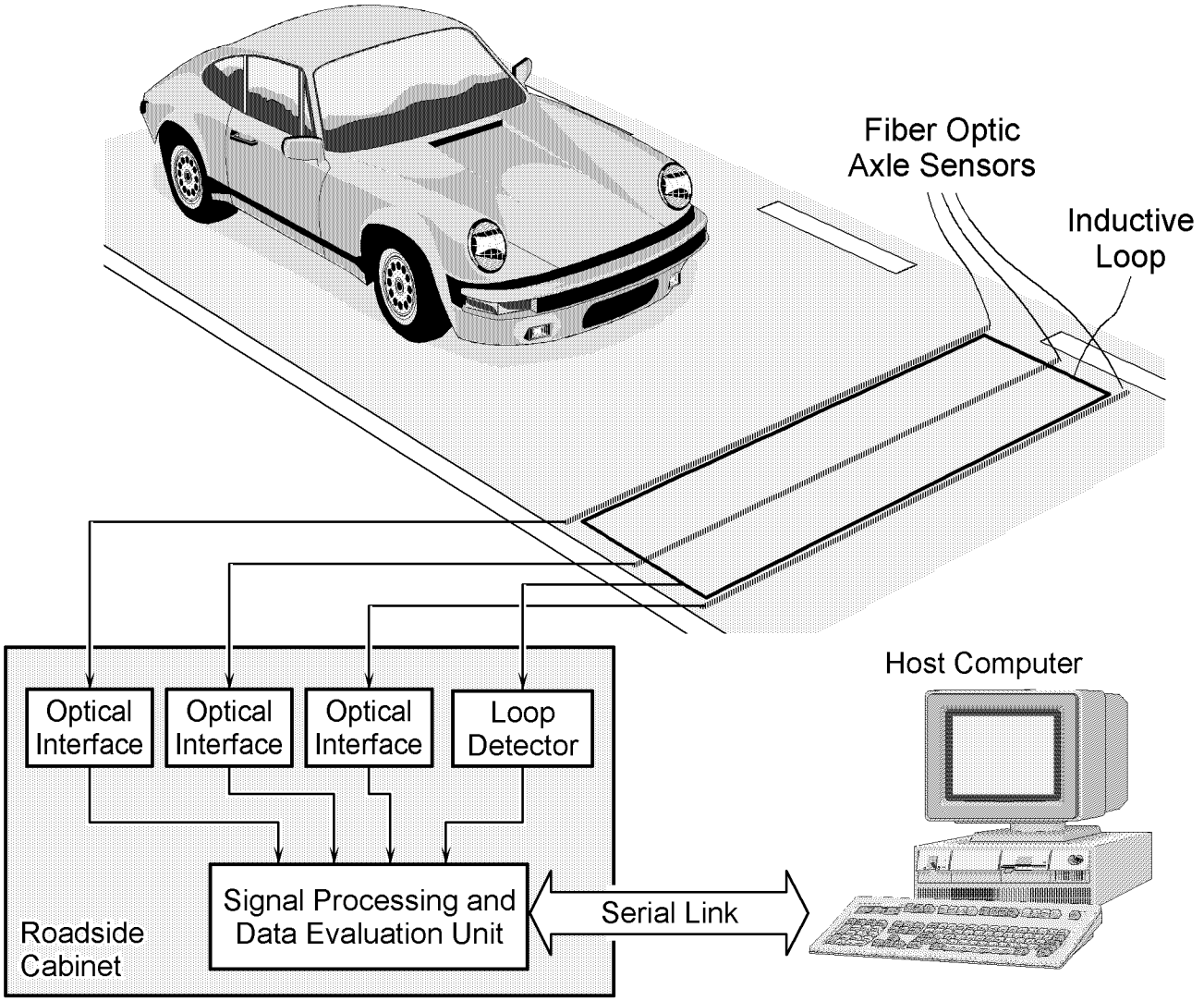
SENSOR LINE GmbH

CLASSAX

Traffic Data Acquisition System



CLASSAX is the name of a new system for vehicle detection, classification, speed measurement and traffic data collection combining the advantages of SENSOR LINE's SPZ fiber optic axle sensors with those of an inductive loop. Originally intended to be a vehicle classification system especially suitable for extremely slow moving traffic, CLASSAX has shown that it can do much more than this. Installation is simple and requires little effort, which can almost be reduced to that for a single inductive loop. All sensors can be installed flush with the roadway surface, thus being protected against snow ploughs and avoiding to produce noise. The detection zone is very well defined and can be made very short, which enhances reliability with slow traffic and is an essential requirement for true multi-lane capability. CLASSAX is compatible with SENSOR LINE's TKV speed measuring process, thus delivering highly accurate speed measurements for each individual axle. These features render CLASSAX a very versatile instrument for a whole string of purposes. Possible applications include vehicle detection, classification and counting, axle counting, traffic statistics, traffic monitoring and control, speed measuring and camera triggering for law enforcement, travel time measurement and weigh-in-motion.

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Technical Description:

CLASSAX is based on three fiber optic axle sensors and one inductive loop, which are sealed in slots cut into the roadway surface. Two of the axle sensors share a common slot with the inductive loop and therefore require no extra cutting expense. The third axle sensor is installed halfway between the other ones. It can be omitted, if the TKV speed measuring process is not required and if some additional decrease of performance is also acceptable. By means of fiber optic feeder cables the axle sensors are connected to optical interfaces, which feed light into the sensors and detect crossing vehicles by analyzing the amount of light which is transmitted through them. The inductive loop is connected to a common loop detector. All this electronic equipment is situated in a roadside cabinet.

