

AUTOMATED ENFORCEMENT OF TRAFFIC LAWS

RICHARD A. RETTING

Motor vehicle travel, while a necessity of modern life, exacts a high toll in crash losses for the convenience and mobility it provides. Each year in the United States motor vehicle crashes cause nearly 3.4 million injuries and about 42,000 fatalities, in addition to extensive property damage. Emergency response, trauma care, and damage to the highway infrastructure impose significant burdens on municipal and state governments.

Highway safety advances, such as airbags, increased seat belt use, laws against alcohol-impaired driving, improvements in vehicle crashworthiness, and better roadway design, have resulted in an impressive and sustained decline in the risk of motor vehicle injuries and fatalities. Between 1966 and 1997, the U.S. fatality rate (per 100 million vehicle miles traveled) declined from 5.5 to 1.6. Such gains, however, are threatened by disturbing trends in increased travel speeds and disregard for traffic signals, and a rise in related types of fatal crashes. For example, the number of fatal crashes at intersections with traffic signals increased nearly 20 percent between 1992 and 1996. And in 24 states that raised speed limits soon after repeal of the national maximum speed limit in 1995, there was a 15-percent increase in fatalities on interstates and freeways (1).

Automated enforcement of traffic laws is increasingly being used or considered by many communities as a sensible countermeasure for deliberate traffic violations such as red light running and speeding. Automated enforcement devices can supplement limited law enforcement resources by detecting and providing evidence of such violations, thereby helping to reduce the frequency of associated motor vehicle crashes.

Growth in Motor Vehicle Travel

Today's highways do not just seem more congested; they have in fact become significantly more crowded, with growth in vehicle travel far outpacing road construction. Between 1960 and 1995 the number of registered motor vehicles in the United States increased 172 percent (from 74 to 201 million), and the number of vehicle miles traveled increased 237 percent. During this same period the number of miles of paved public roads increased by 93 percent.

This growth in vehicle travel has implications not only for highway capacity and traffic operations, but also for the adequacy of law enforcement resources. Police staffing levels have not kept pace with traffic volume. Limited police resources, together with continued increases in travel and urban congestion and a strong public desire for safer roads, have contributed to a growing interest in automated enforcement of traffic laws.

Automated Enforcement Technologies

"Automated enforcement" denotes a broad range of electronic devices and systems that can detect and photograph vehicle actions defined as constituting specific traffic violations. Enforcement itself is not automatic; the photographic evidence gathered by

Safety statistics indicate that higher travel speeds and disregard for traffic signals have led to increase in associated fatal crashes, such as this one resulting from red light running.

The author is Senior Transportation Engineer, Insurance Institute for Highway Safety, Arlington, Virginia.



Evaluation
of red light
cameras in
Arlington,
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1993.



the devices is reviewed by specially trained technicians and law enforcement officers to ensure that tickets are issued in a fair and appropriate manner. Some automated enforcement ticketing procedures call for agreement between two independent evidence reviewers on the appropriateness of the charge before a ticket is issued. As with conventional police traffic law enforcement, those charged with traffic offenses have the opportunity for judicial review of the evidence, and equipment used for automated enforcement is subject to scrutiny and reasonable calibration procedures. Automated enforcement devices currently in use include cameras that document drivers who run red lights, violate speed limits, fail to comply with signals at railroad crossings, and operate their vehicles aggressively.

Red Light Cameras

Approximately 260,000 crashes due to motorists running red lights occur annually in the United States, resulting in more than 150,000 injuries and 800 fatalities (2). Crashes caused by red light running are more likely than other types of crashes to lead to some degree of injury. Red light cameras have been in use in Europe and Australia since the 1970s. They are currently the most widely used form of automated traffic law enforcement in the United States, with about 30 cities presently using such devices.

In most cases a red light camera system is connected to the traffic signal and to sensors in the pavement. The camera is triggered by any vehicle passing over the sensors above a preset minimum speed and at a specified elapsed time after the signal has turned red. A second photograph showing the violator in the intersection is also taken. The camera records the date, time of day, time elapsed since the beginning of the red signal, and speed of the vehicle. Most such camera systems use conventional film to record violations; digital cameras are in limited but increasing use.

Tickets are sent by mail to owners of violating vehicles after a review of the photographic evidence. Depending on state law, either a civil penalty (similar to a parking ticket) is issued to the vehicle owner, or a moving violation with driver's license sanctions is issued to the driver. Enforcement programs limited to civil fines photograph only the vehicle's rear license tag, whereas programs in which moving violations are issued use frontal photography to capture an image of the driver.

Red light cameras are effective in modifying driver behavior. Evaluations of such programs in two U.S. cities—Oxnard, California, and Fairfax, Virginia—revealed that violation rates had decreased by about 40 percent during the first year (3,4). Increases in driver compliance were not limited to camera-equipped sites, but extended to nonequipped intersections as well. These findings are similar to those for camera enforcement in Singapore, where violations declined by 40 percent (5). And in the United Kingdom, a 55 percent decline was reported (6).

