IMS Infrastructure Management Services

Data Collection Services

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IMS DATA COLLECTION SYSTEM

IMS proposes the Laser Road Surface Tester (RST) enhanced with digital imagery and GPS capabilities for the data collection activity. The RST, with its 11 laser sensors is capable of collecting a full array of pavement condition data complete with high accuracy GPS coordinates and multiple view digital images for both rigid and flexible pavements (in real time), as it traverses the roadway. An integrated Digital Condition Rating Subsystem supplements the RST data for additional distress data elements, quality assurance and inventory information. Specialized data processing, using GIS as its backbone, allows the pavement data to be quickly checked for completeness and quality.

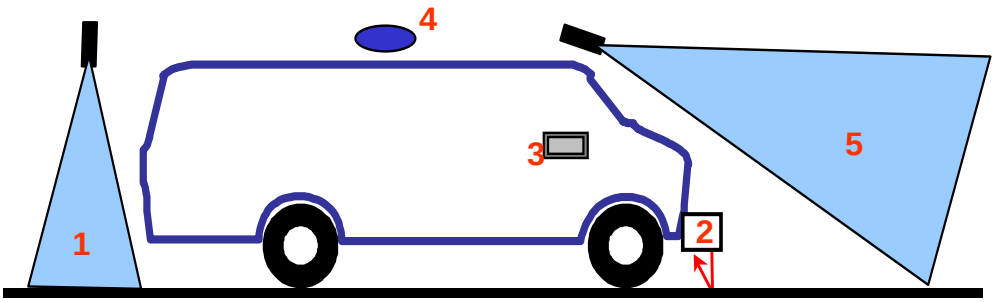
The main components of the enhanced RST are:

- Digital Condition Rating Subsystem that may be customized to collect a variety of roadway attributes and extent-severity based pavement distresses.
- A transducer bar with an array of laser cameras, rate gyroscopes, inclinometers and accelerometers to measure pavement roughness, rutting, cracking, and geometrics.
- Ability to collect dual wheel path roughness to International Roughness Index (IRI) standards.
- Can summarize data in subsection (e.g. 100') and test section intervals (intersections or maximum test length)
- Pavement view cameras for distress processing and QA/QC, plus 3-5 digital cameras for forward, side and right-of-way images.
- High accuracy Global Positioning System (GPS) receiver with inertial navigation for geo-locating of pavement and asset information with excellent accuracy.
- Dual distance measuring instruments to measure linear distances to within +/- 0.5%.
- Built-in software and on-board processors to develop roadway inventories, time code integration, and system monitors.

The Laser RST travels at the posted speed limit and thus does not affect the free flow of traffic. This is important as it allows IMS to:

- Collect data in a timely fashion without having to trade-off accuracy for production.
- Work from a safe, protected environment without risk to the data collectors.
- Eliminate the need to implement traffic control, close lanes or attempt to collect the data from the sidewalk or dodge traffic.
- Collect, validate and safeguard large volumes of data with out the need for transposing data from portable data collection units or paper.

The following diagram illustrates the full configuration of the RST for collection of pavement distress and image data. Data will be collected continuously, in the predominate travel lane and recorded at 100 foot intervals.



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Pavement View Camera	Laser-Camera Array	Digital Condition Rating Subsystem and Processors	Inertial Navigation GPS	Forward and Shoulder View Cameras
Distress data for: • Data QA/QC • Surface distress data extraction using specialized processing software (video based crack evaluation) • Pavement view images	Objective Pavement Distress data for: • Roughness • Rutting • Transverse cracking • Texture • Alligator cracking • Block cracking • Geometrics, crossfall, excessive crown, grade and radius of curvature	Data for: • RST control • Timecode • Roadway inventory • Pave type • Lane count • Full suite of surface distresses • Environmental inputs • Roadway attributes	Data for: • GPS coordinates • Data location verification • Production review	Data for: • Forward view images • Data QA • Right-of-way asset inventory & condition rating

Laser Camera Array

The laser camera array is capable of collecting automated pavement condition data in the form of roughness to International Roughness Index (IRI) standards, wheel path rutting, transverse cracking, block cracking, alligator cracking and texture. The technology driving the laser-camera array removes the subjective nature of pavement condition data collection. The pavement condition data may be processed to provide extent-severity distress ratings, or reduced to a series of index scores for loading into the pavement management software.

Digital Collection/Rating system (DCRS)

The Digital Collection Rating System is a touch screen based tablet computer that allows the user to define what information (distresses, attributes, and asset information) is to be collected and how it is to be quantified. The DCRS is integrated into the data flow through time code, GPS, distance and inventory control. In the context of this survey, the DCRS will be configured to be used as a data collection and checking device. Distress data for the selected software protocols will be collected continuously, while inventory and attribute data will be checked as the survey proceeds. As the operator identifies an attribute, the starting point is noted, and then closed at the end of the attribute (pavement type, lane count etc.). The attribute data is then logged against the corresponding roadway section complete with its GPS coordinate, distance and linear reference. The data can then be plotted against the source data for validation.

