Use Of Hi-Rail Light Geometry Vehicles To Monitor Track For Compliance And Safety

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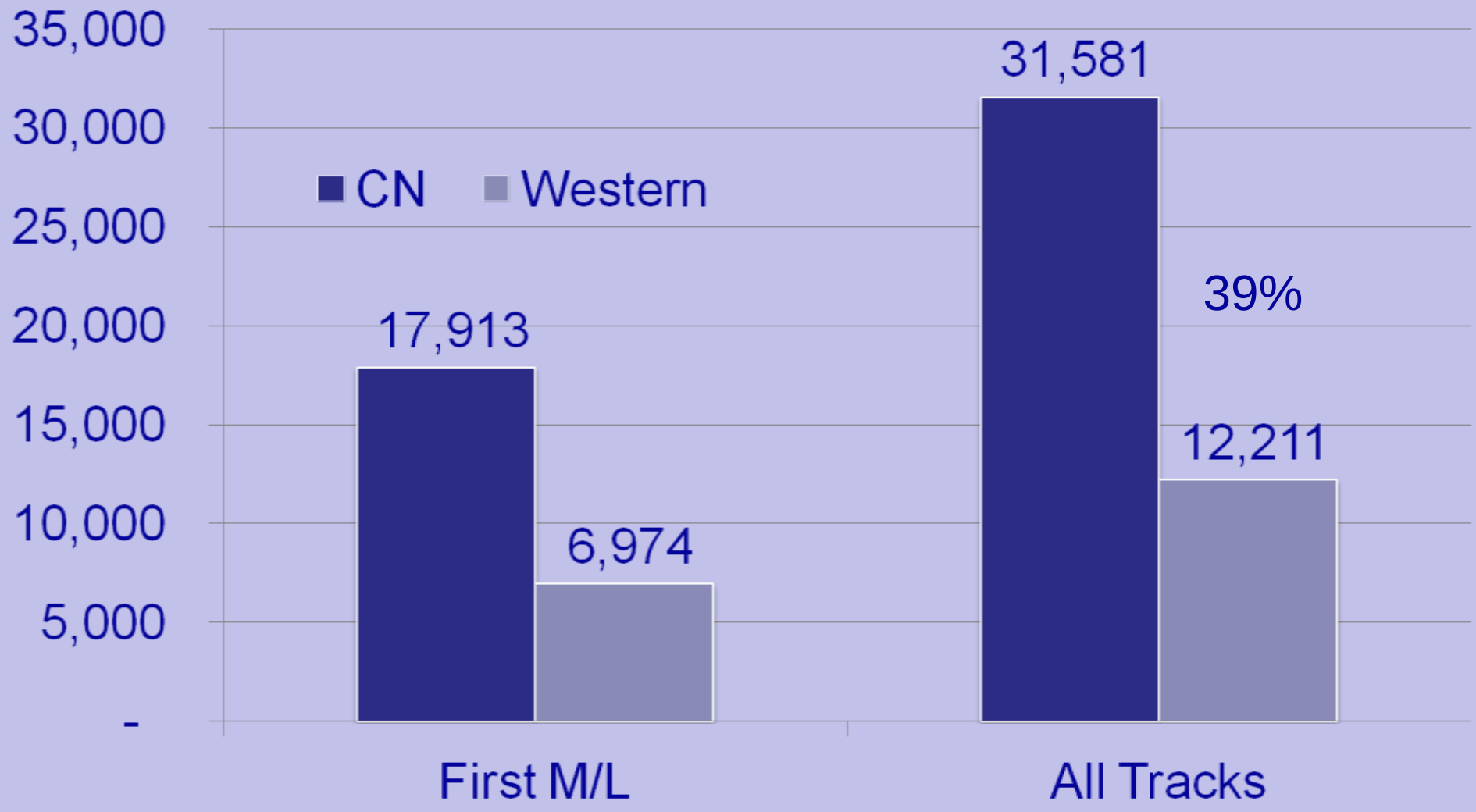
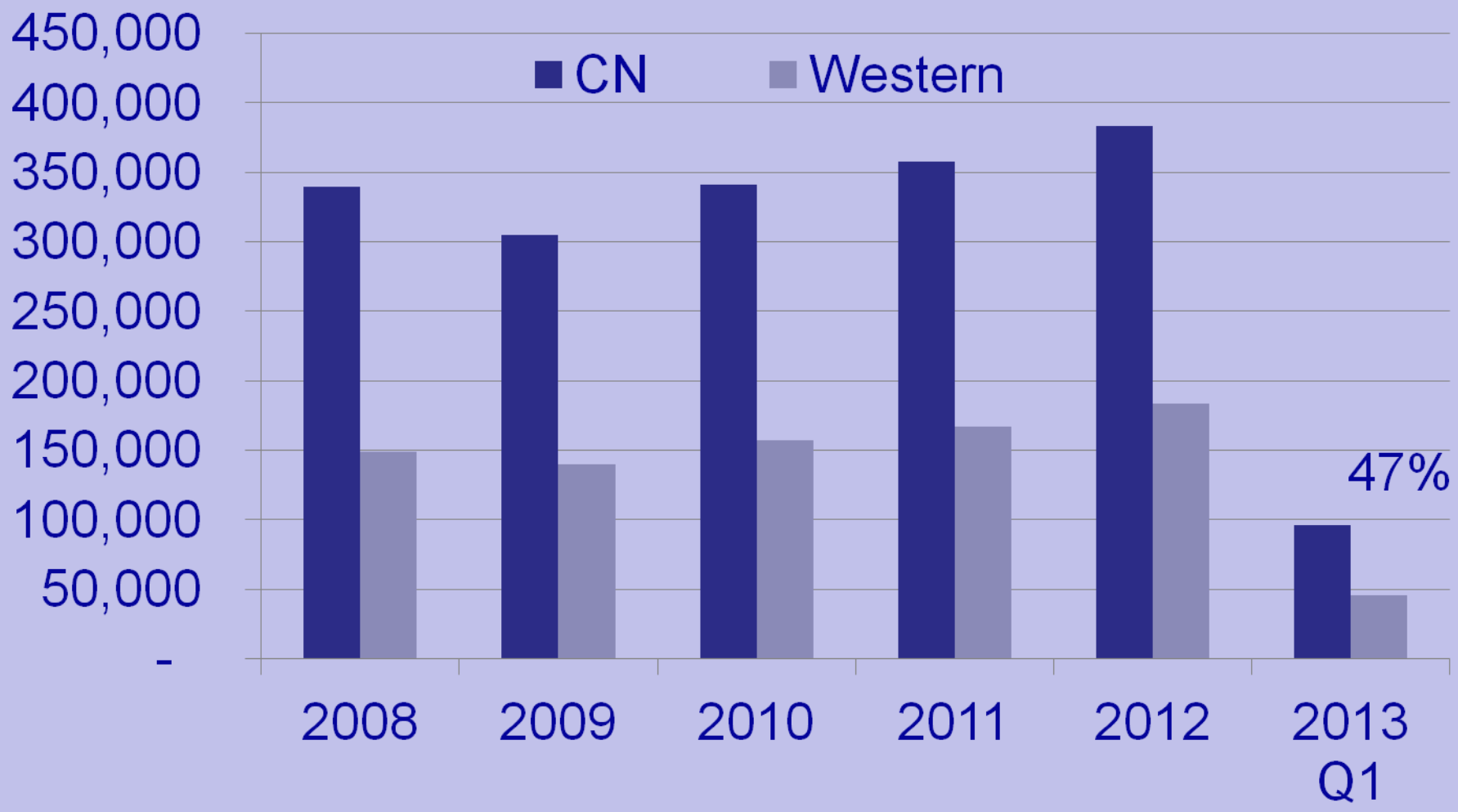
Duluth
Toronto
Minneapolis/St. Paul
Detroit
Sioux City
Omaha
Chicago
St. Louis
Memphis
Jackson
Mobile
Baton Rouge

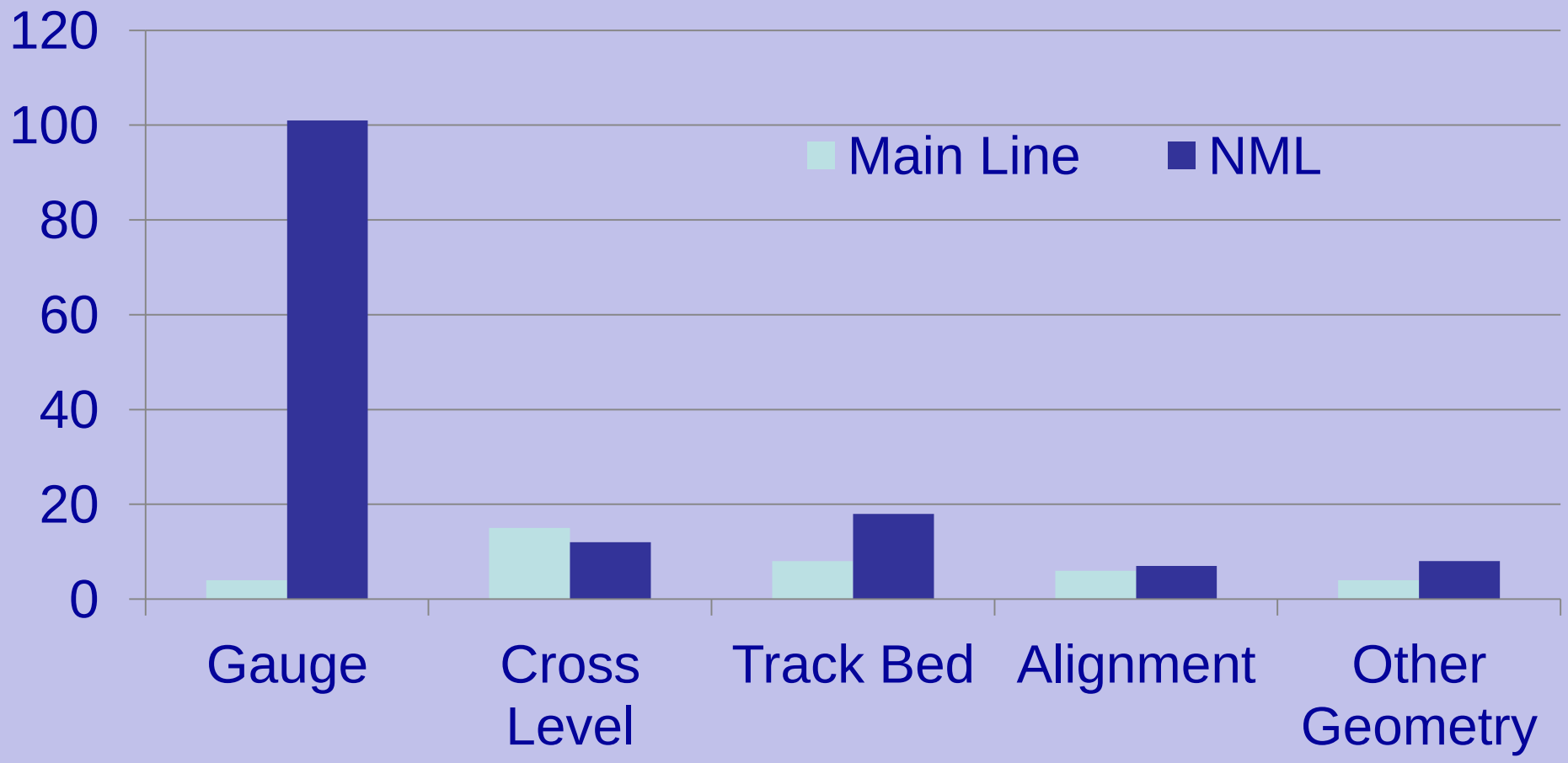
Trackage Statistics (Miles)



