

INO subsystem

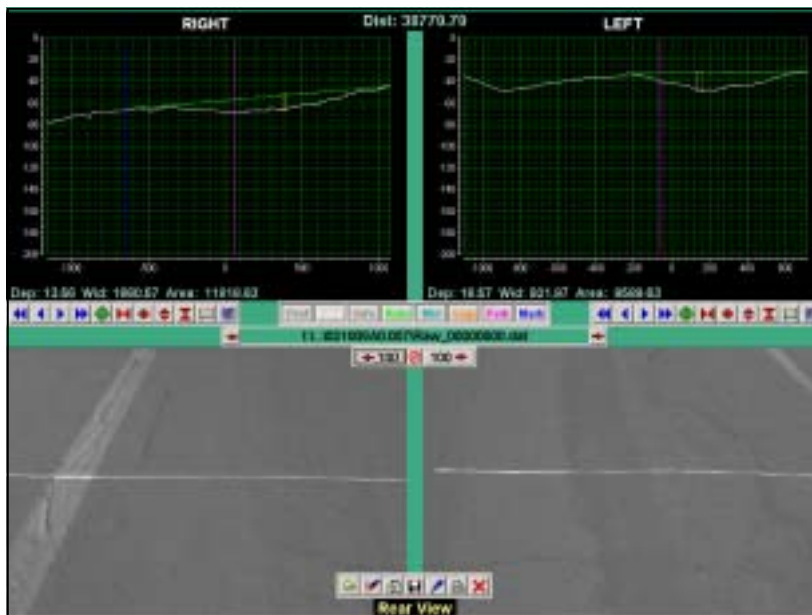
ICC has fully integrated the INO System into its MDR and developed specialized processing and viewing software for use with its data. The INO gives the ability to collect rut information with the highest level of accuracy. It helps overcome traditional collection difficulties that come from wheel path wander and limited measurement points. It is a cost effective way to collect and store transverse profiles of the roadway down to 1.5 meter intervals. Our system uses the INO to determine rut cross-sectional area and volumes, detect edge drop-off, report wheel path location, and identify double or triple rutting. In addition, the system reports center-line location, shoulder and pavement marking locations. Symbol and pavement markings can be viewed in the stored pavement images.

The INO sensor mounting location, height, and tilt are optimized to avoid any degradation of the measurement accuracy while providing a minimum 4.2 m transverse profile width. ICC provides a low-risk interface for the INO rut system. A dedicated computer controls the INO system, tags rut data with distance and time information, performs any required processing on the data, compress it using jpeg technology to optimize file size, and transfers the resulting information to the MDR computer. This technique allows our system to capture the entire raw data stream with rut measurement and intensity data. That means each image can be captured and software can be processed against the total image instead of only where the INO laser-line crosses the road. This feature provides the user an opportunity to store the images for

numerous other applications including marking and symbol conditions.

Automated Determination of Multiple Wheel Path Rutting

The system will determine the presence of multiple wheel path rutting based on the cross-sectional data output from the INO sensors. The System will determine, and store the presence and depth for each of the individual wheel ruts within wheel paths in a transverse profile. The software provides a summary report on the locations (from/to referencing) within the surveyed distance where multiple wheel path rutting was detected. Multiple wheel path rutting analysis and reporting are accomplished in post-processing. Multiple wheel path rutting is displayed in real-time on the operator console.



- Blue Lines Indicate Pavement Marking Locations
- Red Lines Indicate Roughness Laser Location

Accurately View Rut Cross-Section and Pavement Marking Locations



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Automated Determination of Center-line and Shoulder Line Lane Marking Locations

ICC uses the INO 3D intensity reading from each image to determine the presence and location of centerline, shoulder-line pavement markings and referencing the location of collected roughness data (IRI) with the rut data.

Our system determines and reports the following for each cross-section.

- The offset from lane markings to the centerline of each of the rut laser sensors located on the vehicle.
- The offset from the rut laser centerline to each of the roughness lasers.
- The offset to the point of maximum rut depth in each wheel path.

- The average offset and associated standard deviation for each of the above for a specified reporting interval that is user definable.

Automated Determination of Passing Zone Locations

ICC provides software to take the centerline information and provides an algorithm to determine the type of marking present (double solid, solid and dashed, dashed or none) as well as the location of where the centerline marking changes from one type to another.

Rut Cross-sectional Area and Volumes

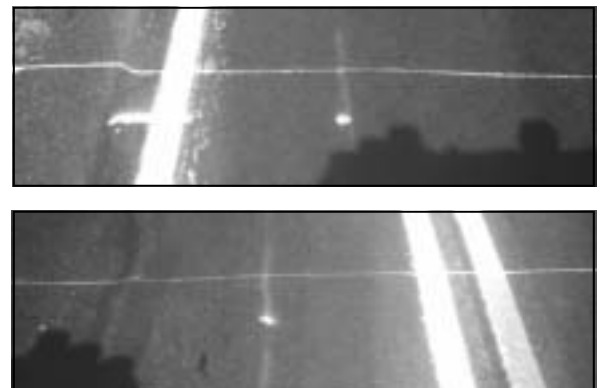
ICC calculates and records the cross-sectional areas of each wheel path rut and the total cross-sectional area of the ruts for each cross-section. The

system applies a 3rd order fit to the rut points and sums the area under the reference plane.

The rut volume for each wheel path and the total rut volume of both wheel paths are calculated from the rut cross-section areas. The resulting rut volumes are stored and reported for a user specified section of road or interval. ICC calculates the volume of each section *by taking* the average of the cross-sectioned area of each pair and multiplying by the distance between. The section volumes are then summed to produce a total. In the absence of INO information the software will best fit missing points and uses the last known profile cross-sectional area.



Report and View Shoulder Drop-Off



Store Raw INO Images for Numerous Applications Including Marking and Symbol Conditions

