

Breakout Session 3: FHWA Road Weather Management Program: Investigating Automation Technologies and Adverse Weather

Organizers, Reporters, and Speakers

Paul Pisano, Road Weather and Work Zone Management Leader, Federal Highway Administration

David Neumeister, Senior Research Scientist, Battelle

Doug Pape, Senior Research Scientist, Battelle

Session Focus

This objective of this session was to provide FHWA's Road Weather research activities and, through discussion, obtain inputs to consider for its research program to better understand the safety and mobility impacts of weather on roadways and support automated vehicles through the promotion of strategies and provision of tools to mitigate impacts.

Session Summary

Part 1: How Automated Vehicles fit in FHWA Road Weather Research

Paul Pisano discussed FHWA's Road Weather research agenda and presented objectives, background, and activities undertaken for the AVAW project. It was emphasized that the Road Weather Management Program seeks to better understand the safety and mobility impacts of weather on roadways, and promote strategies and tools to mitigate those impacts. In conclusion, Pisano summarized at a high level what has been learned on the project thus far and petitioned attendees for input, and specifically encouraged perspectives on AV operations in adverse weather including concerns, information needs, and research ideas. This stakeholder input helps to enable FHWA to realize its role in managing road weather needs, which is expanding as automated vehicles appear.

Part 2: Controlled Experiments of Automated Vehicles in Adverse Weather

Doug Pape discussed findings from the AVAW Technology Scan, which included a brief summary of the technologies used by currently available AVs, how weather is recognized as a limitation of these technologies, and human factors and operational challenges posed when operating AVs in adverse weather.

Pape then provided an overview of the laboratory testing of three production AVs in simulated and real adverse weather for the AVAW project, including the maneuvers performed and weather conditions created. David Neumeister described a series of videos and photos depicting the AVAW laboratory tests. He then summarized test results by maneuver, and relayed observations about the differences found between AV HMIs observed during testing of AVs in adverse weather.

Part 3: Open Discussion on Research Needs

To navigate in adverse weather, vehicles need independent, complementary sensors. This includes conventional video, radar, LiDAR, and possibly thermal imaging (10-12 μ) and ultrasonic sensors. Multiple, external sources (e.g., via V2V and V2I) allow the AV to “see” conditions farther ahead, extend decision horizon (e.g., spatial temporal high-accuracy geo-referenced details). Digital infrastructure (maps) are useful, but questions remain. Who will own and maintain the maps? How is the information delivered to the vehicle?

The environment (including atmospheric conditions and road surface conditions) is a component of the operational design domain (ODD) of a driver assistance system. Whether current conditions are within the ODD of a system can be determined by the human driver at lower levels of automation, or by the vehicle at higher levels. However, for trip planning, especially at higher levels of automation, the vehicle would need to be given information on predicted weather on the planned route. What information and how it is delivered are open questions.

Suggested Action Items

The action items center on transmitting current and forecasted weather information to a vehicle and possibly its driver. The information needs to be of sufficient quality, localization, completeness, and timeliness that it can be used to decide whether to continue or even to begin a trip under automation.

- Need to be able to define the weather component of the ODD. The definition might include these components:
 - Visibility distance (by human eyes, machine vision, and any other sensors on the vehicle)
 - Friction
 - Local conditions (e.g. whether water is standing on the road or a tree has fallen across the road or a rolling work zone is repairing damage)
 - Wind
- Need to determine how weather and road weather data will be collected, quality checked, assimilated, and disseminated. Need to establish who has the responsibility for doing so (National Weather Service, state or local transportation agency, private service, or a combination).
- Need to develop a means to deliver this information to the vehicle and human driver.
 - A standard format would include the necessary information. Standards can build on existing and nascent road weather standards.
 - Communication can plausibly be through V2I, if standards are in place.