FTA

FEDERAL TRANSIT ADMINISTRATION

REPORT SUMMARY

U.S. Department of Transportation
Federal Transit Administration

Vehicle Assist and Automation (VAA) Demonstration Evaluation Report

Background

In 2008, the California Department of Transportation (Caltrans) was awarded $1.9 million by the Federal Transit Administration (FTA) and the Intelligent Transportation Systems Joint Program Office (ITS JPO) for a pilot program to demonstrate the benefits of vehicle assist and automation applications for full-size public transit buses; Caltrans provided a $1.5 million match. Caltrans' partners included Alameda-Contra Costa County Transit District (AC Transit) in California, Lane Transit District (LTD) in Oregon, California Partners for Advanced Transportation Technology (PATH) at the University of California–Berkeley, and three private sector companies.

Objective

The objective of the project was to test lateral guidance/control on a stretch of a high occupancy vehicle (HOV) lane and through a toll booth on AC Transit's M Line, which connects Castro Valley, Hayward, and Union City with San Mateo and Santa Clara counties, crossing the San Mateo-Hayward and Dumbarton bridges, and to test lateral guidance/control and precision docking on a segment of LTD's Emerald Express (EmX) Bus Rapid Transit (BRT), an 11.8-mile BRT system between downtown Eugene and downtown Springfield.

Findings and Conclusions

The unanimous response from all local project partners was that the VAA demonstration was a success and proved that VAA technology can work successfully in bus revenue service.

The VAA was tested on a 60-foot articulated bus and a 1.5-mile segment of the LTD route. The VAA application used two sensing technologies—magnetic markers as the primary technology and differential Global Positioning System (GPS) with inertial navigation sensors as the secondary back-up technology. The VAA system automated the steering function while the bus operator maintained control of acceleration and braking. Ten months' worth of lane position data were collected from the VAA on-board computer system, in addition to data collected from customer surveys, driver surveys and focus groups, accident reports, and maintenance reports. The National Bus Rapid Transit Institute evaluated the VAA system according to six broad areas: bus driver satisfaction, customer satisfaction, efficiency/productivity, technical performance, maintenance, and safety. Among the findings were that the VAA system kept the bus better centered in the busway while it was in motion, and it consistently docked the bus closer to the station platform. Lateral acceleration, the g-force that throws vehicle passengers sideways in a turn, was consistently higher on several of the lane segments when the steering was under automated control. Bus operators in general

drove slightly slower when using the VAA, with speed differences varying from segment to segment, suggesting that they are more cautious with their speed when yielding control of the steering to the VAA. Regarding safety-related incidents within the 1.5-mile test segment, there was only one occurrence of a bus striking the station platform (a non-VAA bus). Note: Numerous contractual issues and delays resulted in AC Transit dropping out of the project.

Regarding technical lessons learned, it was concluded that safety design in VAA systems is a complex and iterative process in which the following elements are all very critical: hardware and software redundancy, fault detection and warning, degraded-mode controls, and fault test procedures. In addition, it was discovered that GPS was not precise enough to be used as a control technology for precision docking. Therefore, the project only included magnetic maker sensing as the primary controller, and GPS was used as a backup source of measurement and location referencing.

Benefits

The unanimous response from all local project partners was that the VAA demonstration was a success and proved that VAA technology can work successfully in bus revenue service. The precision docking was recognized as the most successful element of the demonstration. Bus operators regarded it as a valuable tool for safe and effective docking and believed it contributes personally to lower stress when docking.

Project Information

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This research project was conducted by Rob Gregg and Brian Pessaro of the National Bus Rapid Transit Institute at the University of South Florida's Center for Urban Transportation Research. For more information, contact FTA Project Manager Steve Mortensen at (202) 493-0459, steven.mortensen@dot.gov. All research reports can be found at **www.fta.dot.gov/research**.