TO IMPROVE TRANSPORTATION SYSTEM BY USE MODREN TECHNOLOGY

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Abstract-The Automated Highway System (AHS) concept defines a new relationship between vehicles and the highway infrastructure. AHS refers to a set of designated lanes on a limited access roadway where specially equipped vehicles are operated under completely automatic control. AHS uses vehicle and highway control technologies that shift driving functions from the driver/operator to the vehicle.Throttle, steering, and braking are automatically controlled to provide safer and more convenient travel. AHS also uses communication, sensor and obstacle-detection technologies to recognize and react to external infrastructure conditions. The vehicles and highway cooperate to coordinate vehicle movement, avoid obstacles and improve traffic flow, improving safety and reducing congestion. In sum, the AHS concept combines on-board vehicle intelligence with a range of traffic flow intelligent technologies installed onto existing highway infrastructure and communication technologies that connect vehicles to highway infrastructure.

Keywords- highway control, automatically controlled, traffic flow, traffic flow highway

INTRODUCTION-The idea of automated driving dates back to almost 50 years ago when General Motors (GM) presented a vision of ―driverless‖ vehicles under automated control at the 1939 World fairs in New York. In the 1950's research by industrial organizations conceptualized automated vehicles controlled by mechanical systems and radio controls. After the first appearance of the computers in the 1960's, researchers began to consider the potential use of computers to provide lateral and longitudinal control and traffic management. The fully automated highway concept was initially examined by GM with sponsorship from the US department of Transportation (DOT) in the late1970's. During these times, focus was laid on automated vehicles on a highway as computers were not powerful enough to consider a complete fully automated highway system.

Advances in the computing technologies, micro-electronics and sensors in the 1980's provoked commercial interest in the technologies that might enhance driver capability and perception and both private and public researchers examined partially automated products and services. Among others, the University of California Partners in Advanced Transport and Highways (PATH) has carried out significant research and development in the field of highway automation since the 1980's. As various transportation technologies emerged that could assist driving on one hand and also traffic efficiency on the other, interest in fully automated driving or integrated auto-highway technologies grew once again.

With the passage of the 1991 Intermodal Surface Transport Efficiency Act (ISTEA), efforts were on early prototype development and testing of fully automated vehicles and highways. This act prompted the US DOT to develop the National Automated Highway System Research Programme (NAHSRP), whose goal was to develop specifications for a fully automated highway system concept that would support and stimulate the improvement of vehicle and highway technologies.

In 1994, the US Department of Transportation launched the National Highway System Consortium (NAHSC). The consortium consisted of nine major categories of organization including academia, federal, state, regional and local government besides representatives from vehicle, highway, electronics and communications industries. The consortium believed in expanding the program's expertise and resources, and maintained that the collaborative approach among the stakeholders would be critical in building the common interest that would be required in the early development and deployment of fully automated highway systems. Research continues to this day though it is largely sketchy owing to the withdrawal of the financial support for the National Automated Highway Systems Research Programme (NAHSRP) by the US Department of Transportation in the year 1997.

Many studies conducted by the National Automated Highway Systems Consortium (NAHSC) continue in partial way with a couple of federal programmes like the Intelligent Vehicle Initiative (IVI) with more focus on a nearer-term horizon.

Major AHS Goals

The AHS program is designed to influence how and when vehicle-highway automation will be introduced. AHS deployments will be tailored to meet the needs of public, commercial, transit, and individual travellers in rural and urban communities. The major goals are to:

1. Improve safety by significantly reducing:

- Fatalities.
- Personal injury.
- Pain and suffering.
- Anxiety and stress of driving.

2. Save money and optimize investment by:

- Maximizing efficiency of the existing infrastructure investment.
- Integrating other ITS services and architecture to achieve smooth traffic flow.
- Using available and near-term applied technology to avoid costs of conventional highway build-out.
- Developing affordable equipment, vehicles, infrastructure, operations, maintenance, and user fees.
- Closing the gap on predicted infrastructure needs.
- Using public/private partnerships for shared risk; using the National AHS Consortium as a global focal point to influence foreign deployment efforts.
- Reducing fuel consumption and costs, maintenance, wear-and-tear, labor costs, insurance costs, and property damage.

