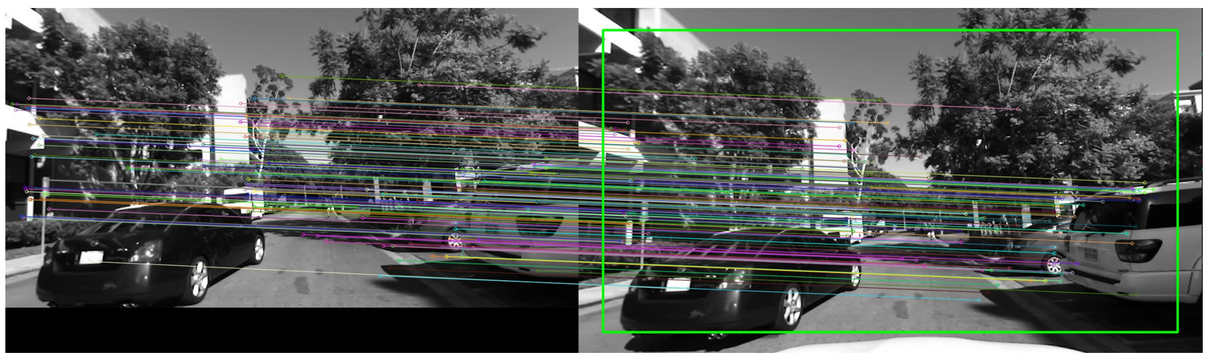
- positioning visual information in other vehicle's coordinate reference system

Wireless Bandwidth Requirements:

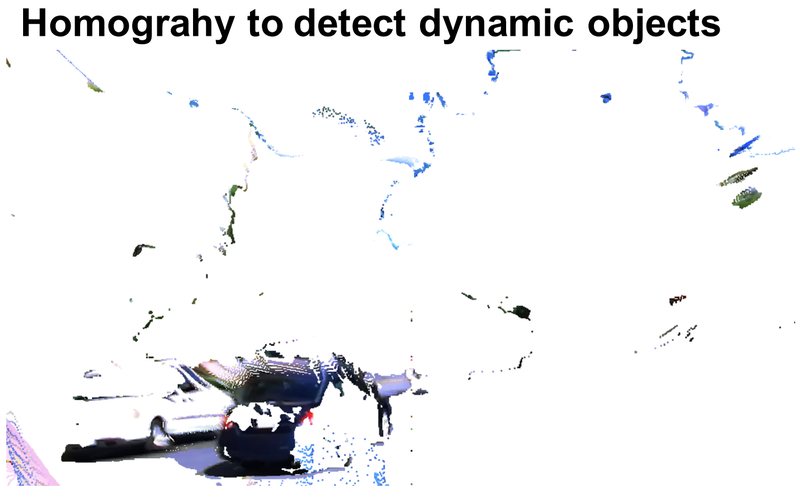
- transferring large amount of data with limited wireless bandwidth

Dynamic Object Isolation:

- distinguishing between dynamic and static objects in the scene



Homograhy to detect dynamic objects



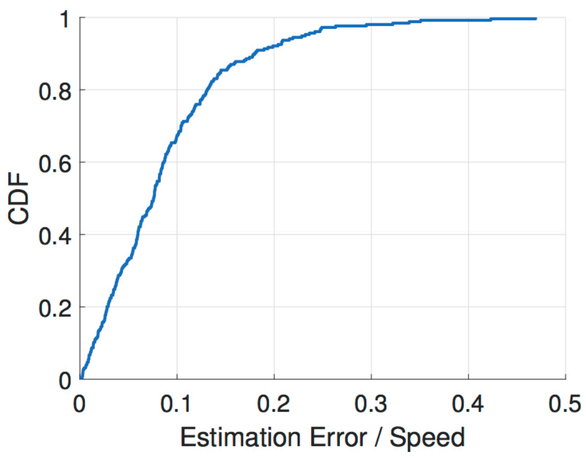
Dynamic objects extracted from the scene

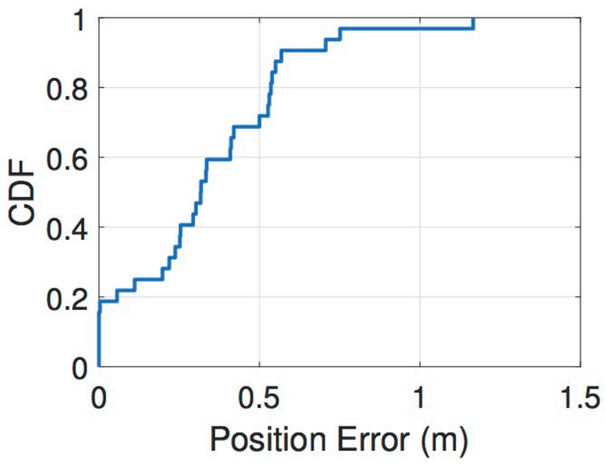
Results

Leader Vehicle

Follower Vehicle

Extended Vision (Follower Vehicle)





Crowdsourced HD Map

- all vehicles contribute to global ***sparse*** HD map
- cloud service stitches map segments from different vehicles
- GPS filter, pose estimation and place recognition
- cloud service shares map segments with vehicles to aid in relative localization