Magnetic Pull

Wireless Magnetic Detector Sitraffic Wimag

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Vehicle detection today is still predominantly achieved with inductive loop detectors. But due to certain deficiencies – reduced lifetime, for instance – there has been a noticeable (albeit rather slow) trend toward aboveground methods. Inductive loops are nevertheless still deployed in more than 50% of new installations as many road authorities deem them superior in terms of detection ability. (Detection rates close to 100% are common in all environmental conditions and they rarely fail during installation or set up.)

But aboveground technologies, such as video and radar, have proved their worth for vehicle detection in many applications. The main advantage of these variants compared to inductive loops is long lifetime. As they are mounted onto a pole or a gantry, they are unaffected by the wear of the road surface so do not need to be replaced when a new layer of asphalt is laid. But such aboveground technologies have not superseded loops in all applications, due mainly to their mounting position. From a pole or gantry, the occlusion of vehicles on adjacent lanes can often not be excluded, while an approach detection of 20-60m from the stop bar is difficult to attain as the gaps between vehicles driving at close distance are not ‘seen’ by the detectors.

A NEW BREED?
A different form of technology might be able to fill the gap between the high detection rate of inductive loops and the long lifetime of aboveground detectors. Wireless magnetic detectors are in-ground detectors able to detect vehicles under all ambient conditions. With their small size and the absence of communications or power cables, the lifetime is far longer than it is for, say, loops.

Shaped like small cubes with dimensions around 7.5 x 7.5 x 5cm³, wireless magnetic detectors are installed into the road surface. A small hole, roughly 10cm in diameter, is drilled in the asphalt and the detector is placed in the hole and subsequently filled with epoxy until the detector is completely covered. With wireless data communication and internal battery power, there is no need for any cables to connect the detector to roadside equipment. As a result, it can be installed with minimal damage to the road surface and in most cases is placed in the middle of the lane – a location of low wear between the lane grooves. Even if the road surface is stressed and starts to corrugate, the sensor will stay in place and continue to operate with full functionality. Moreover, during the winter months, there is no risk of damage from snow plows as the detectors are completely below the road surface.

These newly introduced alternatives to loops and aboveground sensors detect vehicles in road traffic by observing changes in the natural static magnetic field of the Earth, which is changed in direction and strength by any metallic or
magnetic object. In this scenario, the metal objects are the vehicles traveling over the top, which are detected immediately. The detectors are usually equipped with several magneto resistive, Hall or flux sensors that measure the magnetic field strength in two or three axes. A signal processor analyzes the raw signals of the magnetic sensors and can distinguish between changes caused by vehicles and disturbances from other sources. Signals from vehicles on adjacent lanes or temperature drifts of the sensors are suppressed in the signal analysis.

The detection data is communicated wirelessly to an access point mounted on a pole at the roadside. A low-power radio communication is used to ensure a long battery life, even on roads with high traffic volumes. In a typical configuration at an intersection, one access point located on a signal mast or pole collects the data of all detectors in each of the approaches. The data is processed in the access point and sent in real-time to the signal controller.

The advantage of magnetic detection is that it is a pure passive technology, able to detect changes in the ambient field. Detectors such as loops or radar, by comparison, need to generate an electromagnetic field which requires certain minimum input power.

Communication is based on the low-power ZigBee (IEEE 802.15.4) standard and is modified for traffic detection. A special protocol reduces the number of transmissions to a minimum without introducing delays in communication. Each detection event is reported immediately. Without traffic, the detector is almost completely idle apart from a sign of life once every minute. The battery power supply combined with the wireless communication means installation costs are very low.

FIT FOR PURPOSE

Wireless magnetic detectors can be used for many applications in road traffic, ranging from presence detection at intersections to traffic data acquisition with vehicle classification. Similar to inductive loops, a double-sensor configuration with two sensors located at a distance of about 3-4m in the direction of traffic flow can be used to measure vehicle speed, length and to classify the vehicles in two classes. The raw signals of the two sensors are processed in the corresponding access point in order to calculate speed, length and vehicle type.

One of the main advantages of wireless magnetic detectors is the flexibility in choosing the detector locations. With conventional technologies, there are many restrictions relating to the position of the detector. Loops, for example, often cannot be placed too far from the stop bar as the installation cost for the feeder cables would be prohibitive high. Boundary conditions also apply to aboveground detectors, which are often placed near signal heads as access to poles for public street lighting or similar is often not possible. For wireless magnetic detectors, however, installation cost remains low, regardless of where they are installed; wireless data transmission means no increase in cost for large distances from the intersection. And by using repeaters, it is possible to place the detectors up to 500m away from the access point.

For approach detection, wireless magnetic detectors also have a considerable cost advantage over loop detectors as there is no need for the costly installation of feeder cables. Systems based on aboveground detectors will be similar in cost to wireless magnetic detectors although there is extreme disparity in terms of the detection rate. For approach detection, video or radar detectors need to detect the vehicles at a distance of 20-60m whereas wireless magnetic detectors are located exactly at the point of detection so can detect vehicles with a high precision.

After many successful installations for vehicle detection, these detectors are now advancing toward other applications, such as travel-time measurement on arterial roads. By comparing the magnetic signatures at several locations in the network, vehicles can be re-identified and their travel times determined. Indeed, a matching rate of around 50% – which is sufficient for many traffic management systems – has been achieved in the first pilot installations. Therefore, wireless magnetic detectors present themselves to be a cost-effective alternative to systems that do not require matching rates of close to 100%.

Wimag detectors

Sitraffic Wimag is the Siemens brand for the company’s wireless magnetic detectors, which covers the complete range of sensors, including access point, repeaters, etc. For intersection control, Sitraffic Wimag offers a high level of system integration, which reduces the installation cost to a minimum. Many Siemens signal controllers provide a direct link to the Wimag access point, which eliminates the need for interface cards and reduces the risk of failures in the system. The user interface allows a fast assignment of the detectors to the controller inputs, and the correct performance can be controlled easily. With Power over Ethernet, a single cable between access point and controller is sufficient for data and electrical power. Besides the products, Siemens offers the complete service package including installation, set-up and maintenance. Wimag is an easy-to-integrate component of the Sitraffic family of systems from Siemens Mobility and can be expanded step by step to create a comprehensive traffic management system. The Wimag traffic data is available on all levels from the signal controller to the central office of the road network operator.

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