NxGen Rail Services – Track inspection technologies

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A SASSER FAMILY HOLDINGS CO.

January 2020 Texas Rail Advocates
Southwestern 16th Annual Rail Conference

SOUTHWESTERN 16th ANNUAL RAIL CONFERENCE

SASSER
FAMILY COMPANIES

Track Inspection Technologies

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- **Traditional**
  - Manual measurements
  - Human eyes
  - Rail flaw inspection
  - Rail profile measurement
  - Track geometry measurement
- **Emerging**
  - Machine vision systems
  - Ground penetrating radar (GPR)
  - Lidar
  - xRays
  - Track circuit measurements
  - Signaling and radio communications measurements (ERTMS, GMSR, PTC)

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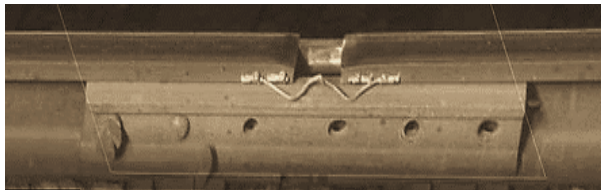
Machine Vision Capabilites

- Rail head inspection
  - Broken rails
  - Wheel burns
  - Corrugation
  - Squashed heads
- Broken or cracked concrete ties
- Wooden tie condition
- Fasteners
- Anchors

- Joint bars
  - Cracks
  - Breaks
  - Missing bolts
- Third rail
- Catenary
  - Height
  - Stagger
  - Wear
- Virtual track walk