Annual Tonnage GTM (Millions)

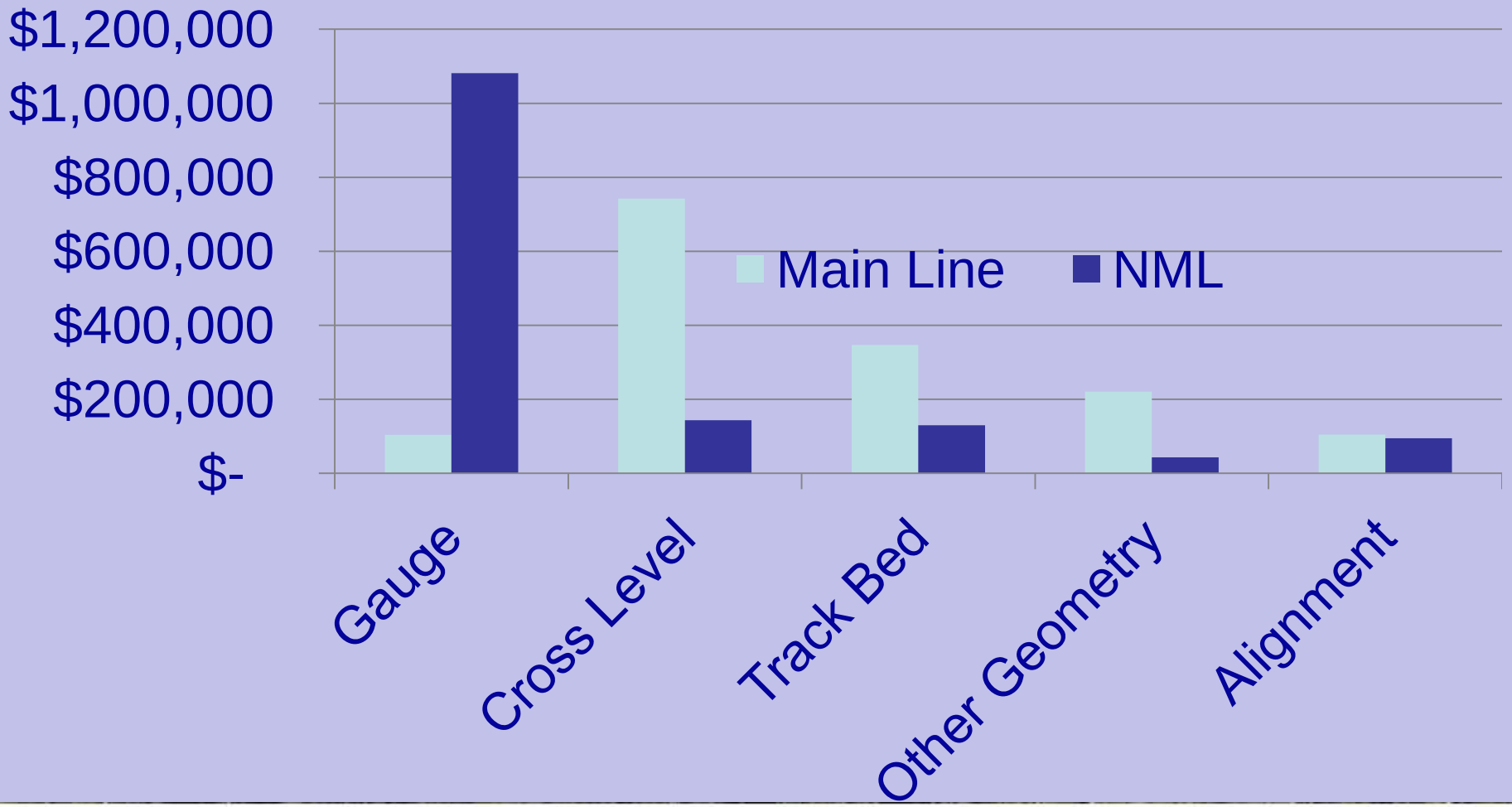


Number of Geometry Derailments by Exception (2005 to 2013)

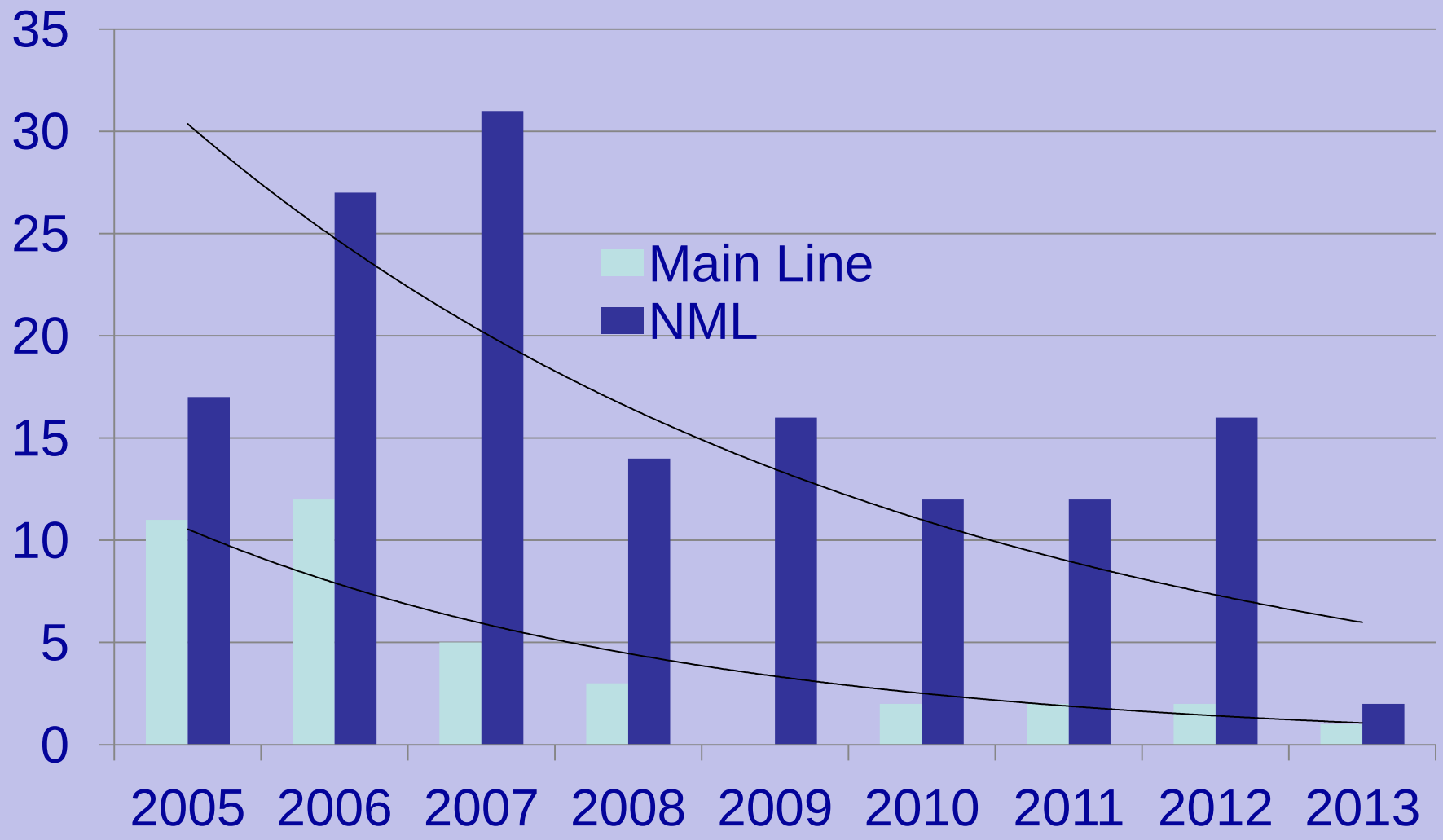


Cost of Derailment by Exception Type

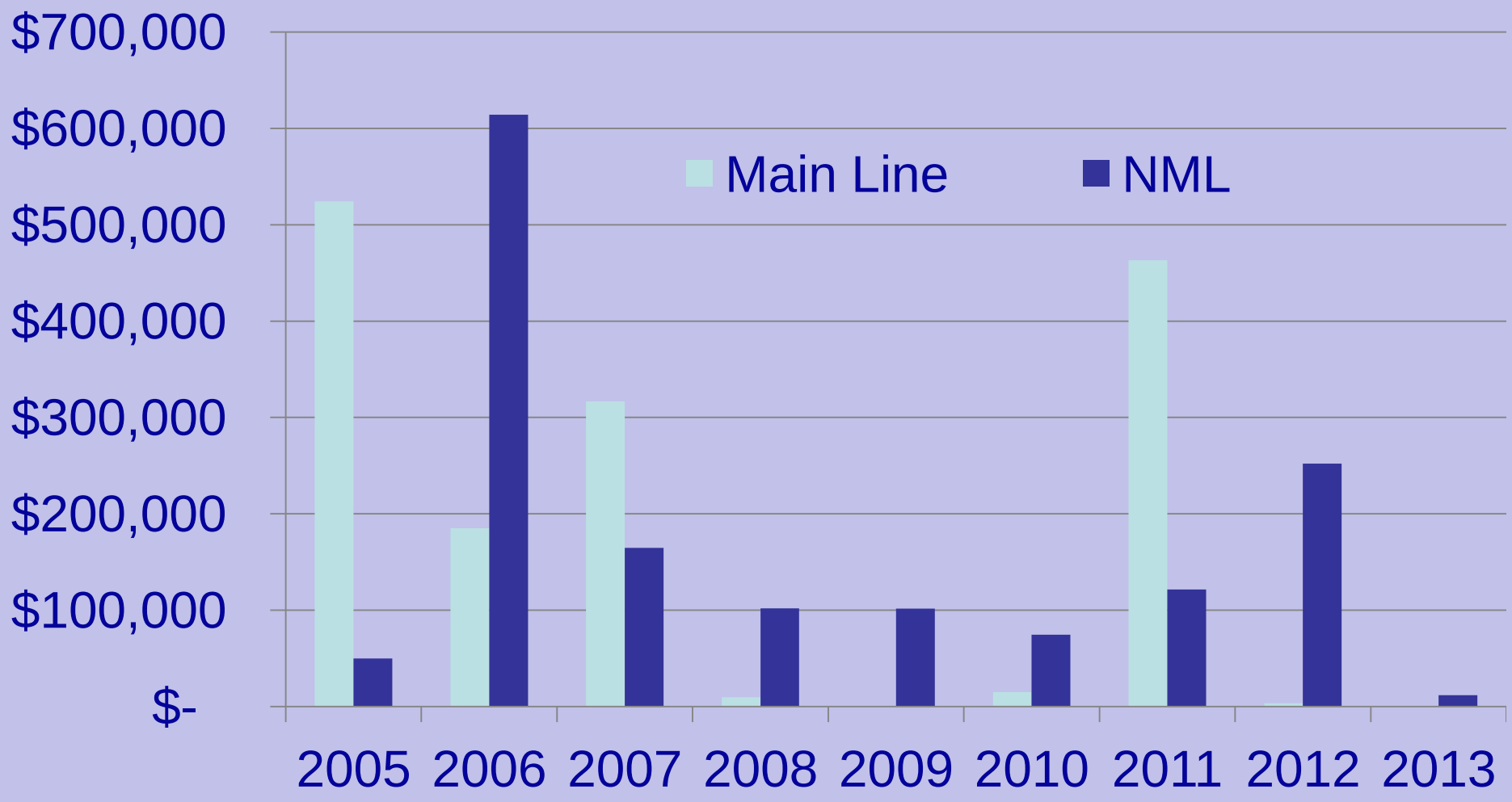
(2005 to 2013)



Geometry Caused Derailments by Year



Cost of Geometry Caused Derailments by Year



Find Defects Before They Find Us…

What is the result of limited track geometry testing?

