TDS
TRANSPORT DATA SYSTEMS

WEIGH IN MOTION SYSTEM

FEATURES

Heavier vehicles cause more damage to your tollroad. If you add weight to the class/fare structure you will have a more equitable system for distribution of cost to those vehicles which use your roads.

With the addition of these sensors, the toll road operator can now add weight to the list of discriminants that can be used to calculate the toll. Small trucks carrying cargo can be differentiated easily from small trucks with no cargo and cars. Each class of truck can be classified based on total weight or on axle weight on the rear axles. This allows the toll road operator to assess tolls in such a way as to more accurately correlate with the vehicles that do the most damage to the roadway. Furthermore the toll road operator can choose not to allow overloaded vehicles onto the toll road in order to protect the road surface and substructure. As a result, expensive maintenance work is significantly reduced, traffic tailbacks are avoided and road safety is increased.

TDS can provide a standalone AVC processor or integrate the software into your lane controller.

Unique classification correlation software easily accommodates new fare schedules and class structures.

USES

As a part of a vehicle classification system for fare collection systems - provides additional methodology for equitable fare structure creation.

Vehicle filtering at border crossings - detect vehicles outside the filter limits.

Overweight detection for roadway protection.

Vehicle weight statistics

ADVANTAGES

Low cost high accuracy solution

High classification accuracy (>99.5%).

Ease of fare schedule modification/upgrade.

Compatible with latest real time operating systems including Lynx, Linux and Windows 2000.

Expandable to include other lane controller functions including the Transport Data Systems license plate capture system. Together they form the basis for your lane operations!

OPERATIONAL PHILOSOPHY

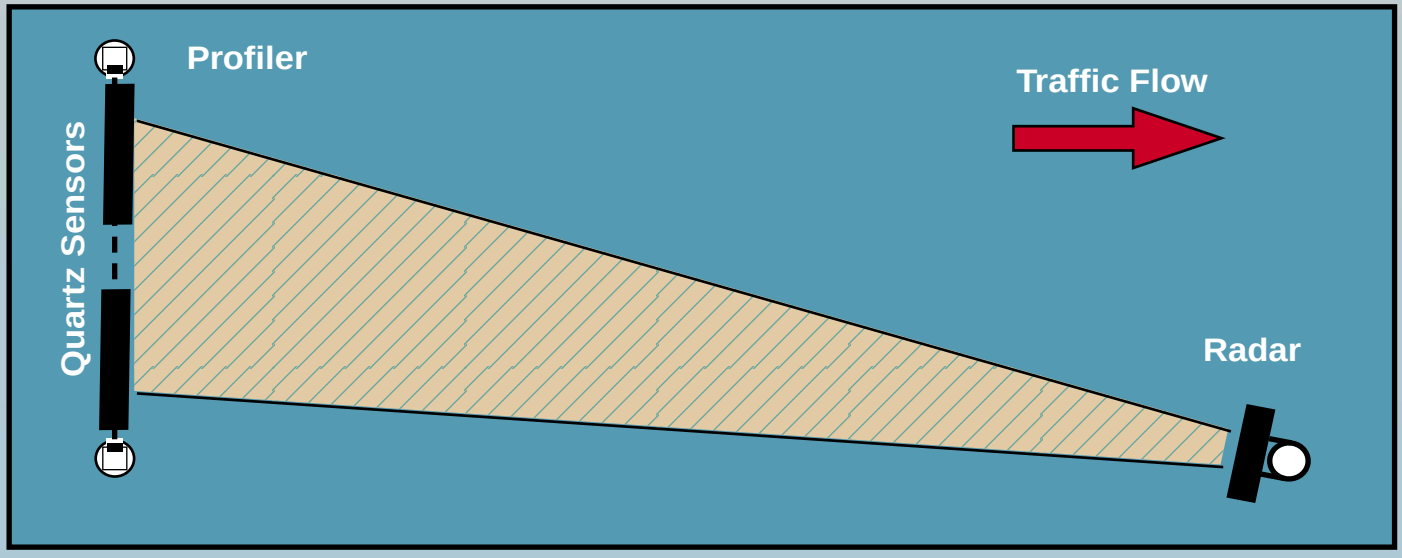
Transport Data Systems has integrated a Weigh-In-Motion (WIM) capability into its AVC product line. The AVC add-on uses quartz sensors from Kistler to provide the raw pressure inputs from the tire crossings. This information coupled with accurate velocity data from the Doppler radar delivers accurate wheel by wheel weight measurements.