Stripped Joint Bar

Broken Joint Bar

Missing Fasteners

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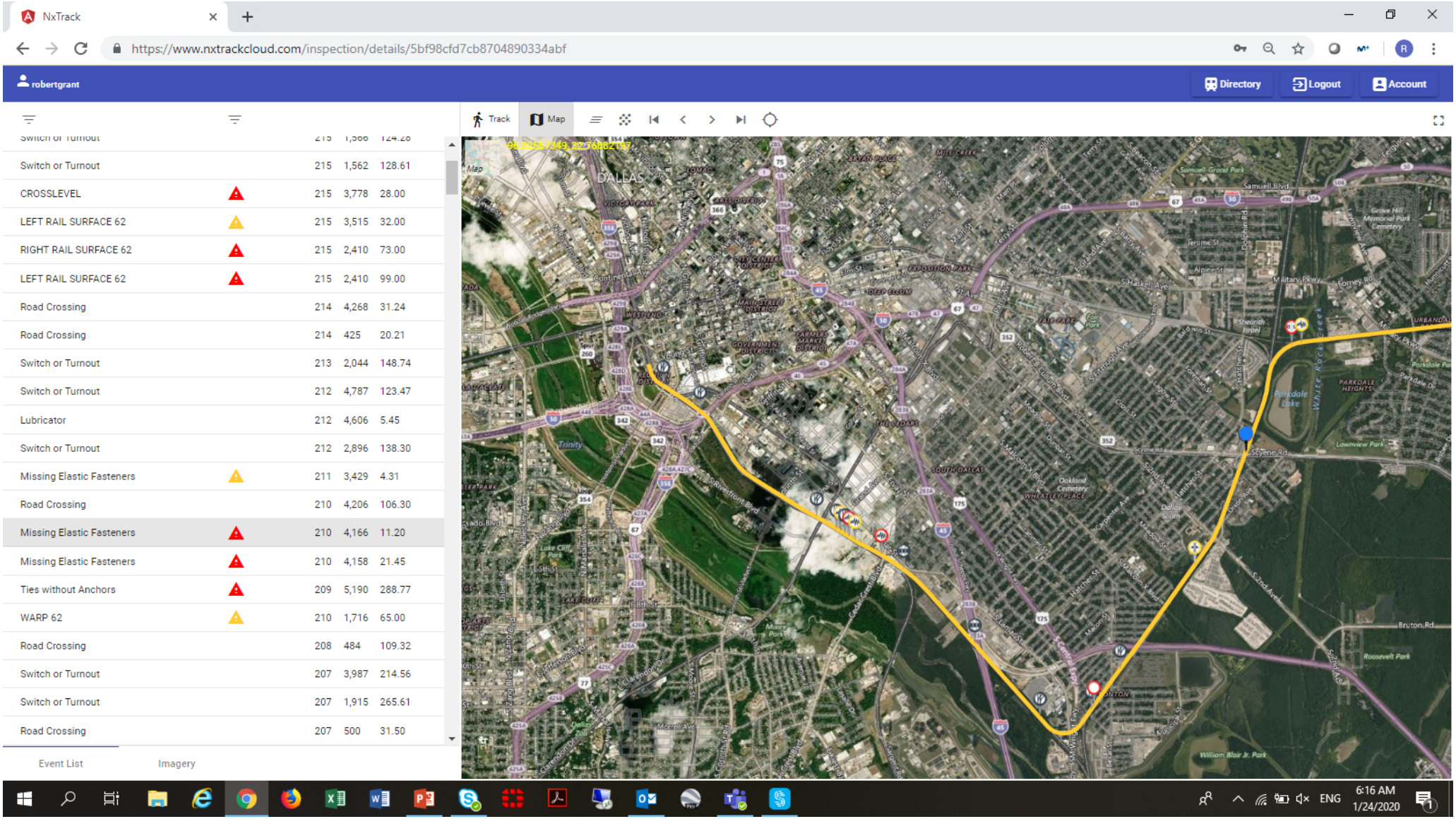
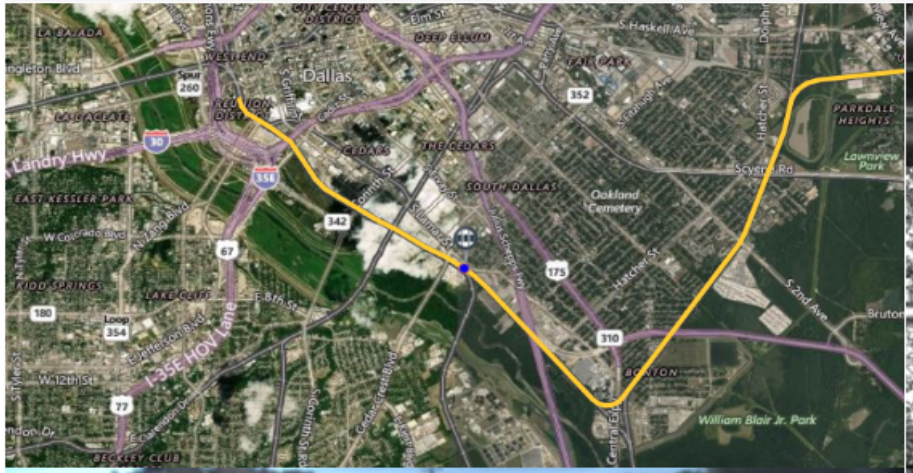
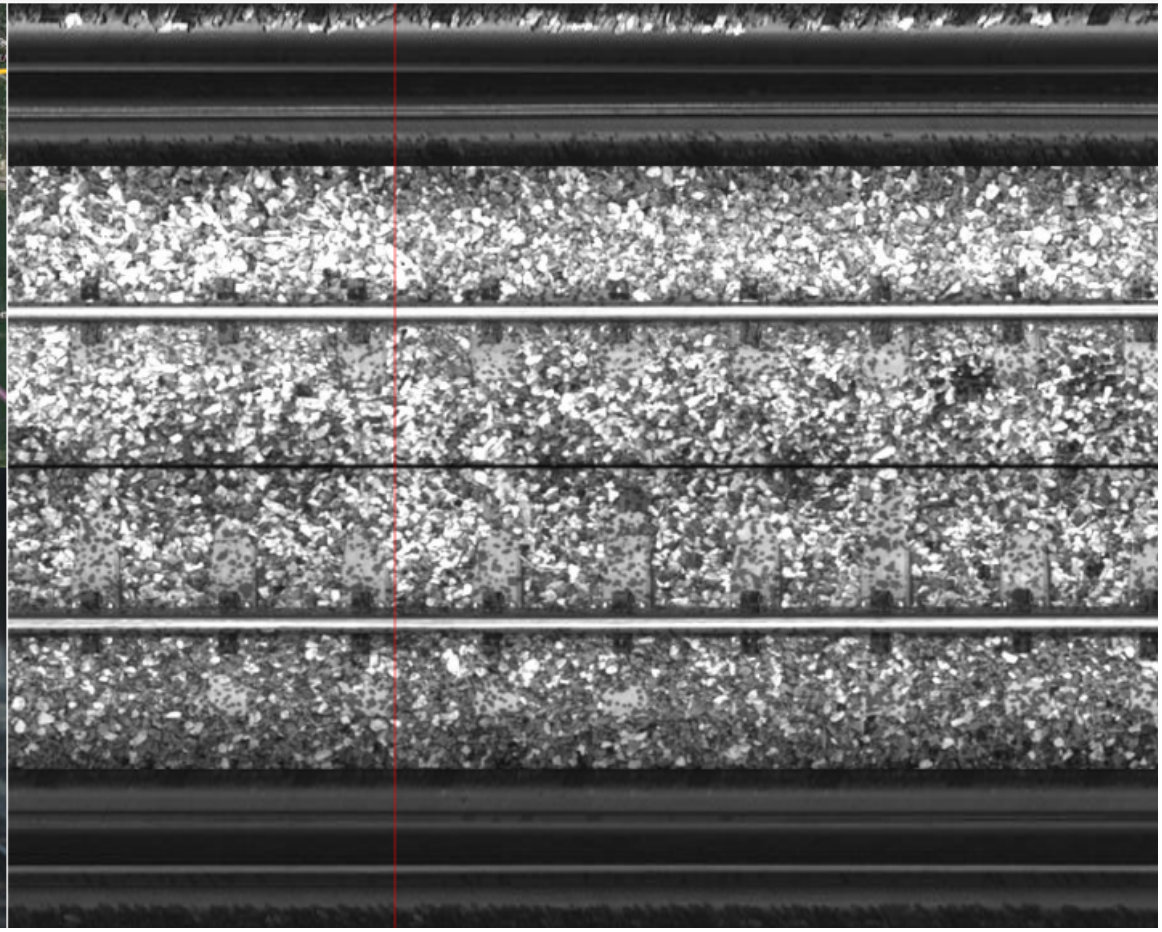