- Increases in slow orders and derailments reduce train velocity
- Wasted energy, higher cost of maintenance

Some exceptions are difficult to identify visually

What is the Ideal Testing Frequency? What Do We Gain?

What affects the changes in track geometry?

- Weather (frost heaves, soft track condition due to saturation)
- Influences in track substructures (Ballast, sub ballast, subgrade)
- Structural influences (bad wheels, poor track hardware, and/or lack of good track maintenance)

How Can We ‘Control the Controllable’?

- Prediction is the best way to be proactive
- Identify geometry issues before any negative impacts on traffic (speed restrictions, train delays)
- Increase “Proactive” and decrease ‘Reactive’ approach

Geometry Exceptions Severity

CN's Geometry Cars classify exceptions in three severity levels:

1. Urgent

2. Near Urgent (90% of urgent +/-)

3. Priority

Geometry Exception Types

- Gauge
- Rail wear/Cant
- Alignment and curvature
- Cross level, Superelevation
- Vmax
- Warp (31/62 ft), Twist
- Surface, Rock & Roll, Runoff

CN 15008/15009 (ImageMap System)

CN 1501 (ENSCO System)

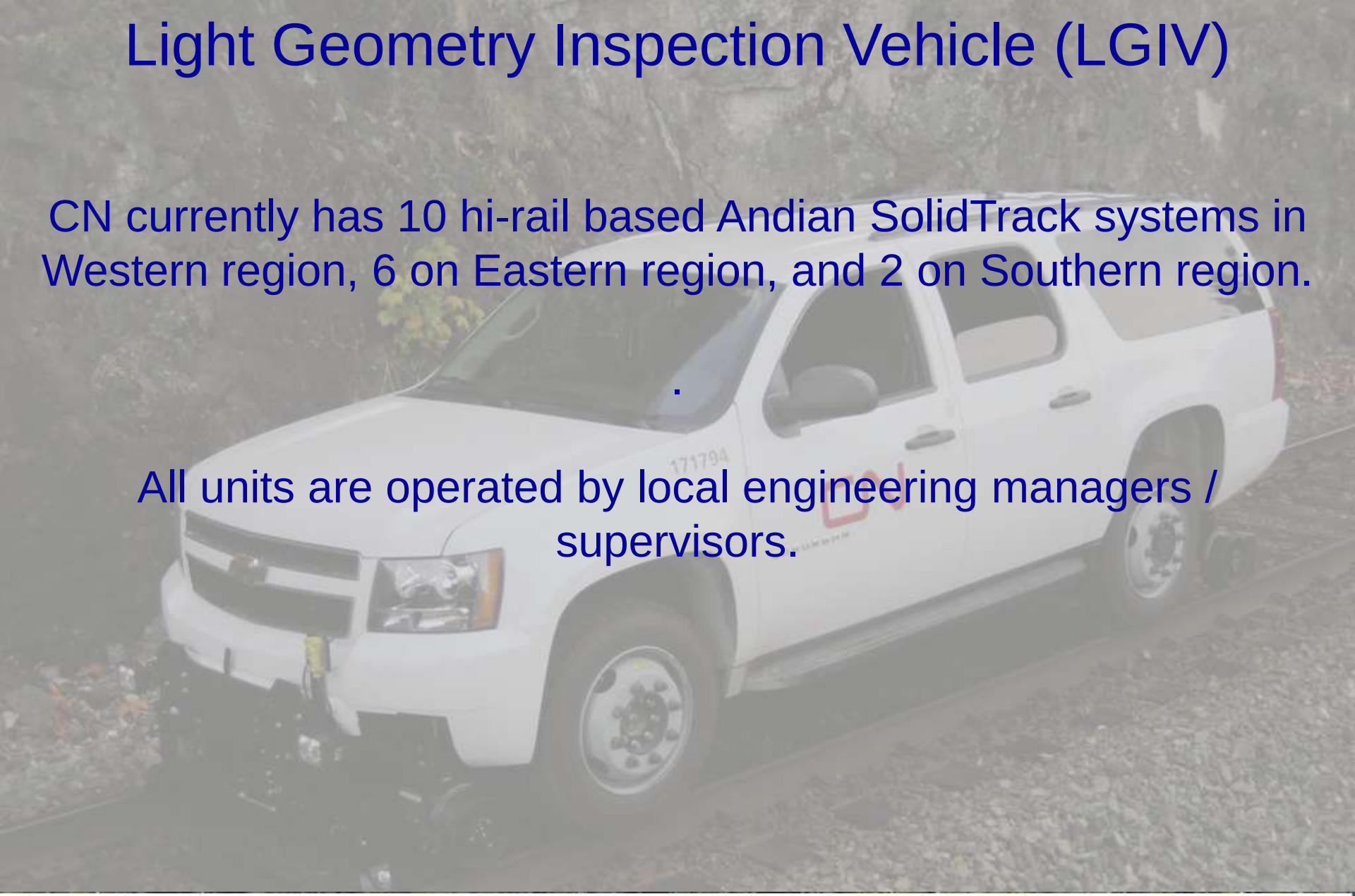
Autonomous Vehicle/Track Interaction (VTI) Monitoring (ENSCO)

It's a tool that:

- Detects vehicle and track interaction deviations
- Provides a proactive approach to reducing damage to vehicles and track
- Improves the track inspection process
- Quantifies and prioritizes the exceptions
- Can prevent costly service and equipment failures

Holland Company's GRMS TrackStar
Contracted as required

Light Geometry Inspection Vehicle (LGIV)



CN currently has 10 hi-rail based Andian SolidTrack systems in Western region, 6 on Eastern region, and 2 on Southern region.

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All units are operated by local engineering managers / supervisors.

The Anatomy of an Andian SolidTrack System

Mechanical gauge sensor

Single person operation with laptop at the driver's finger tips.

Storage and electronic inertial module

Operator's view with real time geometry data


Pre test preparation

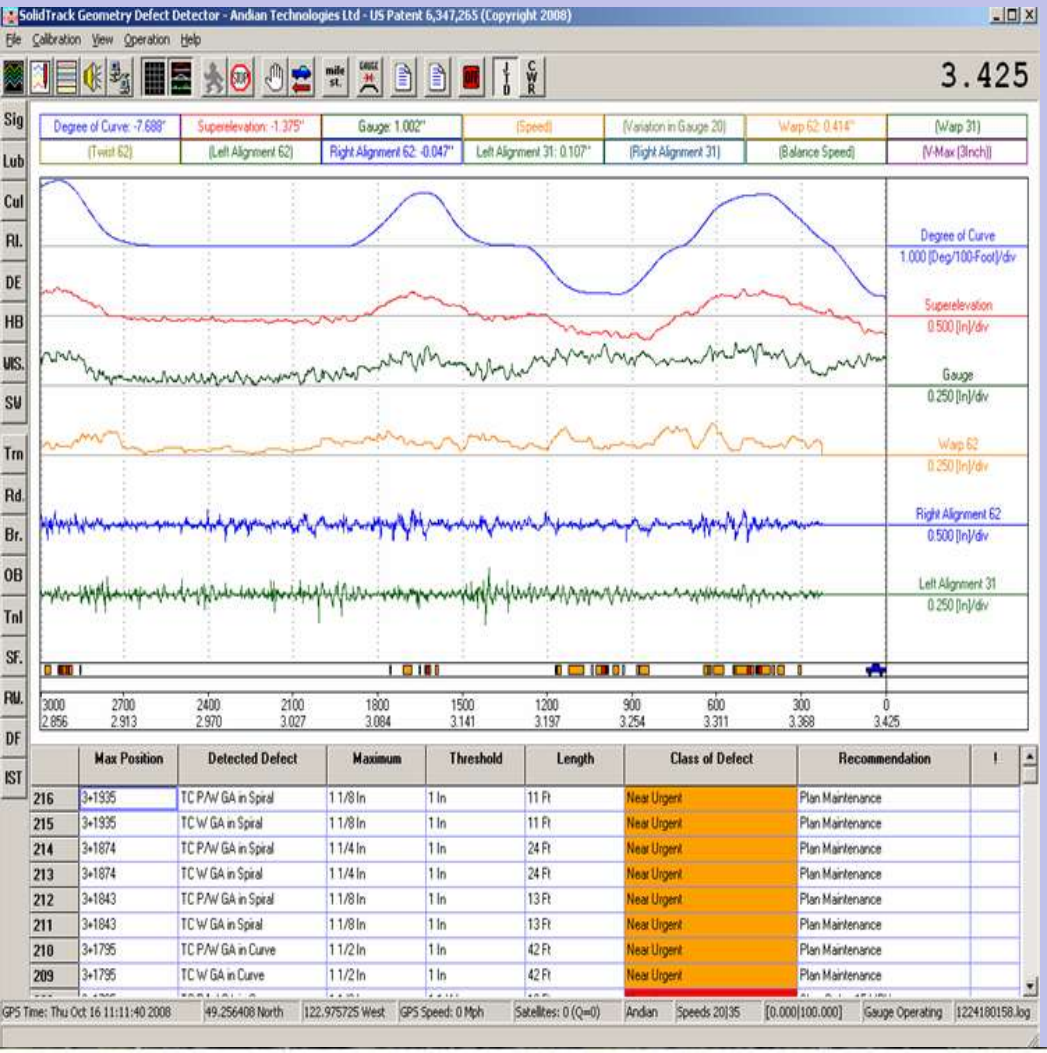

Getting on track


Verify Measurement


Lifting Gage System Prior Of Passing A Switch

SolidTrack Overview Video

What SolidTrack Measures:



- Gauge
- Alignment/Curvature
- Cross level, Superelevation
- Warp/Twist
- Surface, Rock & Roll
- V-Max

•Defects are displayed in real time allowing user to immediately validate the identifies conditions