The output signals are fed into a signal processing and data evaluation unit, which computes axle speeds, wheelbases, vehicle lengths, vehicle classes and so on. It can also perform data compression or statistical computing, or control variable traffic signs or enforcement cameras. As the sensor signals are already pre-processed, the signal processing and data evaluation unit needn't be close to the installation site but can be located at some remote place. It is connected to a host computer via a serial link. All of the data I/O is executed by means of this link. It can be realized as a simple serial interface (e.g. RS-232 or RS-485) but also as a bus system (like profibus or CAN-bus). The software requirements for the host computer depend on what is chosen here. If this is a simple RS-232 interface nothing but a common terminal program is needed. In this case data I/O can also very simply be done via modem if a telephone extension is made available. This is particularly favourable for querying results from independently working data collection sites.

If the vehicle classification capability of CLASSAX is to be utilized this can either be done using a pre-defined classification scheme or by teaching the system any new one as required. For this purpose a laptop or notebook computer is connected to the serial link and the desired classes of passing vehicles are entered on-site, thus collecting a database of vehicle characteristics and generating a classification scheme from it at the same time. The classification software is designed in a way that vehicle classes are identified by a number and a name, where only the number - which identifies one particular set of characteristics - must be unambiguous. By this it is possible to put completely different "looking" vehicles into the same class, which is then identified by the class name. There are class numbers from 1 to 254 available (0 and 255 reserved) so even complicated classification schemes can be set up. It is also possible to override characteristics derived from passing vehicles by manually entering values (e.g. number of axles: passenger cars have always two of them).

The dimensions of the sensor assembly are variable. SENSOR LINE's SPZ fiber optic axle sensors are available with lengths up to 6 m (20 ft), they can be accommodated to the width of the traffic lane. The recommendable length of the detection zone depends on what is intended to do with the particular installation and where it is. The longer it is, the higher is the precision of speed measurements at a given speed. On the other hand maximum reliability of separating close vehicles and axles requires short detection zones. For a german federal road, where speeds of roughly 100 km/h (62 mph) occur, a length of 1 m (3.3 ft) has proven to ensure good overall performance.

