CENTER FOR TRANSPORTATION RESEARCH

PROJECT SUMMARY

Texas Department of Transportation

0-6877 (Phase 2): Communications and Radar-Supported Transportation Operations and Planning (CAR-STOP)

Background

A recent report from the National Highway Traffic Safety Administration indicates that more than 80% of all annual car crashes could be prevented by vehicular communications. To that end, the focus of this project was to develop a framework (conceptualizations, processes, procedures, and algorithms) to harness and mature sensing and communication technology to improve transportation safety, primarily focused on the development of an advanced driver assistance system (ADAS).

What the Researchers Did

- Implemented and tested frameworks for an ADAS that incorporates information derived from both sensing and communication platforms.
- Developed and tested new radar and DSRC-based (dedicated short-range communication) communication paradigms for automotive applications using next-generation millimeter wave communication.

What They Found

- Development of ADAS

  —For the urban intersection scenarios, the results suggest that both DSRC and radar performance deteriorate when vehicles approach each other in intersections with acute horizontal angles. The built environment in such approaches may also block communication signals.

  —Analysis of a collision warning (CW) system for overtaking maneuvers indicate that vehicle-to-vehicle (V2V) communication is significantly more reliable than on-vehicle sensors, except possibly specialized sensors installed on the left side of the vehicle.

  —Analysis of several methods of pedestrian detection show that fusing information from camera and radar or lidar provides a reliable solution.

- Millimeter wave communication systems

  —The research team showed that it is possible to combine both functions of communication and radar through a single waveform. The joint systems can achieve 0.1m range and 0.1m/s velocity estimation accuracies for radar in addition to achieving gigabits-per-second data rates for communication

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Project Completed (Phase 2):
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—This project established the main motivations for sharing raw sensor data among vehicles and infrastructure at gigabits per second: that transmission rate will further automated driving technologies, including advanced CW and more efficient coordination.

—The researchers developed a joint radar and communication hardware prototype operating at the communication frequency already used by DSRC to demonstrate the feasibility of combining these two technologies.

—Based on the proven feasibility of combining communication and radar for onboard use in vehicles, more effort is needed to quantify benefits at lower levels of automation, including collision avoidance (CA), and to study the potential of moving the sensing from the vehicle to the infrastructure.

- We have successfully shown, through applications in simple traffic scenarios, how V2V communications and sensors such as radar, lidar, and cameras can substantially reduce crashes. However, the algorithms and processes still need to be fine-tuned and tested in a larger suite of scenarios.

What This Means

- Our results further reinforce the notion that substantial traffic safety improvement is attainable though the use of automotive communication technologies, but also suggest this goal is likely achievable only through use of combination systems (e.g., of radar/camera sensing and V2V communications). Our new frameworks for integrated CW/CA systems incorporating information from both sensors and communication will help prevent collisions. Overall, CW/CA methods will be increasingly valuable as vehicles are further automated.

- Accidents involving non-motorized traffic participants (pedestrians and bicyclists) can be prevented by sharing raw sensor data (e.g., camera live images) among vehicles. Millimeter wave (mmWave) vehicular communication with high data rates will enable raw sensor data sharing. The mmWave communication systems developed will seamlessly combine mmWave, sensor, and DSRC benefits to create a platform for sharing a multitude of sensor data.

For More Information

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