•User is alerted to defects with color and audio cues

Benefits of SolidTrack Geometry Testing

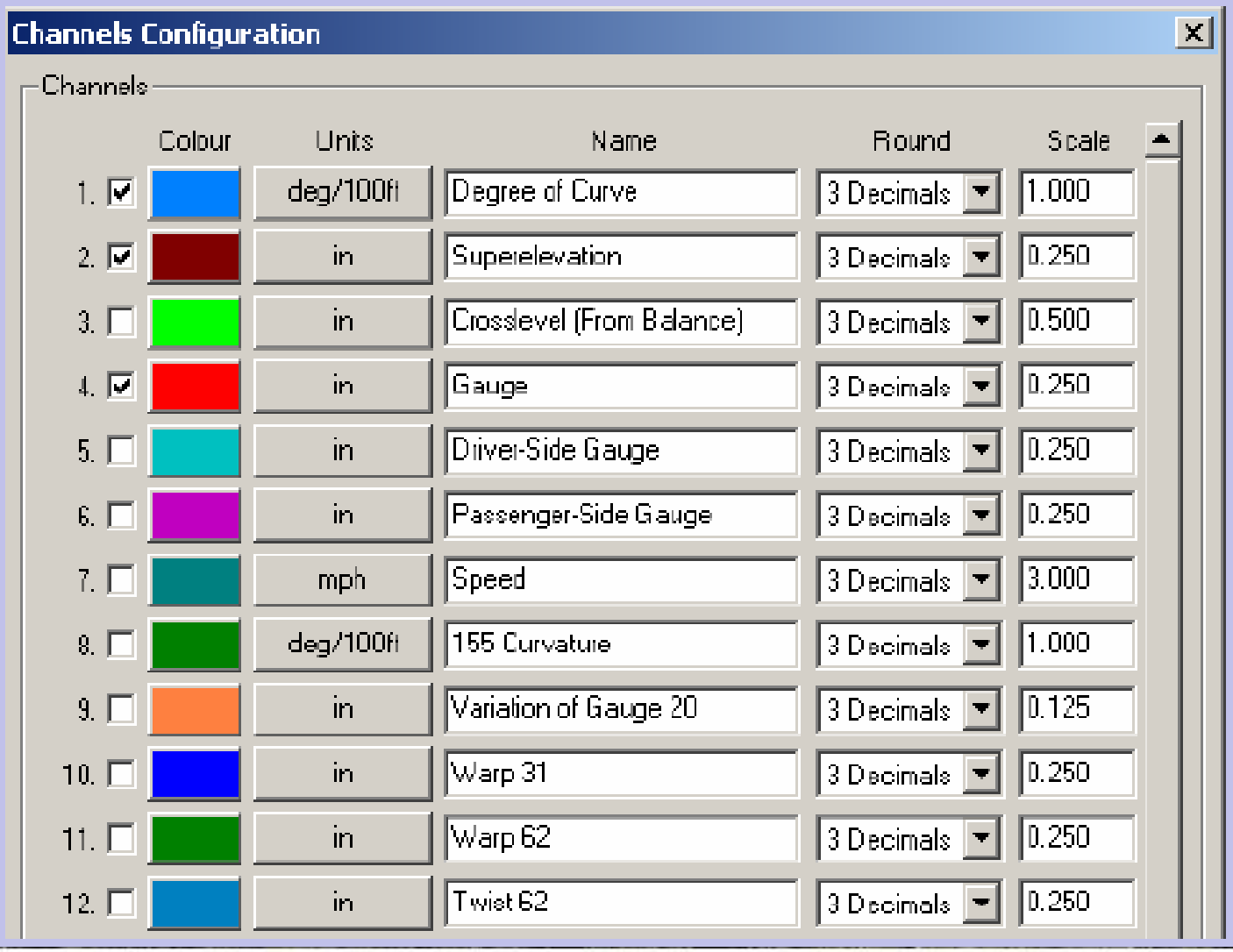
- Increased fluidity/ flexibility (Take off and run)
- Better organization of maintenance and repairs
- No train crew/ Loco unit required
- Maximized track time
- Reduced derailments
- Stop and verify
- Reduced rail wear
- Reduced wheel wear
- Lower fuel consumption

- Training oversight for young supervisors (Seeing Eye Dog)

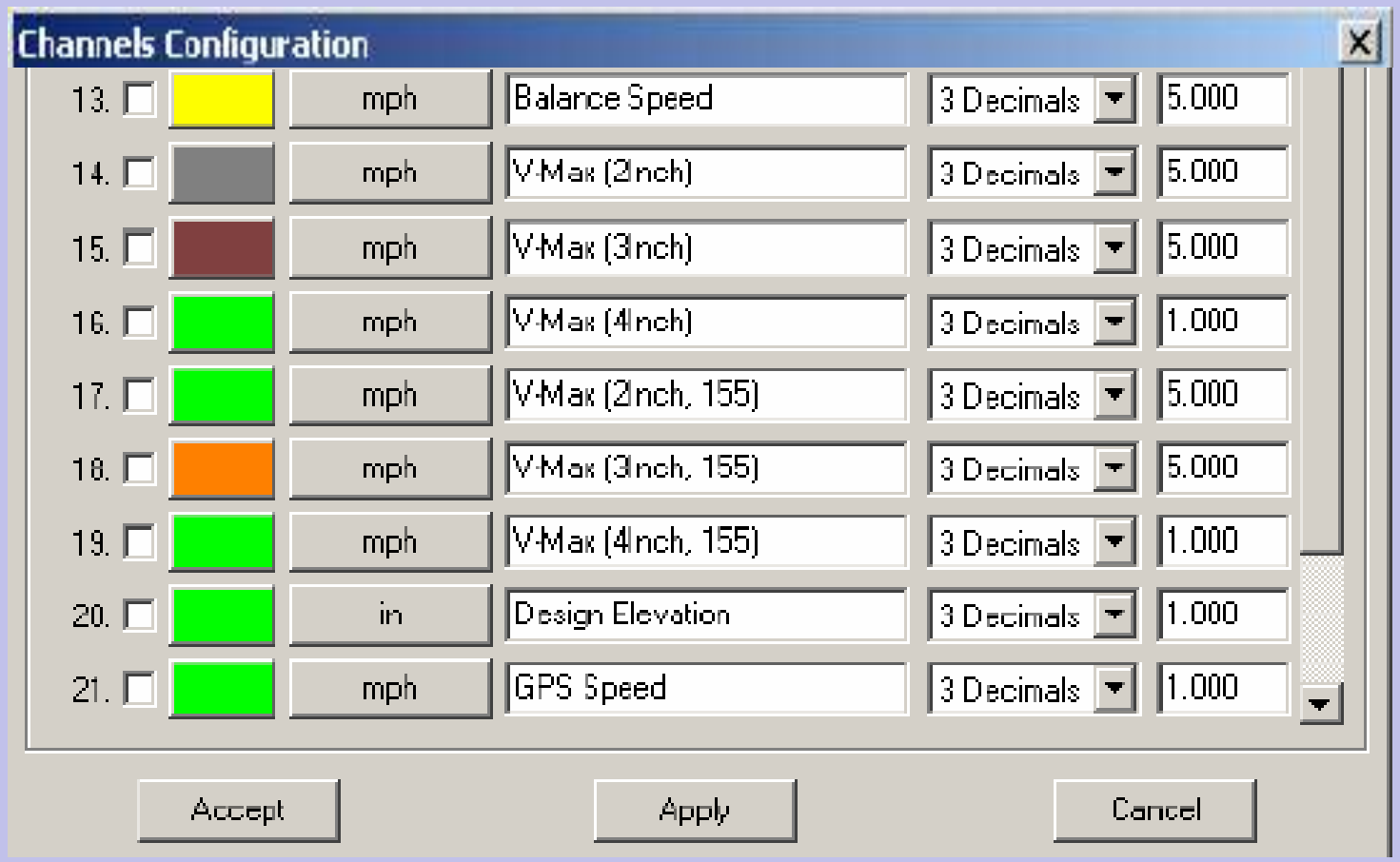
SolidTrack System and Data Management Software

- Slow orders rapidly removed
- Hi-rail geometry allows for rapid deployment
- Highly effective for monitoring rapidly changing track environments
- Ensures total track safety and compliance to enhance and maintain track velocity
- Allows for rapid traceability of defects
- Assures any speed restrictions are warranted
- Capital planning
- Comprehensive software package for better management of scheduling and forecasting of maintenance

SolidTrack Channel Setup (1)

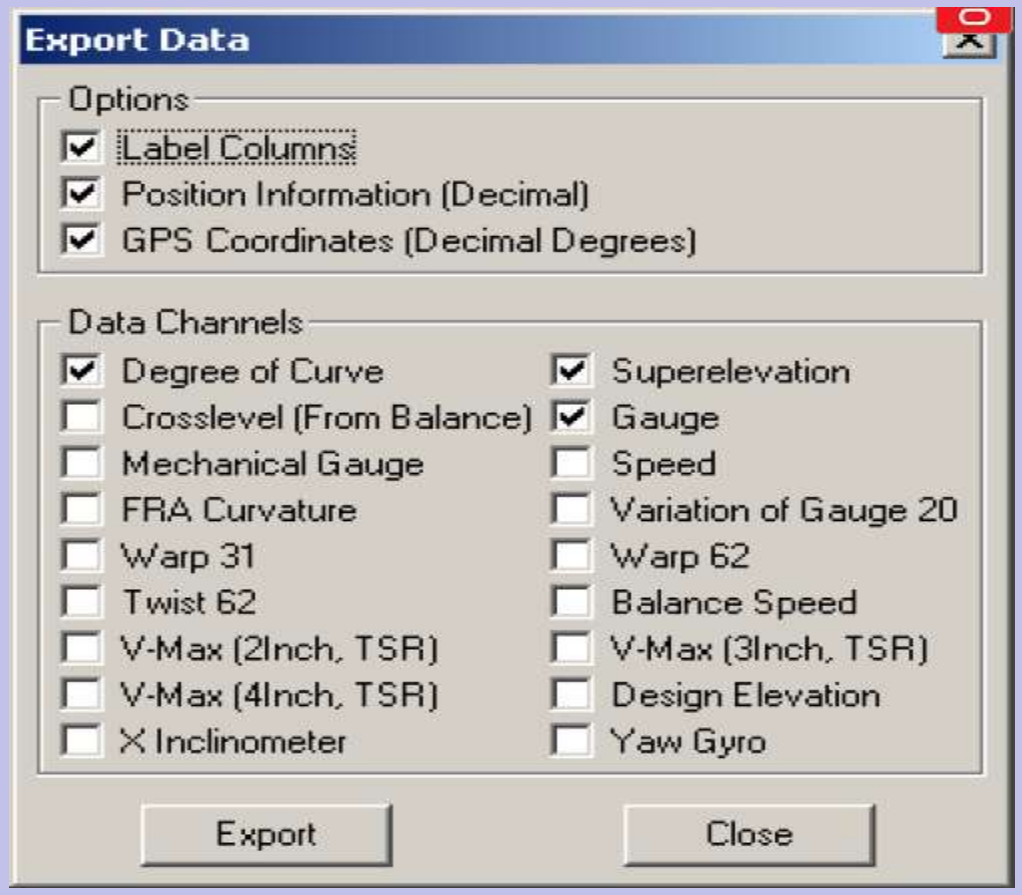


SolidTrack Channel Setup (2)



Exporting data to CSV Format

(useable for any database application)



Comprehensive Software Package

SolidTrack (Client/Server)