It is too soon to evaluate the effects of U.S. camera programs on crash rates, and there has been little evaluation of these effects outside the United States. In Australia, researchers estimated a 10.4 percent reduction in fatalities at camera sites in Victoria and a 24 percent reduction in injury crashes at camera sites in South Australia (7,8). It is generally accepted that red light cameras significantly reduce angle crashes and the overall number of intersection crashes and injuries. In some cases, cameras are associated with an increase in the number of rear-end collisions, although there is evidence that the number of these rear-end collisions has decreased over time.

Speed Cameras

High travel speeds in excess of those warranted by traffic conditions and roadway design are among the most prevalent contributors to motor vehicle crashes. Speeding reduces the time drivers have to avoid crashes and is related directly to crash severity. Few issues in the highway safety literature have received the attention paid to the importance of managing traffic speeds and enforcing speed limits. Because traditional police enforcement is insufficient to ensure reasonable compliance with speed limits, automated speed cameras (photo radar) are used widely to supplement police efforts throughout Europe, Australia, and, to a more limited extent, North America.

Most such cameras use a low-powered Doppler radar speed sensor that triggers the camera to photograph vehicles traveling above a preset speed as they pass a specified point. The camera records the date, time, and vehicle speed, and usually is set to activate only when a vehicle is traveling significantly

faster than the posted limit. Photo radar often is accompanied by a visible police presence to maximize the deterrent effect, but cameras can also be deployed unattended.

Speed cameras have been used in many countries for more than 20 years, and results indicate they are associated with declines in high traffic speeds and associated motor vehicle crashes. For example, in Victoria, Australia, cameras were introduced in late 1989, and police reported that within 3 months the number of offenders triggering the devices had decreased by 50 percent. Fatalities had declined by 30 percent in 1990 as compared with 1989, and the percentage of vehicles significantly exceeding the speed limit had decreased from 20 percent in 1990 to less than 4 percent in 1994 (9). After a year of camera enforcement in British Columbia, researchers reported a 20 percent reduction in traffic fatalities, a 7.4 percent decline in overall crashes, and a significantly lower proportion of speeding vehicles (10). A study of speed camera use in Norway revealed that injury crashes had been reduced by 20 percent on rural roadways equipped with cameras (11).

Railroad Grade-Crossing Cameras

Collisions at railroad grade crossings tend to be catastrophic. Many such crashes occur when drivers deliberately attempt to beat approaching trains to the crossing, even if doing so requires driving around crossing gates. Construction of overpasses is a highly effective solution, but far too costly to be applied at every location. Crossing gates, bells, flashers, and other active warning devices are only partially effective.

Crashes at railroad crossings are primarily a rural problem. In recent years, however, light rail transit lines have been constructed in urban areas, increasing the number of heavily traveled urban grade crossings. For example, Los Angeles began operating its extensive Metro Blue Line light rail system in 1990. In the first 7 years of service there were 353 collisions between trains and motor vehicles, resulting in 33 fatalities (12). Because of the expense and maintenance requirements of camera systems, their deployment at railroad grade crossings is limited mainly to such heavily traveled urban locations.

Some municipal governments and railroad authorities use camera enforcement at grade crossings to improve motorists' compliance with flashing red lights and lowered crossing gates. These applications entail modification of red light camera technology to meet the functional requirements of grade crossings. As with red light programs, tickets are sent by mail to owners of violating vehicles after a review of the photographic evidence, and either a civil penalty is issued to the vehicle owner, or a moving violation with driver's license sanctions is issued to the driver.

Camera enforcement at railroad crossings appears to reduce driver violations substantially. For the Los Angeles Metro Blue Line, the number of violations at the Compton Boulevard crossing dropped from one per hour at the start of enforcement to one every 12 hours during a period of approximately 6 months (12).

Aggressive Driver Cameras

Heightened concern about aggressive driving has led to the implementation of special police traffic law enforcement programs that target violations associated with such aggressive driving practices as tailgating,

TRB Reports on Automated Enforcement

Automated enforcement has been the subject of three Transportation Research Board reports in recent years. NCHRP Synthesis 219, *Photographic Enforcement of Traffic Laws*, published in 1995, describes the various types of automated speed enforcement technologies and their operating and performance characteristics. Experience with these technologies is summarized, including technical, legal, and acceptability issues associated with their use. Longer-term effects on driver compliance and safety are also examined, drawing on both U.S. and non-U.S. experience.

Legal Research Digest 36, *Photographic Traffic Law Enforcement*, published in 1996, focuses on legal issues associated with the use of automated enforcement technologies. More specifically, the report addresses such issues as the admissibility of photographic traffic evidence, existing state laws or ordinances permitting photographic enforcement devices, specific statutory or regulatory revisions necessary in states currently without enabling legislation or statutes, and responses to constitutional and legal challenges likely to be faced by those states that seek to implement such technologies.