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Applications

Vehicle Detection:

The combination of axle sensors and an inductive loop ensures excellent vehicle detection capabilities. CLASSAX can not only detect moving vehicles as well as standing ones but also determine whether they are moving or not and, if so, in what direction and with what speed. The detection zone covers the whole width of the traffic lane, so no motorbikes or even bicycles can pass undetected. Also installations on adjacent lanes can be carried out in a way that lane-changing vehicles are detected once, not twice. Axle detection with SENSOR LINE's SPZ fiber optic sensors is very accurate and very fast, therefore CLASSAX is also well-suited for camera triggering purposes.
These features give access to new solutions for many common purposes. For instance at a street crossing CLASSAX can be used for vehicle-actuation of traffic signals, detection of red light offences and triggering of enforcement cameras.

Speed measurement:

SENSOR LINE's SPZ fiber optic axle sensors are superior detectors for speed measuring purposes. Unlike piezo-electric axle sensors they are insensitive to shocks or vibrations of the roadway surface and respond only to the pressure of the tyres. In addition to that they deliver analogous output signals which can be cross-correlated to determine time delays with maximum precision. Based on this principle SENSOR LINE's TKV speed measuring process can be applied with CLASSAX if the third axle sensor in the middle is installed. With this CLASSAX can deliver four values of speed for each crossing axle. One of these values is of improved accuracy, and by comparing it with the other three values erroneous measurements can be recognized with high certainty. Therefore, when used for speed enforcement, CLASSAX offers a maximum level of reliability and probative weight.

Vehicle Classification:

Classification is the purpose CLASSAX was originally designed for. Due to its short detection zone it is especially well-suited for slow moving traffic with small headways and its performance scarcely degrades with increasing speed. Vehicles are classified according to their length and their axle configuration (the number of axles and the distances between them). As every axle causes its own speed measurement these quantities can be determined very accurately, even when vehicles accelerate or brake.
Since the classification scheme is set up by executing a teach-in process CLASSAX is very versatile and can meet various requirements. Also, the behaviour of an existing installation can be altered when the requirements change.

Applications (cont'd)

Traffic Statistics And Monitoring:

Due to its detection, classification and speed measuring capabilities CLASSAX is an excellent means for all purposes of traffic data acquisition. Regardless whether monitoring of the current traffic flow or long term collection of statistical data is required, CLASSAX can be configured to do the job autonomously while queried from time to time by e.g. a traffic control or surveillance center.

Travel Time Measurement:

To determine the average speed of a vehicle on a somewhat longer travel path it is necessary to capture its features at some first detection site and recognize it at some second one. This requires some kind of description of the vehicle to be sent either from the first detection site to the second or from both of them to a third place. This description must be detailed enough to not confuse different verhicles, but also summarized enough to remain the same in spite of inevitable measuring incertainties. Also, the more detailed a description is, the more computing time it takes to perform an adequate comparison.
Magnetic signatures as acquired when using an inductive loop are very significant "fingerprints", but comparing them by cross-correlation is very time-consuming.
CLASSAX is able to capture such signatures in conjunction with additional data which are not only vehicle characteristics but can also be used to pre-select and pre-process magnetic signatures in a way that the remaining computing effort is dramatically reduced.

Weigh-In-Motion:

The SPZ fiber optic axle sensors used with CLASSAX are not intended to be weigh-in-motion sensors. Nevertheless their analogous output signals are load-dependent and show the difference between light vehicles and heavy ones. The fact that CLASSAX is also able to classify vehicles regardless of their weight can be used to set up systems which for instance calibrate themselves by e.g. comparing the load signals of passenger cars with those of trucks and then are able to at least tell heavy trucks from light and normal ones. Spotting probably overloaded trucks in order to stop and weigh them is a main application for common weigh-in-motion systems, and CLASSAX offers a new approach to handle such and similar tasks.

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