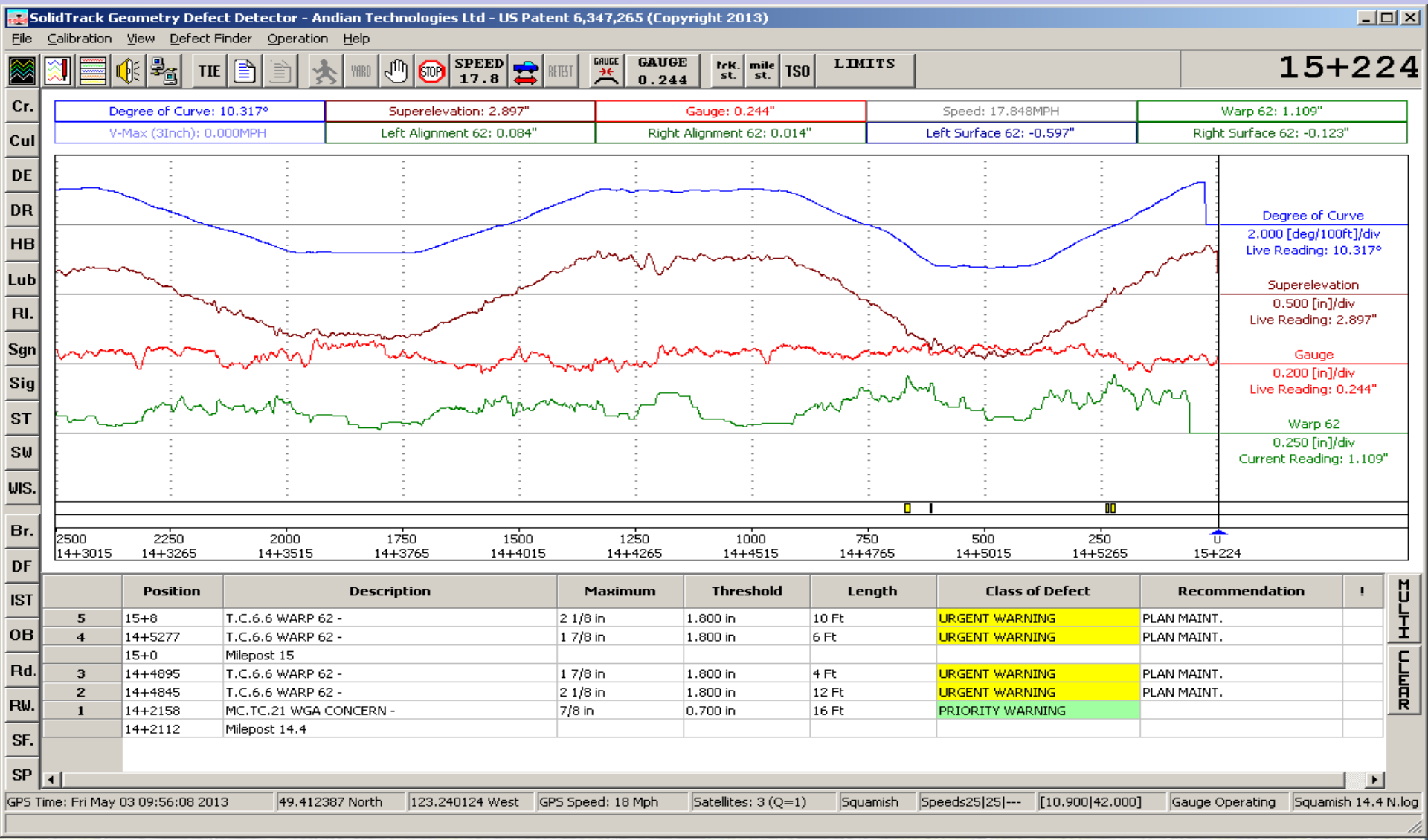
- Records geometry data real time with GPS

- Integrated DefectFinder module to overlay and compare previously collected data while testing

GeoPrint

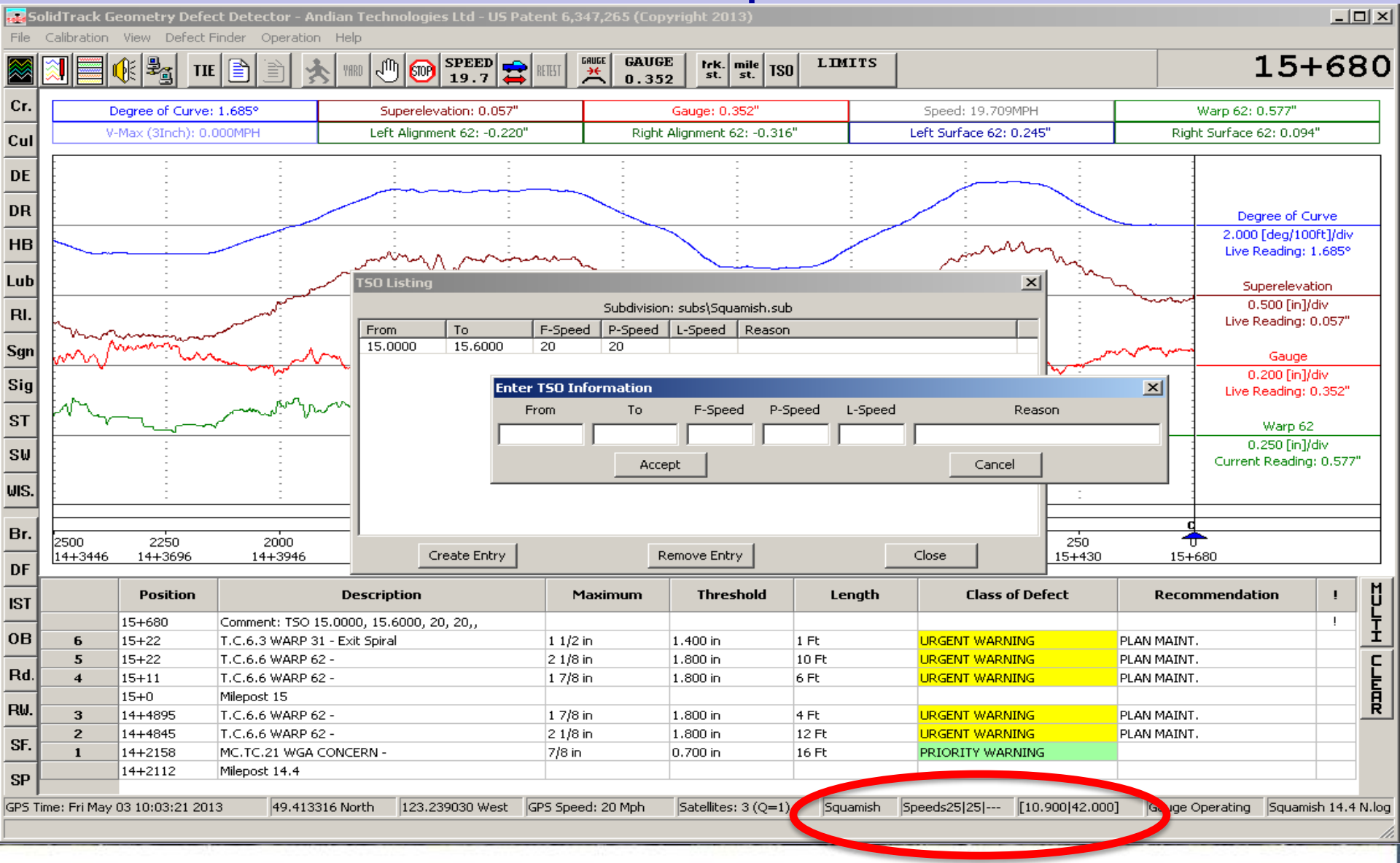
- Post run viewing and data comparison
  Custom report generation.
  Bring the field to the office.

SolidTrack Graphic User Interface (Client)

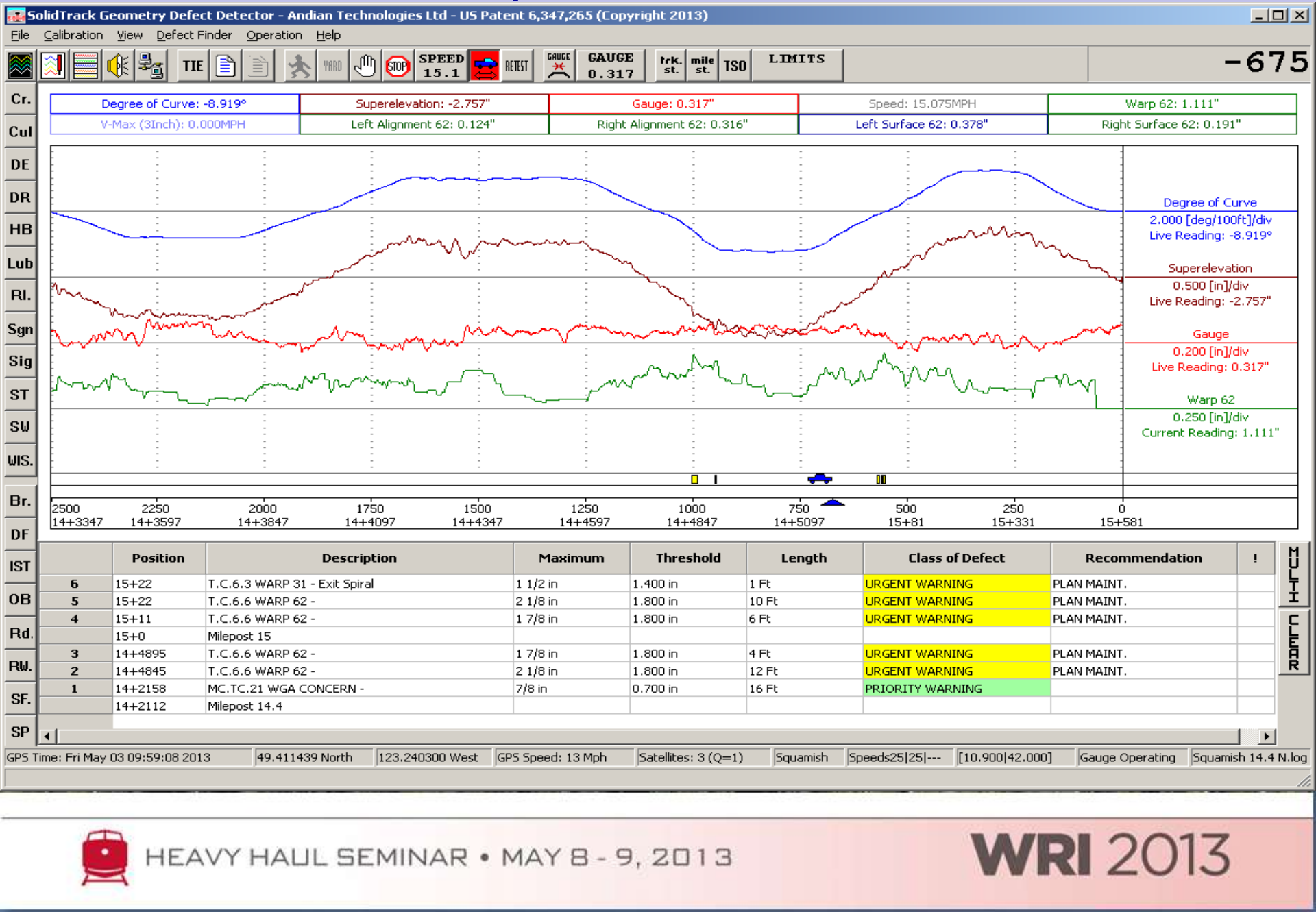


	Position	Description	Maximum	Threshold	Length	Class of Defect	Recommendation	!
5	15+8	T.C.6.6 WARP 62 -	2 1/8 in	1.800 in	10 Ft	URGENT WARNING	PLAN MAINT.	
4	14+5277	T.C.6.6 WARP 62 -	1 7/8 in	1.800 in	6 Ft	URGENT WARNING	PLAN MAINT.	
	15+0	Milepost 15						
3	14+4895	T.C.6.6 WARP 62 -	1 7/8 in	1.800 in	4 Ft	URGENT WARNING	PLAN MAINT.	
2	14+4845	T.C.6.6 WARP 62 -	2 1/8 in	1.800 in	12 Ft	URGENT WARNING	PLAN MAINT.	
1	14+2158	MC.TC.21 WGA CONCERN -	7/8 in	0.700 in	16 Ft	PRIORITY WARNING		
	14+2112	Milepost 14.4						