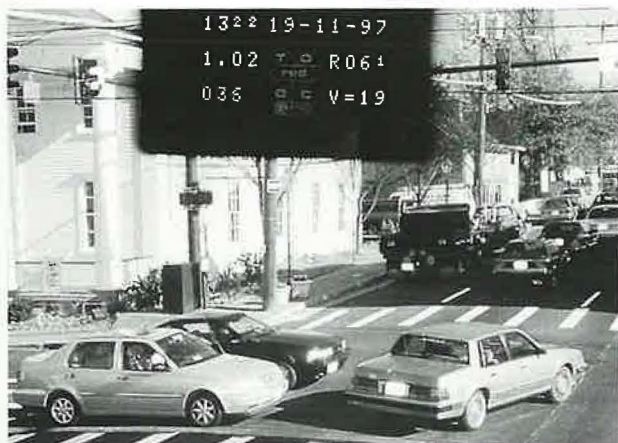
Finally, automated speed management and enforcement technologies are reviewed in TRB Special Report 254, *Managing Speed: Review of Current Practice for Setting and Enforcing Speed Limits*, published in 1998. An appendix to this report provides an in-depth review of experience with the use of automated technologies, particularly for speed enforcement, both in the United States and abroad.

For more information contact Nancy P. Humphrey, Senior Program Officer, Transportation Research Board (telephone 202-334-2948).



Vehicle being driven around lowered railroad-crossing gate in Los Angeles, 1996, as part of grade-crossing camera enforcement program.

Driver surveys in Oxnard, California, and Fairfax, Virginia (right) revealed 80 percent of residents support automated enforcement using red light cameras.



sudden and frequent lane changing, and speeding. Some police agencies have installed video cameras in patrol vehicles to document aggressive driving on heavily traveled roads. Videotape can be used to support police testimony in the prosecution of aggressive driving violations, as has been done successfully with alcohol-impaired driving.

The New York State Police, for example, have installed video cameras in specially equipped patrol cars and passenger vans. These cameras interface with radar units so that a violator's speed appears on the video. Video cameras in unmarked passenger vans are used in conjunction with marked patrol cars to make traffic stops. This approach has proven effective in documenting aggressive driving, as the actions of an unsuspecting motorist are recorded before a marked patrol car arrives on the scene. In Maryland, where state police are experimenting with methods of videotaping aggressive driving from specially equipped vans, conspicuous traffic signs are posted to notify drivers of "aggressive driver imaging in use for your safety."

Other Applications

Other applications of automated traffic law enforcement technology are in more limited use or undergoing further research and development. These applications include enforcement of high-occupancy vehicle and bus lane restrictions, identification of vehicles that evade electronic toll collection, detection of tailgating violations, and enforcement of truck weight restrictions. The primary goals of all such systems are to deter violations of the targeted traffic regulations and to improve the efficiency, effectiveness, and safety of police traffic law enforcement.

Importance of Public Opinion

As with other government policies and programs, implementation and continued deployment of automated enforcement technologies require acceptance and support from the public and elected leaders.

Although the "big brother" issue is raised by some opponents of automated enforcement, public opinion surveys in the United States and abroad consistently reveal wide acceptance and strong public support for red light cameras, as well as support, though not quite as strong, for speed cameras.

Nationwide telephone surveys have revealed that about two-thirds of U.S. residents support the use of red light cameras, with higher levels of support generally being found in urban communities. Driver surveys in the two cities with such camera programs noted earlier—Oxnard, California, and Fairfax, Virginia—revealed that about 80 percent of residents support camera enforcement (3,4). Similar public opinion surveys in European countries revealed that the majority of drivers support or accept red light cameras. A profile of drivers in British Columbia who think the use of red light cameras is unfair includes the following characteristics: male, young to middle aged, driving more than 10,000 km/year, and with two or more convictions in the last 3 years (13).

As noted, public approval of speed cameras is generally less strong than that found for red light cameras, but a majority of drivers still support use of the devices. A 1995 nationwide survey conducted by the Insurance Institute for Highway Safety revealed that 57 percent of U.S. residents support camera use. Surveys in two communities with speed camera programs—Paradise Valley, Arizona, and Pasadena, California—showed that about 61 percent of residents support such programs (14). And surveys of driver attitudes in the United Kingdom revealed that drivers hold more positive than negative views about the presence of speed cameras.

Legal Issues

A detailed review of the complex legal issues associated with automated enforcement is beyond the scope of this article. Several recent Transportation Research Board publications provide useful analyses of major legal issues related to camera enforcement. Highlights are discussed briefly here.

Photographs generally are admissible evidence either as an independent and accurate "silent witness" to an event or as a reasonably fair and accurate representation of events in support of in-court witness testimony. Admissibility of photographs under the silent witness theory requires strong evidence of authenticity and accuracy, given that the photographs may be the only evidence presented; photographs used to support police testimony are subject to less scrutiny. Courts require that automated enforcement devices, like other law enforcement tools, function on the basis of sound scientific principles, be operated by trained and experienced personnel, and be in proper working order as verified through calibration.

continued on page 29