VEHICLE–HIGHWAY AUTOMATION

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Early in the 21st century, vehicle–highway automation will enable the surface transportation system to provide users with enhanced accessibility and mobility. Vehicle–highway automation will encompass a broad range of advanced technologies that collectively will represent the most important performance upgrade of the nation's surface transportation system since the advent of the Interstate highway system.

Performance and Safety Improvements

Vehicle–highway automation technologies and systems fall into four categories:

◆ Warning systems that sense and then advise drivers of potential hazards

◆ Control assistance systems that augment the driver's ability to control the vehicle

◆ Control override systems that intervene in some aspect of the control of the vehicle during unsafe conditions

◆ Automated control systems that control all motions of the vehicle

These systems may be implemented by technology that is contained entirely within the vehicle (i.e., autonomously) or by a combination of in-vehicle and infrastructure technologies (i.e., cooperatively).

Vehicle–highway automation can be expected to benefit both society and individuals by enhancing productivity, mobility, and safety, and thus overall trip quality. The new systems will lead to greater throughput that will effectively result in increased highway capacity without the need to build new lanes or pursue other costly means of accommodating predicted increases in travel demand. Users will reap the benefits of substantially reduced and more predictable travel times. Impaired and elderly drivers may be able to travel by automobile on

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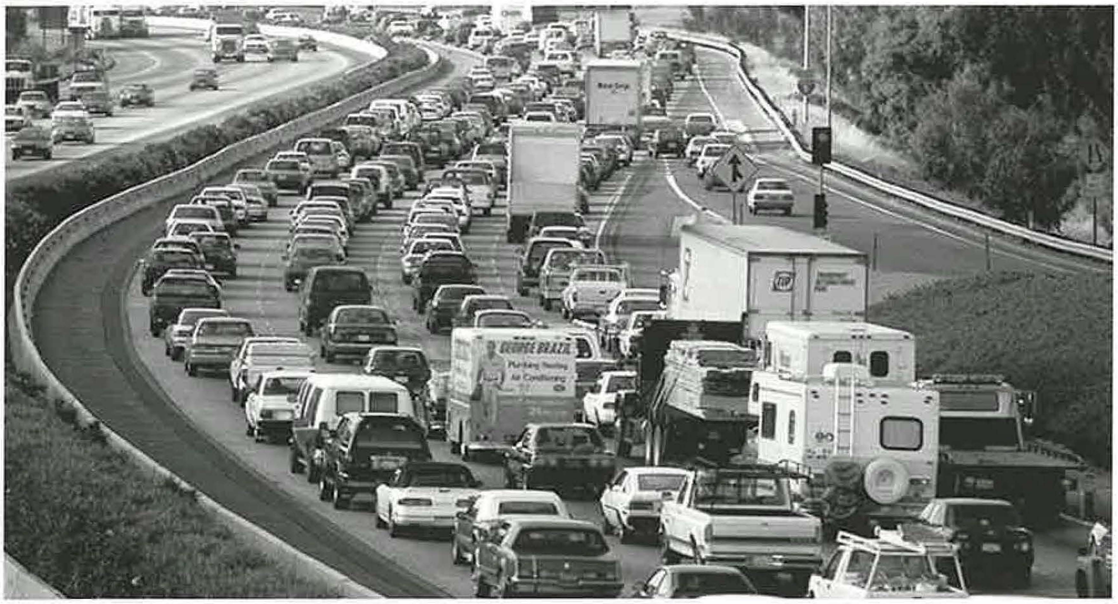

Vehicle–highway automation will result in reduced and more predictable travel times. New systems will lead to greater throughput, increasing highway capacity without the need to build new lanes or pursue other costly means of accommodating increases in travel demand.

high-demand facilities, such as urban freeways, safely and with less anxiety. Transit systems, likely early users of vehicle–highway automation, should be able to offer higher-quality services that are less vulnerable to traffic congestion.

With regard to safety, vehicle–highway automation will use advanced sensing and computing technologies to improve on human performance by providing full attentiveness, consistent responses, and lightning-quick reaction times. Applied in carefully selected operating environments and with appropriate fault-handling features, the new systems can be expected to result in significant decreases in the frequency and severity of highway crashes.

Some would argue that the current transportation infrastructure is so large that this investment dominates the reality of the future of transportation, and only small changes at the margin can be expected. Certainly, the existing highway infrastructure constrains to some extent the design options for various vehicle–highway automation concepts. We believe, however, that because of its many inherent advantages, automation will contribute significantly to the surface transportation system in the new millennium.

Development and Implementation

Safety, availability, reliability, environmental considerations, land use, and energy costs and their interacting influences on private, business, and government activities all affect vehicle–highway demand, use, and operations. The way automation is incorporated into the vehicle–highway system will depend on society's choices in all of these areas.

The rate of implementation of vehicle–highway automation will reflect primarily market forces, such as the services suppliers and consumers think people need, tempered by the capacity to accept and afford those services. The policies and effectiveness of local and regional transportation service providers with regard to delivery of adequate highway capacity and transit services will also have a significant effect on rates of implementation in both rural and metropolitan areas. Additional influences will include vehicle marketing as it reflects perceived trends; national safety policies, such as reduced tolerance for behavior that leads to crashes; and national resource allocation policies.

An especially important factor in the implementation of vehicle–highway automation is the increasingly close working relationships between industry and government in developing the associated technologies and systems. The partnership approach can be particularly fruitful if it facilitates the development of truly cooperative vehicle–highway technologies that bridge the traditional divide between the vehicle and infrastructure sectors.

It is impossible to predict how the many factors that will shape the implementation of vehicle–highway automation will evolve. Nonetheless, various scenarios can be visualized for the development and application of vehicle–highway automation during the next several decades.

Typical Highway Situations

The earliest applications of automation are likely to occur in control assistance systems for passenger and commercial vehicles operating in typical highway situations. These systems sense specific instances of dangerous or deviant driving and provide some form of feedback to the driver. In early systems, this feedback may simply be an auditory warning; in more advanced versions, it may take the additional form of partial vehicle-control assistance. Such systems are already emerging. Vehicle-based collision warning systems currently available provide auditory and visual warnings to the driver. In the near future, these systems may actually apply the brakes in certain defined situations.

Also likely to emerge are systems that warn of or provide control assistance in imminent run-off-the-road situations. Again, driver assistance may include auditory and visual warnings, as well as corrective forces applied to the steering system. Depending on the design, the corrective forces may be relatively light and easily overridden by the driver or in-lane guidance systems while remaining sufficient to maintain the vehicle in the lane on which it is traveling. Research and development are also focusing on vehicle- and highway-based systems that will provide intersection crash avoidance in various driving situations.

Specialty Vehicle Operations

There are two primary areas in which developments in specialty vehicles can be expected—maintenance and emergency operations. Of particular concern is improving the safety of those who operate these vehicles. Automation offers great promise for enhancing worker safety by providing maintenance vehicle guidance in bad weather and detection of roadside obstacles.

Vehicle guidance systems received a significant boost from the technologies produced for the Demo '97 exhibit of the National Automated Highway Systems Consortium in San Diego, California. Several of these guidance concepts are being tested