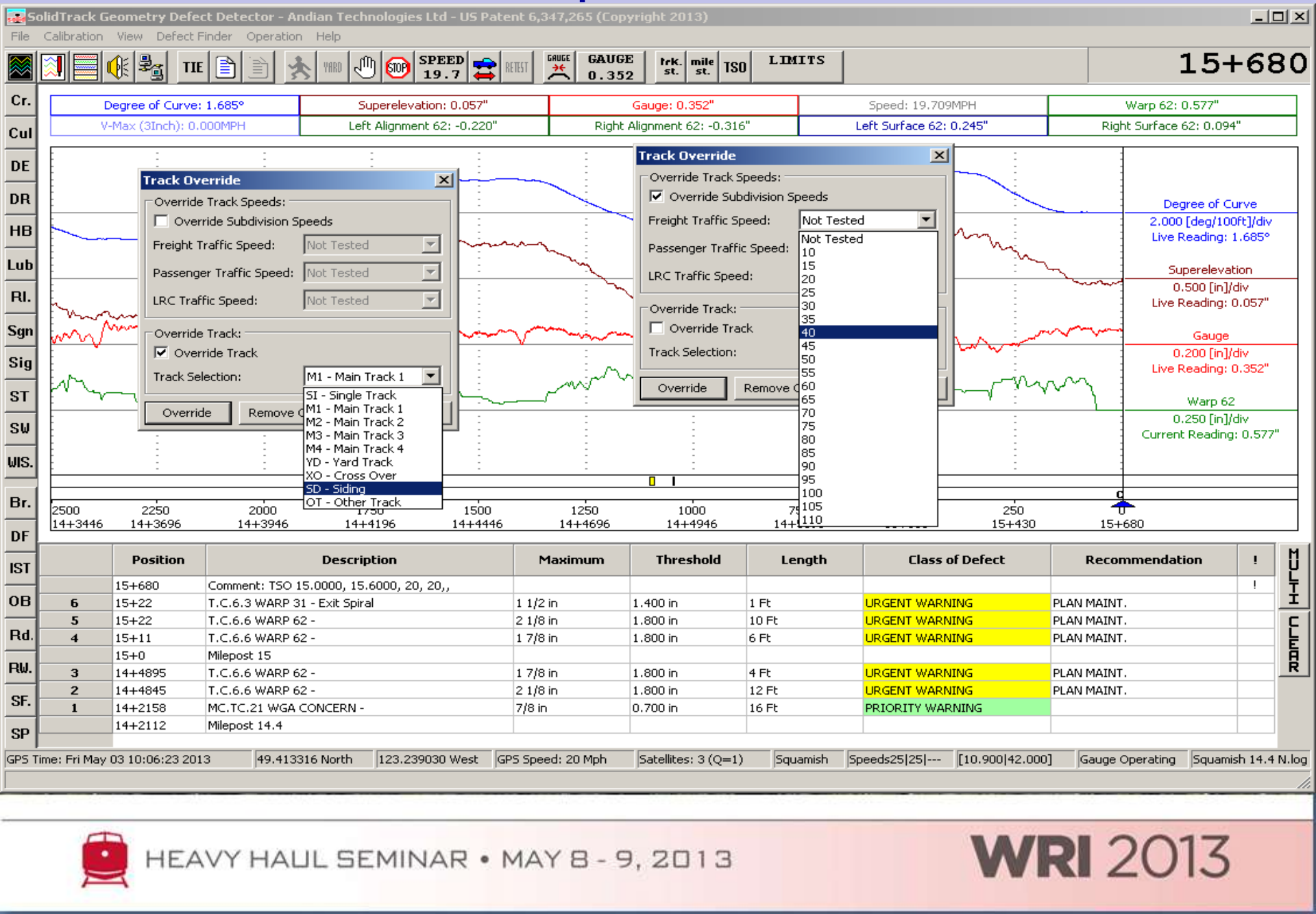
Zone, PSO, TSO speed elevation



Auto Backup and Re-test Features



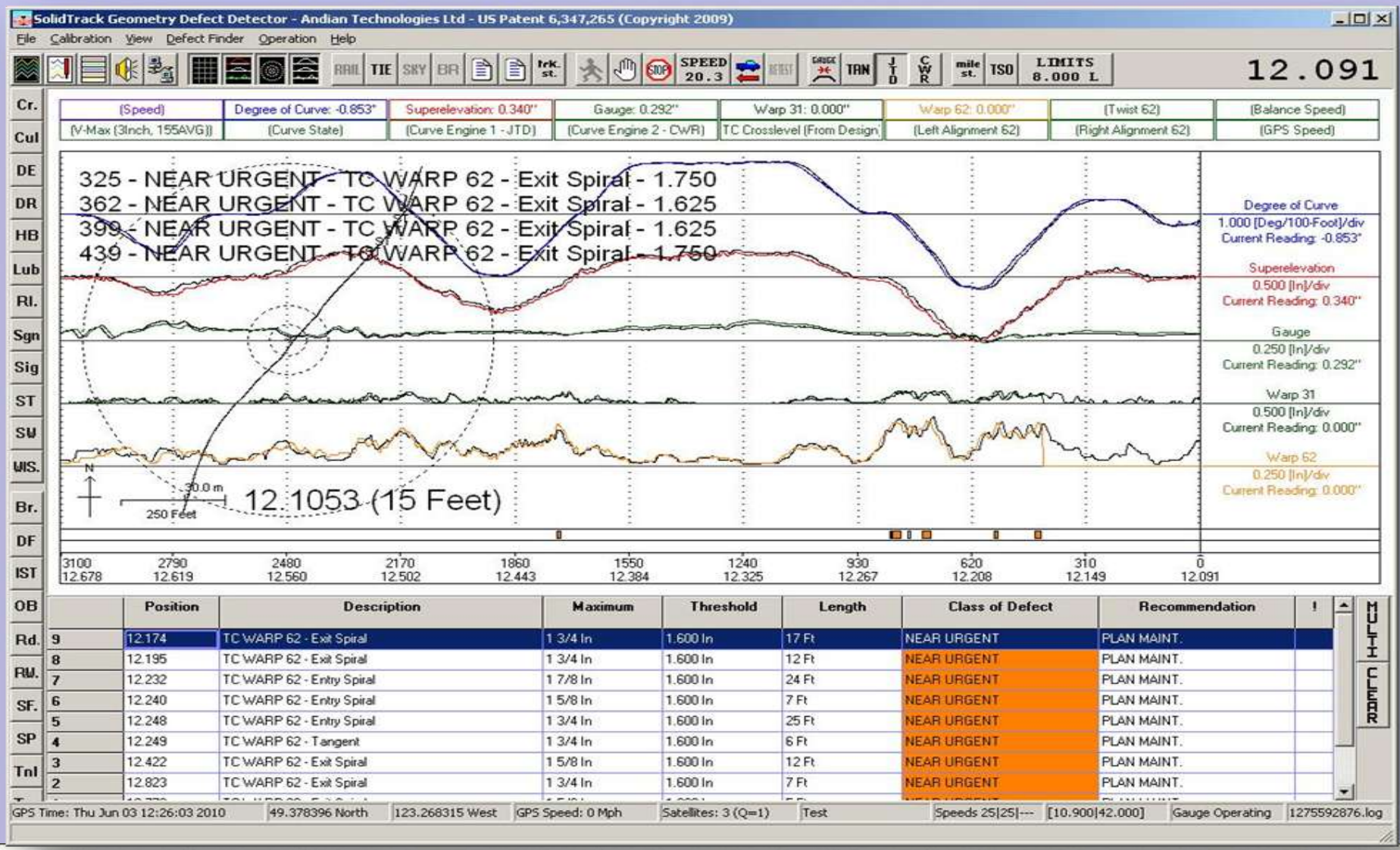
Track ID and Speed Over-ride Mode



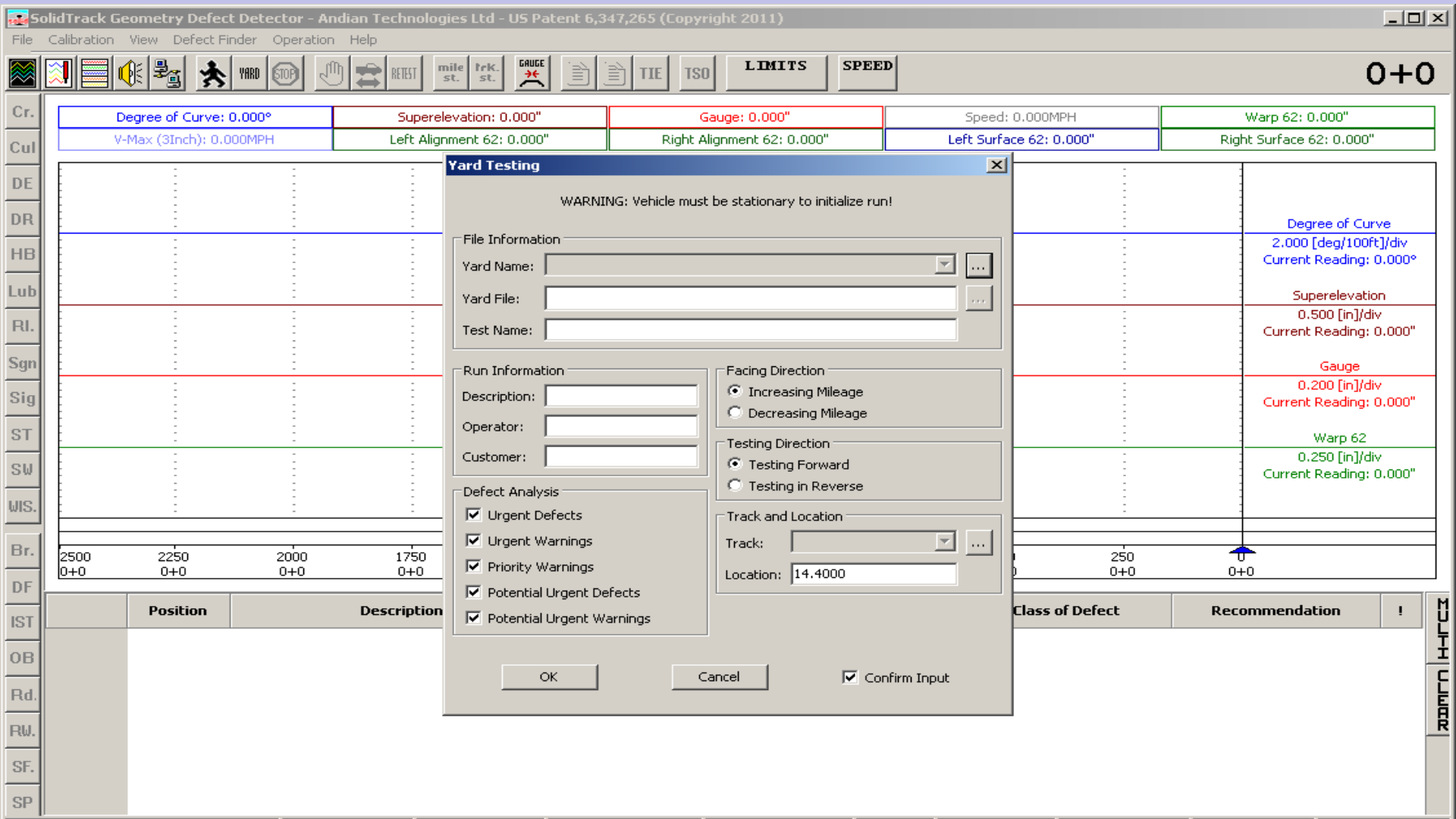
	Position	Description	Maximum	Threshold	Length	Class of Defect	Recommendation	!
	15+680	Comment: TSO 15.0000, 15.6000, 20, 20,,						!
6	15+22	T.C.6.3 WARP 31 - Exit Spiral	1 1/2 in	1.400 in	1 Ft	URGENT WARNING	PLAN MAINT.	
5	15+22	T.C.6.6 WARP 62 -	2 1/8 in	1.800 in	10 Ft	URGENT WARNING	PLAN MAINT.	
4	15+11	T.C.6.6 WARP 62 -	1 7/8 in	1.800 in	6 Ft	URGENT WARNING	PLAN MAINT.	
	15+0	Milepost 15						
3	14+4895	T.C.6.6 WARP 62 -	1 7/8 in	1.800 in	4 Ft	URGENT WARNING	PLAN MAINT.	
2	14+4845	T.C.6.6 WARP 62 -	2 1/8 in	1.800 in	12 Ft	URGENT WARNING	PLAN MAINT.	
1	14+2158	MC.TC.21 WGA CONCERN -	7/8 in	0.700 in	16 Ft	PRIORITY WARNING		
	14+2112	Milepost 14.4						