Distance Measuring

The RST uses dual hub mounted, pulse transducer type distance measuring instruments for collection of linear distances to less than 0.5% (0.005 miles/mile) accuracy. The distance data is integrated with the inventory, GPS coordinate data flow and timecode. The RST is capable of managing and accumulating distance by present means (say every 100 feet) or by the section. It also separates distance where the sensors are paused (for example during a construction detour), or when the survey speed falls below a minimum threshold.

Distance information is used for measuring the length of a roadway, curve and grade reporting, as well as asset and pavement reporting. The measured distance is the base measure for the start of the QA/QC process and is used to check measured distance versus GIS or reported distance.

GPS Coordinate Data Collection

The RST uses the Applanix LV 220 Position and Orientation system for collection of real time kinematic (RTK), differentially corrected, coordinate information. This is a tightly coupled inertial navigation based GPS system incorporating dual Trimble receivers. The unit is largely unaffected by satellite shadow caused by temporary loss of satellite coverage, tree canopy or structures. The level of accuracy for the RST is within a sub meter circle of error at a confidence level of 98%. Coordinate information will be acquired at a rate of 10 Hz, or approximately every 5 feet at highway speeds.

Inventory, Date, Survey Lane, Surface Type

Survey events (such as detours, obstructions or railways crossings) and inventory related items would be collected and noted in the data. RST operators note the surveyed lane, direction, lane count (either per highway or per pass) and predominant naming convention on a section-by-section basis. Highway names will then be crosschecked against data extracted from the videos and GIS. During the survey, changes to the inventory and base attributes will be noted and an exceptions report developed for the County.

Radius of Curvature, Grade and Cross Slope Measurement

Cross slope, radius of curvature and grade are measured with a patented road geometric instrumentation system (US 5,440,923) that is integrated with the RST system. These measurements are carried out independent of vehicle speed between 5-55 mph without the need of traffic control. The achieved repeatability between several runs has shown a correlation of 0.98. The system has been used for a network level survey on the entire Florida Interstate network system (9,000 miles) and the complete New Mexico highway network (8,000 miles).

Downward, Forward, Side and/or Rear View Images

Downward, dual forward, shoulder (or ditch) and rearward view images can be collected using broadcast quality digital video cameras and frame grabber software. Images may be captured at preset distance intervals, time intervals or at a fixed number of images per section. The cameras will be oriented to collect right of way panorama, sign views, ditch views and pavement (roadway) views. The cameras are environmentally enclosed for weather and temperature protection and are equipped with moisture sensors to prevent operation when humidity may affect image quality. All images shall be:

- Date and time stamped, attributed with its route/section identifier and orientation.
- Integrated with the DMI reading to the nearest foot and GPS coordinate information.
- Presented in jpeg format, electronically stored on mass storage devices and/or DVD

Deflection Testing

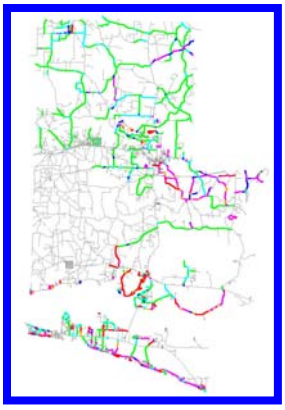
Each street test section surveyed by the Laser RST can receive a deflection test. This testing will be performed using the Dynaflect device and the results of this testing will permit an analysis of the structural capabilities of the existing street section. IMS utilizes all five sensors of the Dynaflect in its structural analysis. This provides valuable information on the capabilities of the pavement, base and subgrade sections, and the interaction between these sections. Although many area agencies include structural analysis as part of their program, the PavePRO software can now be used with or without deflection data. Nationally, some agencies use structural information on arterial and collector streets that tend to fail due to load, but rely on surface only data for residential roads where load is not a major factor in pavement failures. Others use surface only as the primary basis of the evaluation.

The Use of GIS in Managing Data

The role of GIS in pavement management cannot be understated. It is a powerful tool that provides the ability to handle and present vast amounts of data in an efficient manner. For this assignment, GIS will be used in four key areas of work:

1. GIS will be used to verify the streets to be surveyed and to create the routing maps for use during the field surveys.
2. The survey productivity will be tracked through the plotting of the GPS data collected during the field surveys. This will allow IMS to review all streets that have been covered, identify anomalies in the referencing and spot missed streets.
3. GIS will be used in processing the distress and inventory data. By plotting the data we can QA the data and identify data exceptions in addition to proofing out the GIS.
4. Shape files will be created for the visual presentation of condition data and analysis results. The following is a plot from a County highlighting the pavement condition using descriptive terms for public presentation.

