

MARRIAGE MADE IN MICHIGAN

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Autoscope™ and SCATS together in FAST-TRAC
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The use of video for adaptive signal control has been tried and tested in Oakland County, Michigan. While "success" is the word on everyone's lips, attention is now focused on measures of effectiveness.

What began in 1992 as a 28-intersection adaptive signal control system under SCATS is now the world's largest installation of machine vision-based vehicle detection for adaptive intersection control. The FAST-TRAC Program in Oakland County, Michigan, consists of more than 275 Autoscope processors with more than 1,000 Autoscope image sensors.

FAST-TRAC demonstrates the effectiveness of integrating ITS to improve mobility, reduce traffic accidents, and create a traffic information and incident management warehouse. It also demonstrates a successful systems integration effort that ties together surveillance, signal control, and traffic information systems.

The system continuously monitors each SCATS-controlled intersection's traffic flow, and then transmits the information to a central computer, which adjusts traffic signals' cycles accordingly.

At a FAST-TRAC intersection, the Autoscope system provides vehicle volume and occupancy information to the local SCATS controller. This controller processes the data and transmits it to a regional computer, and finally to the Road Commission's traffic operation center. The system automatically adjusts signal timing based on local intersection data and progression requirements for the affected corridors. With this information, the system is able to adjust signals to accommodate one-way rush hour traffic patterns and to improve mobility for motorists attending major public events.

RESULTS SO FAR

Various studies on the effectiveness of FAST-TRAC prove the program is working to decrease accidents, reduce intersection delays, and reduce journey time. One study reported a significant decrease in turn-related accidents at equipped intersections, as well as a decrease in the number of accidents resulting in severe injuries. Studies also show a reduction in intersection delays, even with an increase in traffic volume. A driver perception study revealed that motorists believe the program is doing a good job of reducing their journey time and improving safety.

Oakland County officials report positive results. Feedback from police and local officials indicates that they have seen an improvement in traffic flow as a result of FAST-TRAC installation.



"The Road Commission is always looking for ways to be more cost-effective. Fortunately, we have maturing technology on our side. The Autoscope 2004 is one example of how new technology is allowing us to develop a more reliable, efficient and cost-effective traffic management system," said Brent Bair, managing director of Oakland County's Road Commission.

The Autoscope system accuracy is estimated at 97 percent for traffic detection.

This accuracy has been key to the performance of FAST-TRAC.

SYSTEM BACKGROUND

The FAST-TRAC program was the first installation of the Autoscope wide area video vehicle detection system, along with the AWA Delta 3 SCATS controller. As well as adaptive control, the system included cars equipped with Ali-Scout, a beacon-based route guidance system in Troy, Michigan.

Today, the project includes five regional computers controlling about 300 intersections in 11 communities in southern Oakland County. It is a large-scale deployment of an integrated advanced traffic management system (ATMS) and advanced traveler information system (ATIS). The system is operational 24 hours a day, with staff available at the traffic operation center 11 hours a day.

The system has been so successful that plans are well underway to share data with the Michigan Department of Transportation's Detroit metropolitan transportation center. In addition, officials are exploring options to integrate FAST-TRAC with the area's public transportation agencies.

The four-phase program spans five years. FAST-TRAC has been in Phase II B until now, and is starting its third phase. The successful integration of the Autoscope detection system with the SCATS adaptive control system has resulted in continued deployment that will eventually grow to over 1,000 intersections. Cooperation among the participants, along with competent project management, are key ingredients in making this project successful, and have made the development of the next generation adaptive control feasible.

The Oakland County General Government, the Road Commission for Oakland County, the Michigan Department of Transportation, US Congress, and Siemens provided initial funding for the program.

AUTOSCOPE BACKGROUND

The FAST-TRAC project was the first installation of a commercialized, field-hardened video vehicle detection system - the Autoscope 2003 - in North America. Officials selected the Autoscope system for the pilot program, where 23 of the total 28 intersections would use machine vision detection. Officials based their selection on the Autoscope system's ability to provide detection regardless of the pavement condition or weather, in addition to its ease of deployment, detector placement flexibility, and minimal disruption to traffic during installation.