GPS Time: Fri May 03 10:06:23 2013 | 49.413316 North | 123.239030 West | GPS Speed: 20 Mph | Satellites: 3 (Q=1) | Squamish | Speeds25|25|--- | [10.900|42.000] | Gauge Operating | Squamish 14.4 N.log

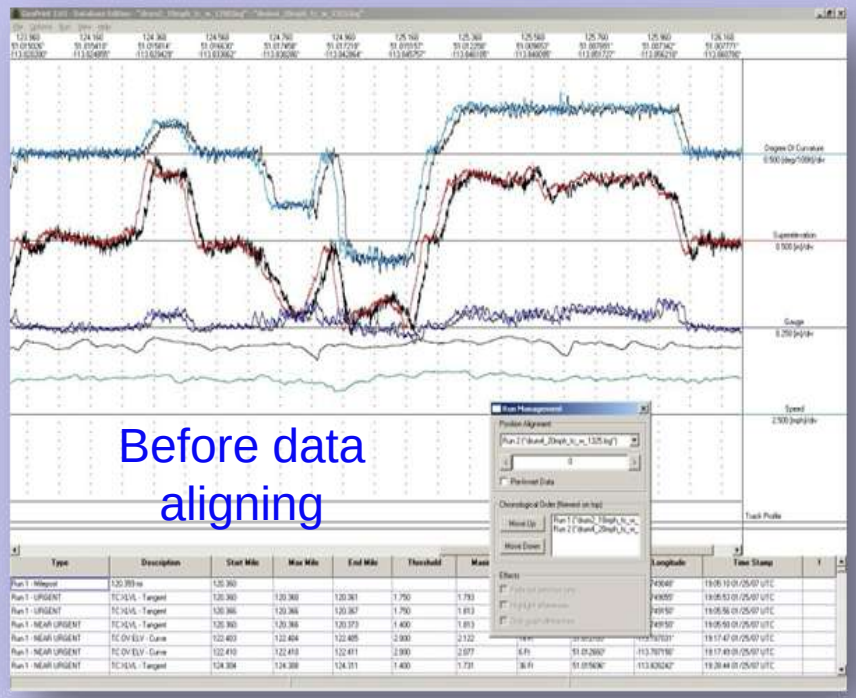
Integrated DefectFinder – Previous Run Overlay



YardMaster Mode



Post-run Viewing (GeoPrint)

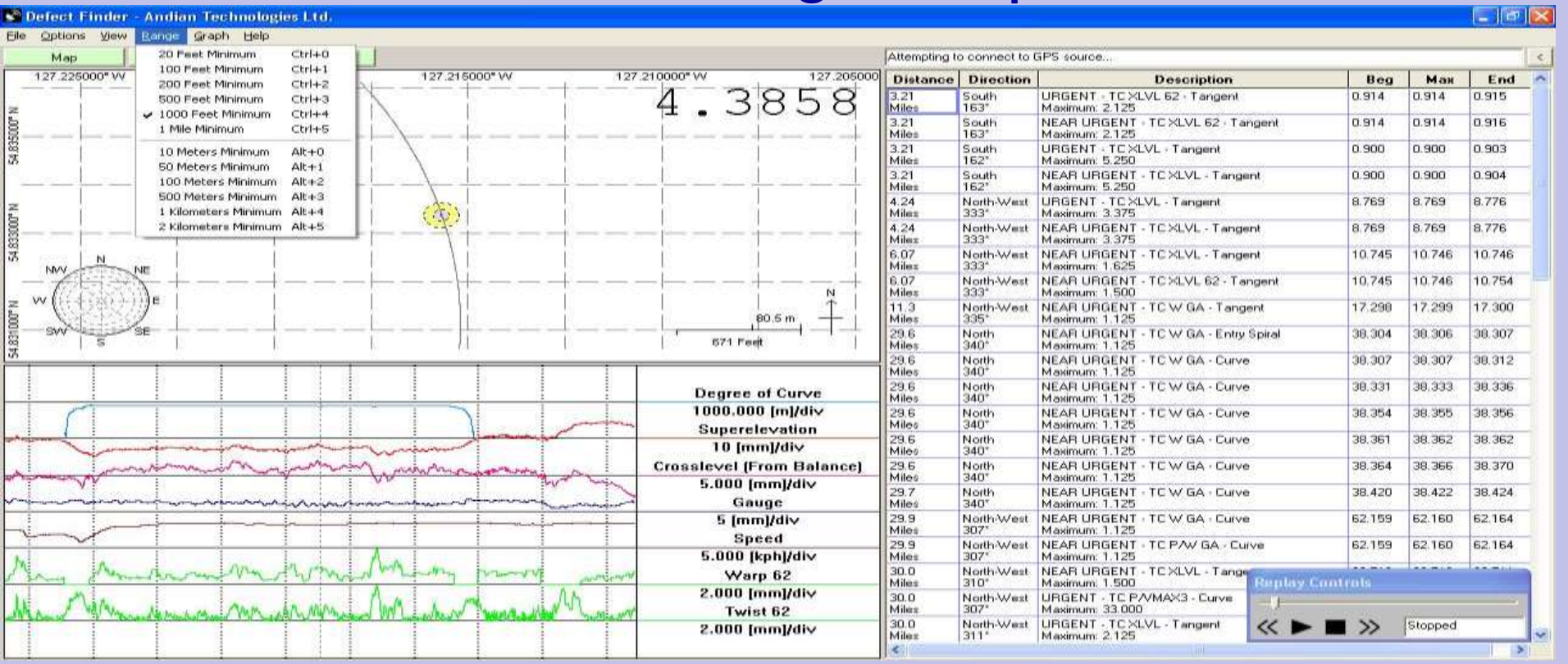


- Aligning two separate runs to examine geometric properties that may have changed over time.
- Measurements can be made in both magnitude and distance.
- An excellent tool for the analysis, measurement, display, and printing of geometry data.

DefectFinder (Stand-alone software)

- Assists in finding recorded defects with GPS accuracy.
- User can access geometry data with a portable computer.
- Uses any type of waypoint file.
- Other considerations:
  Solid Track data for maintenance and capital planning .

DefectFinder – Locating Exceptions with GPS

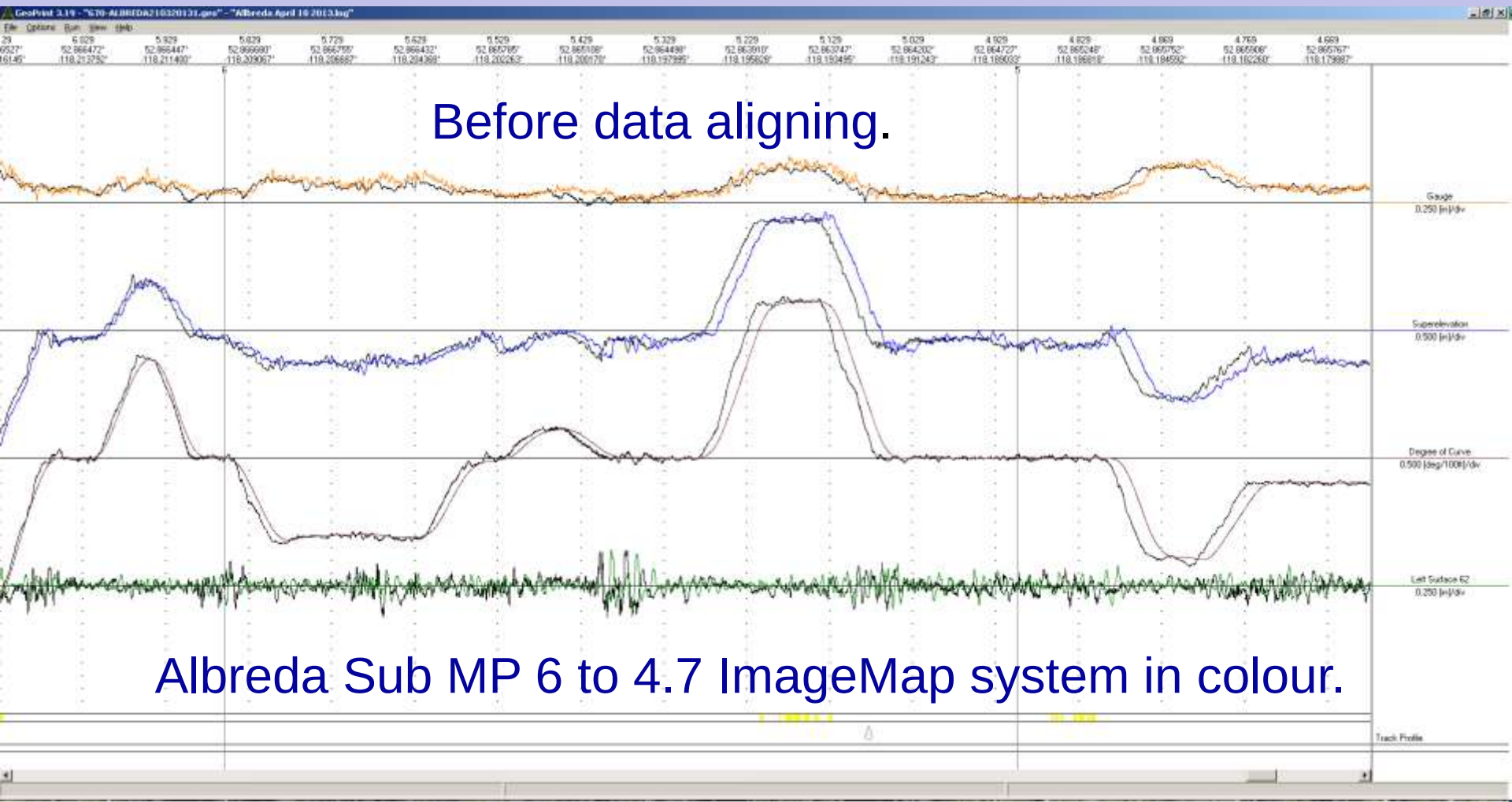


Loaded a previous Log file onto a laptop computer coupled with a GPS receiver, which allows crews to drive up to the defect location quickly and accurately.

Load up TEST car, railwear, RFD defects, track features, any standard waypoint file.

How Does It Compare?