Very Good
Good
Fair
Acceptable
Unacceptable
Unacceptable - Recon

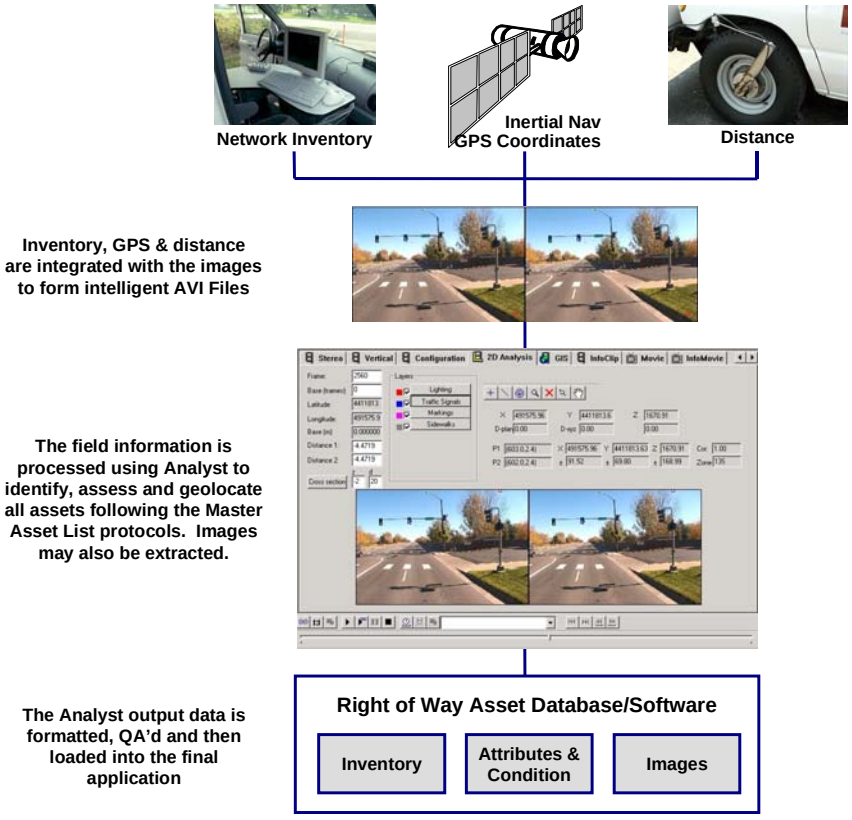


Roadway Attribute Database Development – Trident 3D Analyst

The RST uses high-end GPS coordinate data and digital cameras positioned so that all attributes/assets requiring data capture are visible in either the front, side or rear cameras. The images and GPS data are merged on a frame-by-frame basis along with the street inventory. The images are then post processed using a specialty piece of software called ***Trident 3D Analyst.***

Stereo analysis allows the GPS coordinates to be transferred to the asset and thus accurately positioned relative to their real world location, without the requirement of each asset having to be physically visited. The stop and start coordinates, and stationing, of all attributes or points of interest may accurately located and referenced.

Analyst is an open architecture system that allows virtually any type of attribute/asset to be defined for collection of location, attribute, and condition data. Once an attribute/asset is observed the operator toggles to the individual record input screen and proceeds to input the appropriate attribute and associated information. Wherever possible, “pick lists” are employed to streamline the data entry function and provide uniform, high quality data. For example, the location of turnouts may be noted (stop & start distance and X, Y, Z), complete with pick list entries for the type and location.



Prior to completion of the right of way inventory database development, a document called the **Master Asset List** (MAL) will need to be created. The MAL defines what assets or inventory items are to be data based, what attributes will be noted as well as the response. The MAL also defines the methodology for condition rating each asset. Essentially the Master Asset List is the direct equivalent of a "data direction" as it sets the rules for right of way asset data collection.

This methodology can be used to inventory, locate (GPS coordinates with sub meter accuracy), identify attributes and conditions of County assets and features including:

Point Assets/Features

- Signs
- Storm Inlets
- Signals
- Utility Poles
- Pedestrian Crossings
- Bridges
- Street Lights
- Fire Hydrants
- Drainage Structures
- Railroad Crossings
- Pavement Markings
- Trees

Linear Assets/Features

- Barrier Walls
- Medians
- Sidewalks
- Pavement Striping
- Guardrails
- Curbing
- One Way Streets
- Fences
- Bike Paths
- Number of Lanes
- Ditches