Since the successful completion of the pilot project, officials have added more than 200 Autoscope systems, and the project continues to expand. Of the 300 intersections in the FAST-TRAC program, the vast majority use machine vision for vehicle detection.

The basic Autoscope system consists of a machine vision processor, the image sensor, and a computer (laptop or personal) to program the detector layout. A video card is available to allow the user to view live video at the intersection on the VGA monitor.

The video detection system can detect traffic in multiple locations within the image sensor's field-of-view and can process video from up to four sensors simultaneously. The user can specify "virtual" detectors in a matter of minutes, and can easily change detector layouts. To achieve flexible detection zone placement, the user "draws" detectors on a VGA monitor using a mouse.

For a typical intersection, there is one image sensor for each intersection approach. Each corner of an intersection has an image sensor, typically on 35 to 45 ft. poles. The controller cabinet houses the Autoscope processor. Only during initial system set-up is the computer necessary. Users can configure the Autoscope processor for a modem connection, allowing operators to remotely access the system by telephone line.

AUTOSCOPE AND SCATS

The SCATS system has unique vehicle detection requirements for adaptive control. To compute consistent degree-of-saturation results for all approaches, vehicles and

congestion levels, the detector size must be about 15 ft. The SCATS control strategy minimizes unnecessary green time throughout a system to suit the prevailing average traffic conditions. Users place detectors at the stop line for adequate coverage of the stopped vehicles. These detectors allow a vehicle movement phase and will dynamically adjust cycle, split, and offset times.

"IN OAKLAND COUNTY, THE DETECTION REGIONS COVERED BY THE 275 AUTOSCOPE PROCESSORS EQUAL THE COVERAGE OF 6,000 INDUCTIVE LOOP DETECTORS"

Members of the Road Commission selected machine vision technology for FAST-TRAC because of the maintenance and reliability concerns of conventional loop technology. In Oakland County, the detection regions covered by the 275 Autoscope processors equal the coverage of 6,000 inductive loop detectors. The road surfaces in Oakland County are typical of northern American cities, with an assortment of concrete slabs, asphalt surfaces, and patches. It would be difficult for loops to survive long-term in this environment. To fulfill the 15 ft. length requirement, loops would have to span across multiple surfaces and survive seasonal shifts in road surfaces.

The Autoscope video vehicle detection system allows users to place virtual detectors on the video display, rather than physically placing the detectors on roadway pavement. With a click of the mouse, users can easily remove and modify the detectors. For the FAST-TRAC program, image sensors are mounted on luminaire pole extension arms. Users place the image sensors at a 45 degree angle above the stop line. The user then places appropriate-sized virtual detectors on the desired stop line locations. Each time a vehicle crosses these detectors, the system generates a detection signal (presence and passage) via the Autoscope processor's external interface module. The signal is similar to that produce by loop detectors (NEMA standard TS/1 and TS/2 interface).

As noted, the non-intrusive system offers many significant benefits. Poor pavement or adverse weather conditions do not affect its reliability, and one image sensor can replace many loops. The system also simplifies maintenance and offers flexible detector placement.

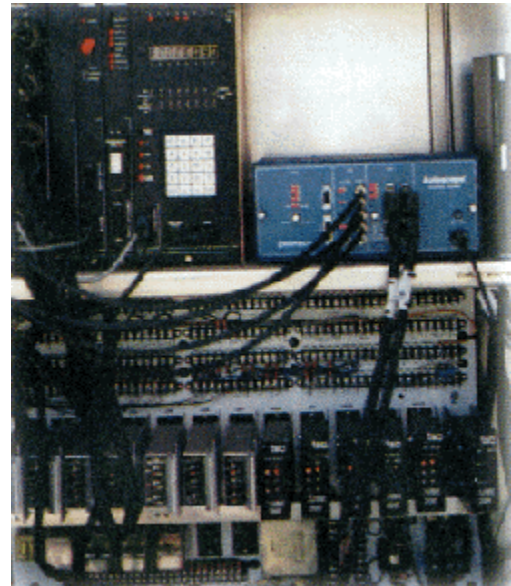
One example of the flexible detector placement became evident when motorists were stopping beyond the detection area in left-turn lanes, causing some vehicles to miss their protected left-turn movement. This was easily solved by placing virtual left-turn lane detectors beyond the left-turn stop bar, providing a more efficient and safer intersection for motorists.