Comparison Between Heavy Geometry System (ImageMap) and SolidTrack



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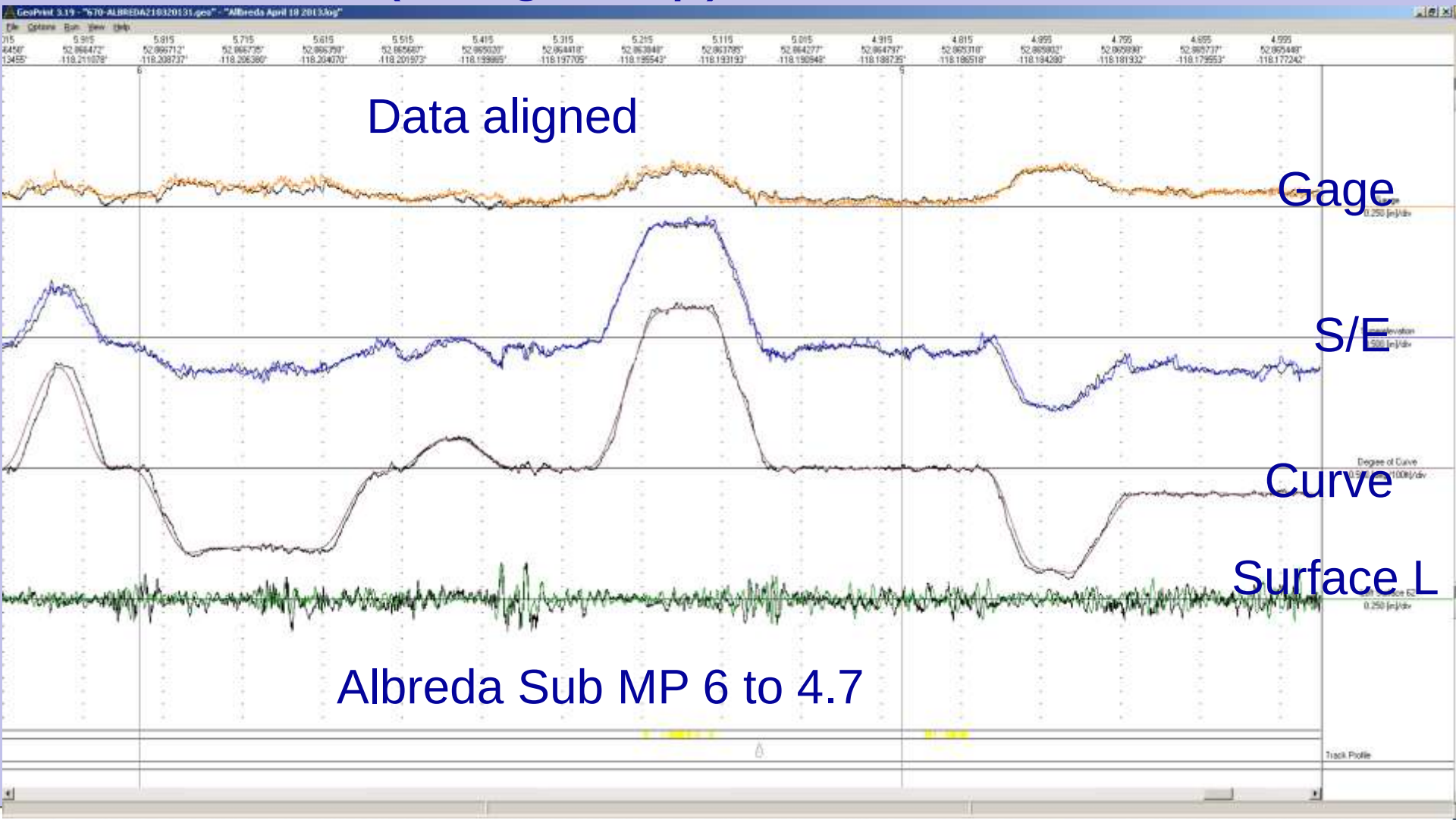


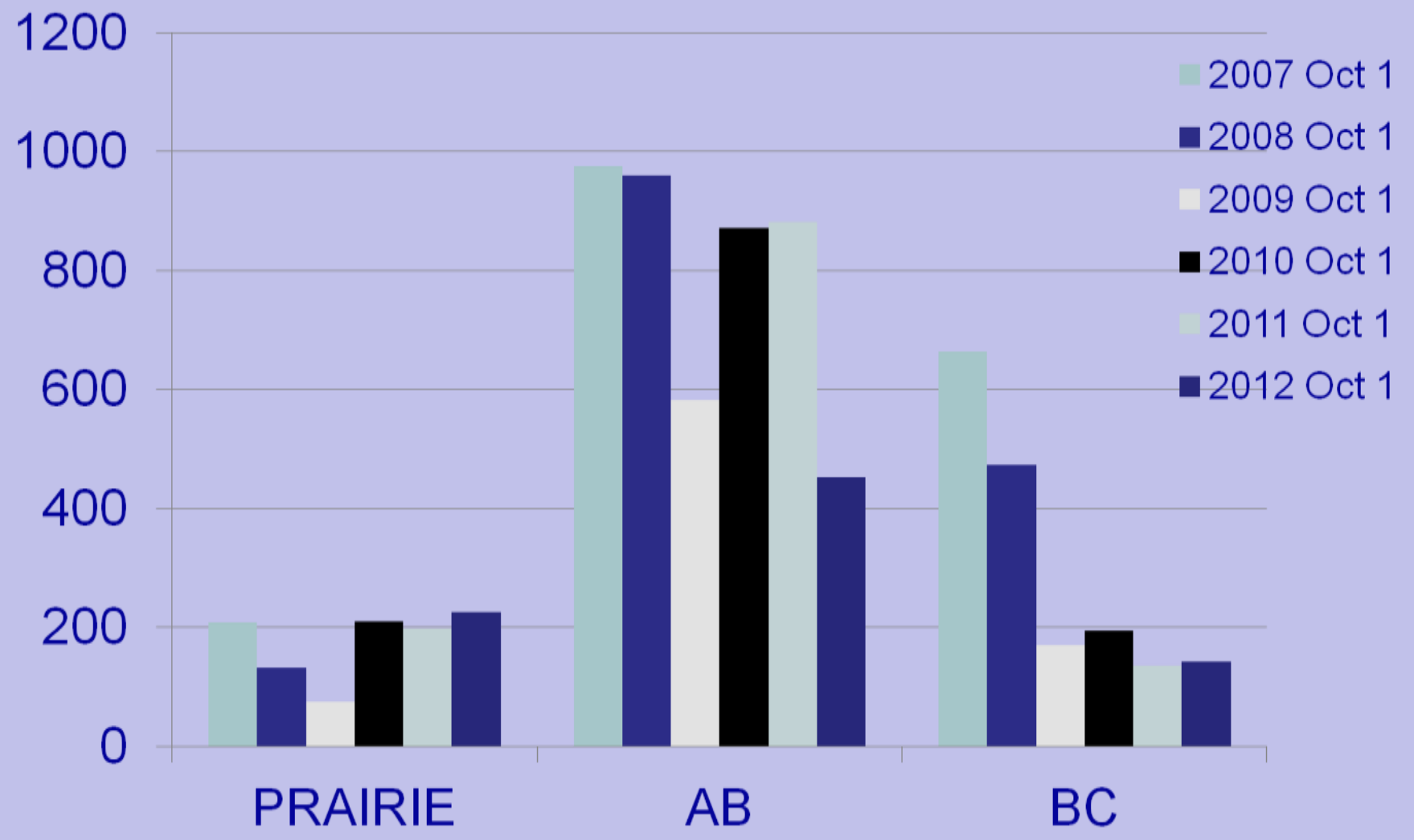
Summary

- Affordable electronic track geometry inspection system.
- Simple, Accurate, Reliable, and Robust
- Most of the travelling can be done on public roads, before getting on track
- Evaluate track condition while inspection are being complete

- On/off track within minutes, to maximizes track time
- Rapid deployment to any questionable locations, unlike heavy geometry car testing is based on a schedule and is rail bound. Immediate response to emerging issues
- Great supplemental geometry testing tool.
  Some low density trackage only receive one or two heavy track geometry tests per year

- Ease of training within a very short period of time
- Horning experienced supervisors' inspection skills
- On track, real time scenario for knowledge transfer and discussion
- Development tool for young supervisors with less experience. Training oversight for in track geometry exception recognitions (Seeing Eye Dog)
- Observed significant decrease in geometry caused derailments and overall reduction in slow orders in face of >30% increase in rail traffic.

Total October 1st TSO minutes by Sub Region



•Accepted as electronic geometry testing for Class 1 and Class 2 track by Transport Canada (RRTS - 4)

Track

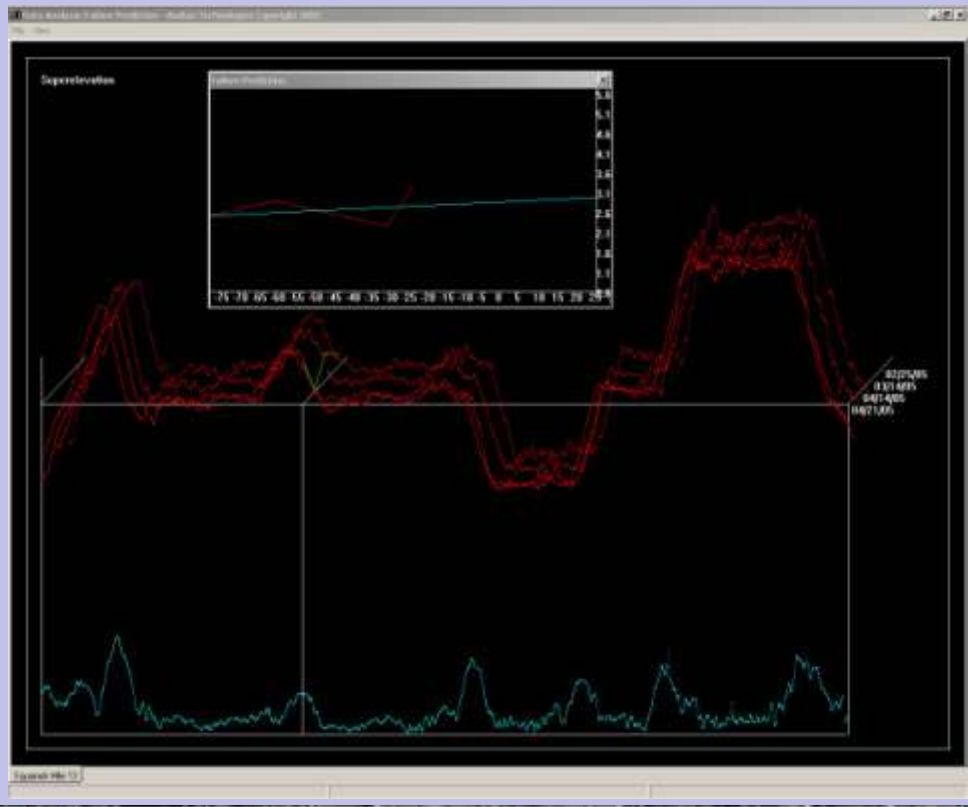
Designated Minimum Electronic Geometry Inspection Frequency Table

Class of Track	Annual Frequency Requirements			
	< 5 MGT	5 – 15 MGT	15 - 35 MGT	> 35 MGT
Class 1	N/A	LGIV – Twice Or HGIV - Once	LGIV – Three times Or HGIV - Once	LGIV – Three times Or HGIV - Once
Class 2	LGIV – Twice Or HGIV - Once	LGIV – Three times Or HGIV - Once	LGIV – Three times Or HGIV Twice	LGIV – Quarterly Or HGIV Twice
Class 3	HGIV - Once	HGIV – Once	HGIV – Twice	HGIV – Twice
Class 4	HGIV – Twice	HGIV – Twice	HGIV – Twice	HGIV - Twice
Class 5	HGIV – Twice	HGIV – Twice	HGIV – Twice	HGIV – Three times
Crossovers*	LGIV – Twice Or HGIV - Once	LGIV – Twice Or HGIV - Once	LGIV – Twice Or HGIV - Once	LGIV – Twice Or HGIV - Once

Where will we go next?

We will be elevating SolidTrack “Predictor” software in the coming weeks to extend data capabilities.

“Predictor” software plots successive geometry runs and forecasts future geometry values for greater asset utilization.



Questions ?