Inside information

Advanced sensor and data-collection technologies provide road authorities with the information they need to make informed business decisions.

As the need for more detailed data on the vehicles using road infrastructure continues to grow, design and maintenance is becoming increasingly complex and expensive. In the design of roadways, there is a need for statistics on lateral positioning, load distributions across lanes and peak loading. Information on a commercial vehicle’s load distribution, both laterally and per axle, is required for enforcement. In the domain of traffic safety, readouts on tire overinflation or underinflation pressure, and the lateral lane position of each vehicle, can be used to protect motorists. In the case of tolling, vehicle position and speed-independent axle load measurement would be worthwhile.

IRD has been working to address the needs of road engineers through the development of a new sensor and data collection system. The VectorSense sensor suite and Vehicle Information in Motion (VI2M) traffic data system can differentiate between single, dual and super-single tires, measure axle width, determine vehicle lateral lane position, detect tire overinflation and underinflation pressure, and determine unequal wheel and axle loading. The VectorSense sensor suite extends available options as either a standalone system or as an enhancement to existing vehicle count, classification, and weigh-in-motion (WIM) installations. This enhanced traffic data collection information can be used to support pavement maintenance planning functions and provides previously unavailable traffic data inputs for Mechanistic-Empirical Pavement Design Guide (MEPDG) requirements. In addition, the VI2M traffic data system can provide safety and enforcement information for use in commercial vehicle source/destination studies and transportation corridor management.

The VI2M traffic data system provides information on time, distance (location from the end of the sensor) and pressure (load) for points along sensors installed in the roadway transverse to the direction of traffic flow. From these measurements, it is possible to determine a footprint pressure profile and location for each tire on a vehicle as it rolls over the sensor.

Intelligent and accurate

The VectorSense sensor suite can provide a true tire ‘footprint’. The width of a tire is a relatively straightforward measurement, but it is a particularly important measure for commercial vehicle operations, where distinguishing single standard width, ‘super single’ width and dual tire configurations are important considerations for safety and enforcement programs. Additionally, the VI2M traffic data system can differentiate between normal, overinflated and underinflated tires. Another of the VectorSense sensor suite’s key safety applications is lateral load sensing. If the data for the axle shows that the loads on either side of the axle are widely different, an imbalanced lateral load is indicated.

Some of the more exciting applications for the VectorSense sensor suite are in traffic data collection and tolling. The sensor was developed, in part, to address issues such as detecting non-standard axle arrangements, that have proven difficult with other types of sensors. With the VectorSense sensor suite, the width of a vehicle’s axle is achieved by measuring the distance between the centers of the tire contact patches. The position of every tire on the vehicle can be determined, so all types of vehicle configurations can be identified, including bicycles, motorcycles and three-wheelers. From VectorSense sensor suite data, the VI2M system can also...
determine the lateral position of the vehicle in a lane. If an installation has sensors installed in adjacent lanes, vehicles traversing both lanes can be detected. All of these measurements can be made independent of vehicle speed. With a typical VectorSense sensor suite installation, speed and axle spacings can be accurately determined using the time interval between activations of the sensors by successive tires.

The VectorSense sensor suite can also provide a speed-independent approximation of the load on a tire using the peak pressure and maximum width measurements. Tests are underway to determine the degree of accuracy available when vehicle speeds are taken into consideration.

**Enhanced measurement**

Infrastructure asset management is a vital function for agencies overseeing road systems. Calculations for roadway design and maintenance make use of traffic data inputs such as vehicle classification and load data to assist in making current and future plans. The VectorSense sensor suite provides additional parameters to enhance vehicle classification algorithms and accuracy.

A wide variety of sensors for traffic data collection, commercial vehicle enforcement, tolling and traffic safety applications continue to be made in the industry. The VectorSense sensor suite, as a new ITS technology providing enhanced vehicle measurement capabilities, has the potential to not only cost-effectively perform these existing functions but also to provide additional traffic and vehicle information that is not currently available. It can furthermore provide improved and more accurate vehicle information for road structure designers, road management agencies, toll authorities, and many others in the transportation industry.