3. Improve accessibility and mobility by:

- Improving employee on-time performance, resulting in a more effective work force.
- Facilitating "just-in-time" deliveries.
- Improving public transportation service, increasing customer access, and expanding service levels, resulting in increased revenue, reduced costs, and reduced accidents.
- Achieving a smooth traffic flow, reducing delays, travel times, travel time variability, and driver stress.
- Making driving more accessible to less able drivers.

4. Improve environmental efficiencies by:

- Reducing emissions per vehicle-mile travelled.
- Providing a solid base for reliable, lower cost transit.
- Providing an efficient base for electric-powered vehicles and alternative fuel vehicles.

5. Create jobs by:

- Providing a stronger national economy and increasing global competitiveness.
- Increasing jobs in research and development and in early ITS deployment.
- Facilitating technology transfer (e.g., from military to civilian use).
- Creating new U.S. automotive products and new technology-based industry to compete in the international marketplace.

Figure 2.1 – A concept drawing of an Automated Highway System with dedicated

Methodology

As shown in figure 2.1, a driver electing to use such an automated highway might first pass through a validation lane, similar to today's high-occupancy-vehicle (HOV) or carpooling lanes. The system would then determine if the car will function correctly in an automated mode, establish its destination, and deduct any tolls from the driver's credit account. Improperly operating vehicles would be diverted to manual lanes.

The driver would then steer into a merging area, and the car would be guided through a gate onto an automated lane. An automatic control system would coordinate the movement of newly entering and existing traffic. Once travelling in automated mode, the driver could relax until the turnoff. The reverse process would take the vehicle off the highway. At this point, the system would need to check whether the driver could retake control, then take appropriate action if the driver were asleep, sick, or even dead.

The alternative to this kind of dedicated lane system is a mixed traffic system, in which automated and non-automated vehicles would share the roadway. This approach requires more-extensive modifications to the highway infrastructure, but would provide the biggest payoff in terms of capacity increase.

In fact, a spectrum of approaches can be envisioned for highway automation systems in which the degree of each vehicle's autonomy varies. On one end of the range would be fully independent or "free-agent" vehicles with their own proximity sensors that would enable vehicles to stop safely even if the vehicle ahead were to apply the brakes suddenly. In the middle would be vehicles that could adapt to various levels of cooperation with other vehicles (platooning). At the other end would be systems that rely to a lesser or greater degree on the highway infrastructure for automated support. In general, however, most of the technology would be installed in the car.

The Five Concept Families

Independent Vehicle Concept:•

his concept puts a smart vehicle in the existing infrastructure. In-vehicle technology lets the vehicle operate automatically with on-board sensors and computers. The vehicle can use data from roadside systems but does not depend on infrastructure support.

Cooperative Concept:•

his concept lets smart vehicles communicate with each other, although not with the infrastructure. With on-board radar, vision, and other sensors, these AHS-equipped vehicles will be able to communicate with each other and coordinate their driving operations, thereby achieving best throughput and safety.

Infrastructure-Supported Concept:•

smart infrastructure can greatly improve the quality of AHS services and better integrate AHS with local transportation networks. This concept envisions automated vehicles in dedicated lanes using global information and two-way communication with the smart infrastructure to support vehicle decision-making and operation.

Infrastructure-Assisted Concept:•

In this concept, the automated roadside system provides inter-vehicle coordination during entry, exit, merging, and emergencies. This concept may provide the greatest throughput benefit; it also may require the greatest civil infrastructure investment.

Adaptable Concept:•

his concept acknowledges the fact that AHS implementation will vary by locality. It envisions the development of a wide range of compatible standards that leave as many of the specific architecture decisions, solutions, and deployment progressions as possible to area stakeholders.