The TDS weigh-in-motion system uses a combination of two Kistler quartz detectors and a Doppler radar to calculate the weight of a vehicle. The system is designed to be added to the TDS automatic vehicle classification system but could be implemented on a stand-alone basis. It is particularly well suited to pre-classification systems as applied to smart card tolling systems. Since the sensors also provide the axle data, a separate axle detector is not required.

The Kistler quartz sensor provides a measure of the total pressure that is applied to the sensor during the period that the wheel is actually on the sensor. To determine the actual weight, the unit requires the speed of the vehicle. Classically system designers have included multiple quartz sensors to determine the velocity of the vehicle and loops to provide vehicle separation. Depending on the system design, the accuracy of the velocity can vary considerably. Since the actual weight calculation is directly dependent on velocity, this error translates directly to an error in the weight measurement. Furthermore loops are notoriously noisy and can result in incorrect vehicle separations.

The TDS AVC system uses a profiler and a Doppler radar to provide the ability to separate vehicles and classify them using axle locations along with length and a height profile. This provides a very accurate instantaneous velocity measurement 16 times a second. This velocity plus the quartz sensor outputs can provide accurate and reliable vehicle weight information. It also provides for excellent vehicle separation.

The quartz sensors can also fill the requirement for axle detection, thereby eliminating the need for additional axle detectors.



In order for the quartz sensors to operate properly, the vehicle can not stop on the sensors. Therefore it is imperative that the vehicles be metered through the measurement area. In order to accomplish this, a separate traffic light and/or gate is used to control the entry of the vehicle into the measurement zone. This technique not only guarantees a more accurate weight measurement but also increases the fundamental accuracy of the vehicle classifier.

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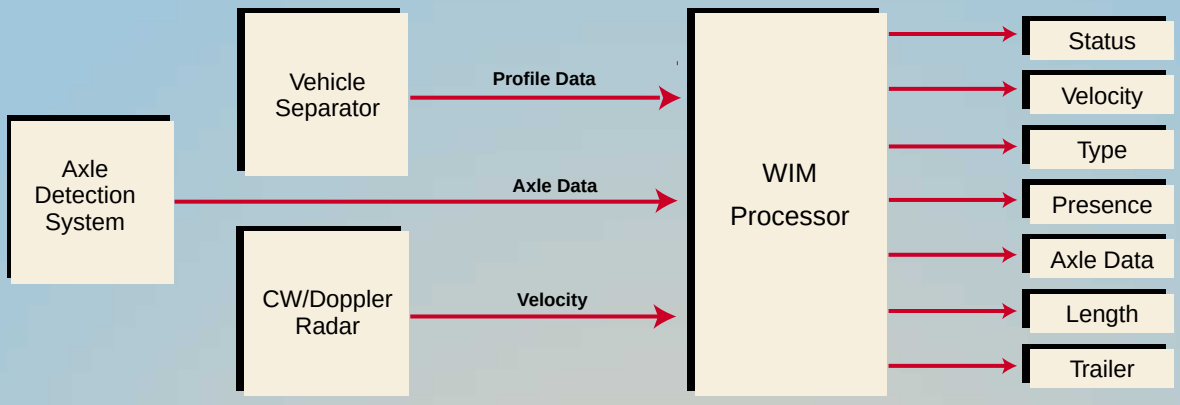

BASIC DESIGN

The basic building blocks of the system include a vehicle profiler, a high frequency CW Doppler radar, an axle detection system and a computer system for processing the sensor data. While its primary function is to provide the axle weights, the system is also capable of providing the following information about a vehicle.

