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TECHNICAL SUMMARY

Opportunities for Advanced Vehicle Control Systems in Commercial Vehicle Operations and Public Transportation Systems

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Intelligent TransportationSystems

This technical summary announces the completion of a Federal Highway Administration (FHWA) Intelligent Transportation Systems (ITS) study that is documented in a separate report (publication no. FHWA-RD-96-139). Many of the enabling technologies for automatic or assisted control of ground vehicles are mature enough for deployment, but may not be released for many years due to other concerns. This study investigates early deployment opportunities for advanced vehicle control systems (AVCS) for lateral and longitudinal vehicle control. Transit bus and commercial vehicle operations are explored individually as testbeds for these new control technologies. See report-ordering information at the end of this summary.

Introduction

There are many ITS initiatives currently underway to improve the mobility, efficiency, and safety of ground transportation. Of particular interest in this study are applications of AVCS for transit bus and commercial vehicle operations. While the improvement of these operations through new technology is being addressed by the Advanced Public Transportation Systems (APTS) and Commercial Vehicle Operations (CVO) functional areas of ITS, specific vehicle control approaches have largely gone ignored. Despite the profound impact that AVCS promises for increased mobility, many in the transportation community regard vehicle control as high-risk technology, either doubting its technical capabilities and cost-effectiveness or fearing legal and institutional repercussions of deployment. As a consequence, AVCS developers are moving cautiously, with their investments directed toward more distant, rather than near-term, deployments. This trend may be seen most notably in the automotive industry where a great deal of vehicle control research has been performed, but very little has been applied to production. Similarly, FHWA, in cooperation with various public and private sector partners, is developing a specification for technically sophisticated automated highway systems (AI-IS) that will not begin to be deployed for at least 5 years. Rather than wait for assured public acceptance of AVCS and resolution of all system issues, it is proposed here that existing AVCS work be leveraged for focused applications to demonstrate near-term benefits and encourage wider acceptance. This study addresses the excellent opportunities offered in the areas of truck and bus operations.

Freight movement and public transportation are vital functions that depend heavily on the performance of the vehicles and drivers. In many instances, the driving operations performed are highly repetitive and are thus more appropriate for automation or assisted driving than for conventional operations. This is particularly the case for transit and freight facilities reserved for a narrow set of functions, for example, terminals, vehicle maintenance areas, and dedicated roadways. Such facilities offer a further advantage for vehicle control applications because they are designed to streamline specific vehicle operations and the operating environments are typically well structured. A final advantage of exclusive facilities is the fact that the vehicles, infrastructure, and labor force are probably managed by a single entity, thus minimizing institutional issues that frequently plague ITS deployment efforts.

For the study presented here, the contractor analyzed vehicle operations for transit buses and trucks, with a particular emphasis on operations in dedicated facilities. A separate analysis of available AVCS technologies and providers allowed an integration of operational needs with feasible technologies. The report outlines all findings and provides specific recommendations for near-term and long-term AVCS deployment opportunities in freight movement and transit.

Methodology

To arrive at recommendations for the synthesis of AVCS technologies with specific vehicle operations, a three-step approach was used:

1. Examine the history of vehicle control and automation associated with transit and commercial vehicles.

2. Assess the user needs for operational improvements.

3. Assess the available AVCS technologies to achieve improvements.

To get a complete picture of the opportunities and technologies available, transit operators, fleet managers, terminal/port operators, vehicle manufacturers, consultants, and various researchers were contacted. An expert from both the public transportation and commercial vehicle areas provided personal insight and access to management at facilities around the country. From meetings and discussions with this varied group, concepts emerged for incremental deployment opportunities, as did a better understanding of the capabilities and contributions that each could provide toward a system deployment.

Results

The results of the report are a series of recommendations for proceeding towards a deployment phase. Discussions with transit and freight operators and technology providers indicated a genuine interest in the AVCS concepts, but also some concerns regarding technical, economic, and institutional challenges. For deployment to become reality, a development team of diverse organizations must be established and costs clearly defined for an operational field test. The most promising field test possibilities are described below.

For transit bus operations, the most suitable deployment opportunities for AVCS exist on exclusive busways (bus-only roads) or large bus servicing facilities used for daily maintenance operations. Busways would provide a testing ground for a lateral control/lane-keeping system. The system design could range in complexity from purely advisory to fully automatic steering control mode. Such a system would provide immediate utility on the existing busway and would serve as a building block for future systems. Maintenance operations in service garages require dedicated drivers to move vehicles through a routine servicing sequence. By fully automating the movement of buses within such facilities, labor costs could be dramatically reduced.

For commercial vehicle operations, the best near-term deployment opportunities for AVCS exist within freight transfer terminals and ports. These dedicated facilities are designed and operated with efficiency as a primary goal. Typically, the movements of trailers and containers between loading and unloading areas are performed by dedicated drivers; however, automating some or all of the vehicle movements within these facilities would obviate the need for drivers. Two concepts for fully automated vehicles should be explored further:

1. Modified automated tractors for trailer movement within a conventional freight terminal.

2. Custom-built automated guided vehicles (AGV's) for container movement at a seaport.

While the first concept has no existing precedent, the second has already been successfully demonstrated at the Port of Rotterdam.

A wide range of technologies are discussed for bus and truck control. It appears likely that a successful deployment would involve multiple technologies. Among the more promising systems are machine vision, Differential Global Positioning System (DGPS), active and passive magnetic trail following, and inertial navigation. All of these technologies have been successfully demonstrated in various vehicle control applications.

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Distribution-This technical summary is being distributed according to a standard distribution. Direct distribution is being made to the Regions and Divisions.

Availability-The publication will be available in December 1996. Copies will be available from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161. A limited number of copies will be available from the R&T Report Center, HRD-11, FHWA, 9701 Philadelphia Court, Unit Q, Lanham, Maryland 20706, telephone: (301) 577-0818, fax: (301) 577-1421. This report will also be posted on the FHWA Automated Highway System World Wide Web page at http://www.volpe.dot.gov/ahs/.

Key Words-AVCS, automated vehicle, ARTS, CVO, ITS, AHS.

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