The Five Layer Theory

The physical layer comprises all the on-board vehicle controllers of the physical components of a vehicle. These include the engine and transmission, brake and steering control systems, as well as the different lateral and longitudinal vehicle guidance and range sensors. The main function of the physical layer is to decouple the longitudinal and lateral vehicle guidance control and to approximately linearize the physical layer dynamics.The regulation layer is responsible for the longitudinal and lateral guidance of the vehicle, and the execution of the manoeuvres ordered by the coordination layer. The regulation layer must carry out two longitudinal control tasks. The first task is that of a vehicle follower in a platoon and consists in maintaining a prescribed constant spacing from the preceding vehicle. The second task is that of a platoon leader or free agent and consists in safely and efficiently executing a manoeuvre commanded by the coordination layer.The coordination layer is responsible for selecting the activity that the vehicle should attempt or continue to execute, in order to realize its currently assigned activity plan. It communicates and coordinates its actions with its peers—the coordination layers of neighboujring vehicles—and supervises and commands the regulation layer to execute or abort manoeuvres. It also communicates with the link layer roadside control system, from which it periodically receives an updated activity plan.There is one link layer controller for each 0.5 to 5 km-long segment of the highway, called a link. Its task is to control the traffic flow within the link so as to attain its full capacity and minimize vehicle travel time and undesirable transient phenomena, such as congestion. A link is itself subdivided in sections, one per lane. A link receives and discharges traffic flow from and to neighbouring links, as well as AHS entrances and exits. The controller measures aggregated vehicle densities in each of the link's sections. These densities are specific to vehicle type, including origin and destination, and whether the vehicle is a platoon leader, follower or is changing lanes. It broadcasts commands in the form of a specific activity plan for each vehicle type and section, to the vehicle coordination layer controllers.The link layer controller receives commands from the network layer in the form of demands on the inlet traffic flows at the AHS entrances, and outlet flow constraints at the AHS exits, as well as desired inlet-to-outlet traffic flow split ratios, in case a vehicle can take more than one route to each the same destination, while travelling in that highway link.The task of the network layer is to control entering traffic and route traffic flow within the network of highway links that constitute the AHS, in order to optimize the capacity and average vehicle travel time of the AHS and minimize transient congestion in any of its highway links.

POTENTIAL BENEFITS

Researchers have attempted to estimate benefits that might accrue from the implementation of automated highway systems. Table 2 summarizes potential benefits. Many of the benefits shown in the table are fairly speculative; the systems they would depend upon are not yet in existence and there is no clear evidence that the system can produce the following benefits in reality.It is anticipated that automated highway and related advanced vehicle control and safety technologies would significantly reduce traffic congestion and enhance safety in highway driving. This in turn would potentially cut travel time, and therefore, driving would be more predictable and reliable. The Mobility 2000 report, sponsored by the Texas Transportation Institute, projected that collision prevention systems could reduce accidents by 70 percent or 90 percent on fully automated highways.Research focused on collision prevention systems has estimated possible savings in a relatively short period of time. For example, collision avoidance systems have been estimated to have the potential to reduce annual loss of life on U.S. roads by 50 percent by 2020. In addition, preliminary National Highway Traffic Safety Administration estimates show that rear-ends, lane-change, and roadway-departure crash-avoidance systems have the potential to reduce crashes by one-sixth, or about 1.2 million crashes a year.

CONCLUSION

Automated Highway Systems brings major transportation benefits in terms of safety, efficiency, affordability and usability, and environment in order to achieve its development goals.A key feature of the control design architecture is the separation of the various control functions into distinct layers with well-defined interfaces. Each layer is then designed with its own model that is suited to the functions for which it is responsible. The models at the various layers are different not only in terms of their formal structure (ranging from differential equations to state machines to static graphs), but also in the entities that have a role in them.The AHS is a complex large-scale control system, whose design required advances in sensor, actuator, and communication technologies (not discussed here) and in techniques of control system synthesis and analysis. It is a measure of the advanced state of the art that these techniques have reached a stage that they could be successfully used in the AHS project.Though it has been said so, the reasons why many federal programs like the National Automated Highway System Research Program (NAHSRP) failed was that the program was trapped in technology-optimism. Several U.S. DOT reports on AHS show that there are no technical and non-technical showstoppers. However, legal, institutional, and societal challenges just as critical as technical issues. Moreover, these institutional and societal issues cannot be settled in one day, because they are much to do with people's perception, behavior, consensus and social changes based on those.

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