

## **A NEW VISION**

As published by Traffic Technology International  
Annual Review 2001 Issue

*The Korean Vision for Vehicle Detection*  
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Video based vehicle detection using machine vision processing has been an important part of the American experience of traffic management over the past decade. Several large system installations, each employing hundreds of cameras acting as vehicle sensors, have been deployed across the US with good results. The technology has been slower to take off in other parts of the world where the old inductive loop technology has continued in general use.

### **A trend change in vehicle detection – the way forward for Korea**

Smaller system installations, where in most cases the full functionality of video image detection may not have been exploited, exist in most countries both in Europe and Asia. Concerns about cost and performance have probably dictated the design process for new traffic management projects and although the in-ground loop solution has been seen as increasingly costly and cumbersome from the aspect of installation and maintenance, there has been a resistance to large scale changes. However, in country after country, both in Europe and Asia, the position of design institutes, traffic consultants and decisionmakers within local authorities is now undergoing a change.

One country where this change can be clearly noticed is Korea. The municipality of Seoul, the capital of South Korea, has decided to abandon the use of inductive loops for new traffic management projects in the Seoul area. The Korean Highway Corporation has made a similar decision for new projects along the major interurban expressways under its responsibility. These decisions have been based on cost and performance as well as the obvious added benefit of providing video for surveillance purposes as well as the capability to perform multiple task detection over a wide area, something which would be very impractical using loop technology.

Since 1997, Seoul has been using a system for vehicle detection based on video image processing on the Olympic Expressway, an inner-city multi-lane expressway running along the Southern bank of the Han river towards the Olympic Stadium, located in the bustling and heavily congested business district of Kangnam Gu. The Autoscope wide area video detection system is used and it employs a total of 34 cameras whose video images are fed through 17 image processing units, each handling 2 camera inputs, while being capable of handling up to 4 camera inputs. The Autoscope product is developed by Image Sensing Systems, Inc. (ISS) of St. Paul, Minnesota. Throughout Asia the application and project implementation support for Autoscope is provided by Flow Traffic Limited which has offices in Hong Kong, China and Thailand.

On the Olympic Expressway, Autoscope is used for the collection of average vehicle speed, volume and occupancy data, while the system's incident detection algorithm detects incidents on the expressway. The data and live video signals are transmitted to the city's traffic management centre via fibre optic cable. Special purpose custom application software is polling each of the Autoscope Machine Visions Processors (MVPs)

every 30 seconds through the ScopeServer communication server. Processed data is then providing estimated travel times, and this information is displayed to motorists via Changeable Message Signs (CMS).

Three years of practical experience of obtaining reliable real time data together with video images along the Olympic Expressway has convinced the city authorities to engage in a large scale technology shift for current and future traffic management tasks. In the summer of year 2000, the design for Seoul's next major traffic management project was finished and approved by the city and it includes 216 detection points, each using one camera with multiple detection tasks being performed simultaneously in each field of view.

The name of this ambitious project, the largest single contract for a turnkey intelligent transport system in Korea, is Seoul Naebu Expressway, its Korean name indicating an inner city ring road. This expressway is located on the Northern side of the Han River, has 3-4 lanes in each direction and is 40.1 km in length. The road is mainly elevated and connects Kangbyon Expressway, which runs along the bank of the Han River on the North side opposite to the Olympic Expressway, and the Tongbu Expressway. It was opened for traffic in February 1999 with limited traffic control and surveillance capabilities.



***An Autoscope Image Sensor (AIS) on pan/tilt mechanism being used for area surveillance on the Olympic Highway in Seoul, Korea and the AIS being used to collect real-time traffic data for Automatic Incident Detection***

## **Problems and objectives for Seoul Naebu Expressway**

It is necessary to understand some of the key problems that provided the incentive for Seoul to engage in its ambitious task. The expressway seemed to be accident prone and studies showed that 40 % of the road had insufficient sight distance for safely stopping vehicles travelling at speeds of 80 km/h. 78 traffic accidents occurred within the first 5 months of operation and this was a strong signal that improvements were needed. There were also serious problems with incident response since the main part of the road is elevated and there furthermore was no provision for emergency lanes. Serious problems with traffic congestion appeared as a result of, among other factors, exit and entrance ramps being directly linked to critical intersections. There were also difficulties in diverting traffic to alternative routes.

By the end of 1999, Seoul Naebu Expressway was getting close to the limits of its capacity, and clear objectives for the traffic management system to be implemented had been set. These included the implementation of an advanced incident detection and management system with traffic flow to be maintained at speeds over 40 km/h and stable levels of traffic volume through more effective use of traffic direction, the provision of traffic information to drivers and via internet and broadcast media as well as speed violation enforcement.



***Real-time traffic information collected with Autoscope is relayed to motorists using variable message signs***

In order to handle the problems presented and achieve the various objectives outlined, there was a strong awareness of the necessity and importance of acquiring reliable and continuous traffic data simultaneously along the entire roadway, through the 4 km long tunnel system that forms an integral part of the expressway and at each point of exit and entrance to the ring road. Early in year 2000 it was decided to award the contract to SK C&C, possibly Korea's leading integrator of intelligent transport systems, and their partner Entel

Systems, an experienced local traffic management systems provider. As a crucial part of the design proposal, Autoscope video image detection had been selected for the task of traffic data collection.

## Vehicle detection with a vision

A total of 216 cameras or Autoscope image sensors (AIS) for vehicle detection are installed at 500 metre intervals along the entire roadway. Additional cameras are installed in the tunnels to ensure full coverage in this more sensitive environment and there are further AIS detectors employed at each entrance and exit ramp. The 216 cameras provide real time video back to the Traffic Management Centre (TMC) in point-to-point communication via fibre optic cable, where images are processed by Machine Vision Processors (MVP) in the 54 Autoscope wide area video vehicle detection systems. Data from thousands of detection zones are polled every 20 or 30 seconds with information collected from count detectors, speed detectors, vehicle length detectors, stopped vehicle detectors and occupancy detectors. Queue detection using presence detectors is furthermore provided for the ramp metering system and wrong-way vehicle detection provides an additional important feature. Autoscope's integrated incident detection algorithm is being used in conjunction with locally developed algorithms.

The Seoul Municipality has tested the Autoscope systems in severe adverse weather conditions as well as problematic light conditions and been satisfied of accurate performance that meets and generally exceeds the performance experienced from traditional inductive loop detection employed elsewhere in the city. The advantages of ease of installation, ease of maintenance, total cost competitiveness and reliability have convinced the contractors as well as the employer in Seoul to build their systems on detection provided by Autoscope. The Autoscope installation in Seoul is currently the biggest deployment of video image detection in Asia but there are strong indications that other major cities are rapidly following suit. A major trend shift and a new vision for vehicle detection is on its way not only in the United States but also in Asia.

## References:

Much of the information regarding the Seoul Naebu Expressway contained in this article has been taken from a paper ("The Overview of Seoul Naebu Expressway Traffic Management System" by Lee Joon Hee, Lee Jae Deuk and Oh Ki Do) presented at the ITS Asia 2000 exhibition in Beijing, July 2000.

***Seoul's modern traffic management centre can view any image from 54 Autoscoptes installed at 500 m intervals along roadway linked via fiber optic cable***