Included in this article is an example of an Autoscope detector file at the intersection of Adams and Walton streets in the FAST-TRAC project. There are virtual detectors at the stop line of each lane at all intersection approaches. When a vehicle enters the detection zone, the detector sends a signal to the SCATS controller. With this information, the system automatically develops an optimal signal timing plan for the entire intersection network.

NEW DEVELOPMENTS

Image Sensing Systems, Inc. (ISS) has been working closely with the Road Commission for the development of several advanced traffic detection applications as part of the FAST-TRAC Phase II B program. Nearly all ITS applications expansion programs require the automatic collection of comprehensive, accurate and timely measures of effectiveness (MOEs). The necessary MOE data includes items such as travel time, queues, stops, delays, energy consumption, weather data, road surface conditions, visibility, and incidents. The MOE data is necessary to meet the demands of developing the next generation of ITS applications.

As part of Phase II B, ISS is developing MOEs to monitor the real-time performance of an intersection, as well as congestion levels within an arterial network. The system will also use MOEs to quantify the performance of adaptive rather than fixed-time control strategies, evaluate and monitor the SCATS performance at critical intersections, and provide up-to-date congestion information for transportation planners. The company developed several MOEs from existing Autoscope detection data related to level of service, density, and space occupancy. Practical and research approaches followed the development stage to directly measure the queue size or vehicle count, and queue length or distance. With this real-time information, additional MOEs, such as measurement of stops, delays, inferred energy consumption and vehicle emissions, can easily be integrated into future ATMS.



Measuring queues at an intersection requires a different camera view to that used by the FAST-TRAC program. Since it is highly desirable to measure queues with the same camera used for SCATS adaptive control, ISS has conducted extensive field testing on optimal image sensor placement. Two intersections are sites for incident detection and traffic data collection. In addition to the existing equipment at the intersection, two Autoscope processors and six image sensors have been installed at these two locations.

The Road Commission prefers automatic incident detection at intersections. As part of Phase II B, ISS is developing an application to monitor the Autoscope units for stopped-vehicle incident alarms. The application will also manage video from the Autoscope image sensors that will accompany an alarm for incident verification.

The Road Commission is also exploring ways to establish remote communications links to each Autoscope unit. Having a communications link with each unit allows users to perform various maintenance activities from the control center. The activities include

verification of detection performance, detector layout changes, software upgrades, and diagnostics. In research, remote units are communicating via telephone lines with ScopeServer, the Autoscope communications server software. ISS is pursuing developing technology that may allow the multiplexing of the Autoscope unit's data with SCATS data. If this is successful, it will allow remote communications without adding costly communications links at each intersection.

Another recent application will automatically and systematically retrieve snapshots or still images from the Autoscope image sensors at a fixed time interval specified by the control center operator. This will allow operators to monitor the sensor's faceplate cleanliness, video clarity, condensation in the camera enclosure, and ice accumulation on the faceplate. The application collects the snapshots from each sensor and archives them on the server's hard drive. Operators can verify that a sensor is functioning properly by comparing collected still images.

The Autoscope system is manufactured and distributed in North America by Econolite Control Products, Inc. (ECPI) of Anaheim, California. ECPI's distributor Traffic Control Corporation (TCC) of Lombard, Illinois, provides Autoscope sales and support to Oakland County for FAST-TRAC.

Image Sensing Systems, Inc. of St. Paul, Minnesota, is the research and development company behind the Autoscope technology. It distributes the Autoscope system outside North America through various strategic partners.