- Length of the vehicle(s) and hitch location
- Number of axles
- Relative position of the axle

VEHICLE SEPARATOR

The system can be delivered with one of two different profiler types, namely a five foot light curtain or an overhead laser scanner. Both sensors do an excellent job of separating vehicles and detecting hitches. The overhead scanner can also provide both height and width measurements on the vehicle if required. The overhead scanner is typically easier to install but does require an overhead structure like a canopy for mounting.

DOPPLER RADAR

A key element in this design is the use of the CW Doppler radar. The radar provides very accurate velocity on the target as it passes over the weight sensors. The radar beam pattern is designed to cover a single lane when mounted 35 to 45 feet from the light curtain. This pattern size eliminates false detection of vehicles in adjacent lanes.

AXLE DETECTION SYSTEM

The axle detection system provides information about each axle on the vehicle. The weight sensing is done by Kistler Lineas quartz sensor. The quartz sensors provide an indication that a axle is passing through the weighing zone. The quartz sensor transmits pressure data that when combined with the radar velocity provides an accurate measurement of the weight of the axle.

WIM PROCESSOR

The WIM processor is an Intel based PC. The interface to your lane controller is available in serial form via RS-232 or RS-422. It is also available via a 10/100baseT network connection. For more information concerning this interface please refer to the Software Interface Specification located on the Support page of our website.

The WIM software can be implemented in your lane controller if you are running Linux, Windows NT/2000 or one of the real time Unix based operating systems such as Lynx or QNX.

THE QUARTZ SENSOR

Kistler's LINEAS WIM Type 9195C is a force sensor with quartz elements. The sensor is a modular element that is installed into a slot that is saw-cut across an asphalt or concrete road. When a force is applied to the sensor surface, the quartz disks yield an electric charge proportional to the applied force through the piezoelectric effect. The electric charge is converted by a charge amplifier into a proportional voltage which can then be processed as required. Key characteristics include:

- Excellent long term stability.
- Measures very accurately at both walking and freeway speeds.
- Insensitive to temperature changes.
- Frost-resistant and protective against ingress of water.
- Quasistatic and dynamic calibration is possible.
- Wide measuring range.

The sensor is not dislodged from the road and can be reground by up to 10 mm in the event of road deformations.

The sensors are available in 0.75 and 1.0 meter lengths. Two or more sensors can be connected together to make a longer single sensor strip. Several sensors that are installed adjacent to one another can be connected electrically in parallel and operated with a single charge amplifier. The output signal then corresponds to the sum of the forces acting simultaneously on all sensors connected.

Kistler-supplied sand/epoxy grout secures the sensor strips into the pavement slots. After curing, the hardened grout and the exposed top surfaces of the sensor modules are ground flush with the surrounding pavement using a belt sander. After grinding, the sensors may be immediately exposed to traffic. An overnight post cure is recommended before calibration and acceptance tests are performed.

CHARGE AMPLIFIER

The industrial charge amplifier (Type 5038A2Y43) is a 2 channel amplifier. Each channel converts the charge output of the Lineas sensor to a proportional voltage. The adjusting potentiometers are designed as plug in units to avoid the need for recalibration when an amplifier is replaced. The unit requires an unregulated 15 to 20 volt DC supply. Its key features include:

- Robust aluminum diecast housing
- Vibration proof
- No adjustments required

LANE CONTROLLER INTERFACE

The outputs of the sensor amplifier are brought to the lane controller over special cables capable of extending the distance from the sensor amplifier to over 80 feet. The signals are fed into a digital processing card which contains a 12 bit analog to digital converter.

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