NxTrack
https://www.nxtrackcloud.com/inspection/details/5bf98cfd7cb8704890334abf
robertgrant
Directory
Logout
Account
Track
Map
Switch or Turnout 215 1,562 128.61
CROSSLEVEL 215 3,778 28.00
LEFT RAIL SURFACE 62 215 3,515 32.00
RIGHT RAIL SURFACE 62 215 2,410 73.00
LEFT RAIL SURFACE 62 215 2,410 99.00
Road Crossing 214 4,268 31.24
Road Crossing 214 425 20.21
Switch or Turnout 213 2,044 148.74
Switch or Turnout 212 4,787 123.47
Lubricator 212 4,606 5.45
Switch or Turnout 212 2,896 138.30
Missing Elastic Fasteners 211 3,429 4.31
Road Crossing 210 4,206 106.30
Missing Elastic Fasteners 210 4,166 11.20
Missing Elastic Fasteners 210 4,158 21.45
Ties without Anchors 209 5,190 288.77
WARP 62 210 1,716 65.00
Road Crossing 208 484 109.32
Switch or Turnout 207 3,987 214.56
Switch or Turnout 207 1,915 265.61
Road Crossing 207 500 31.50
Event List
Imagery
DALLAS
ENG
6:16 AM
1/24/2020

robertgrant

Line Inspector | Track Inspector | Joint Inspector | Allow Zoom | Track | Map

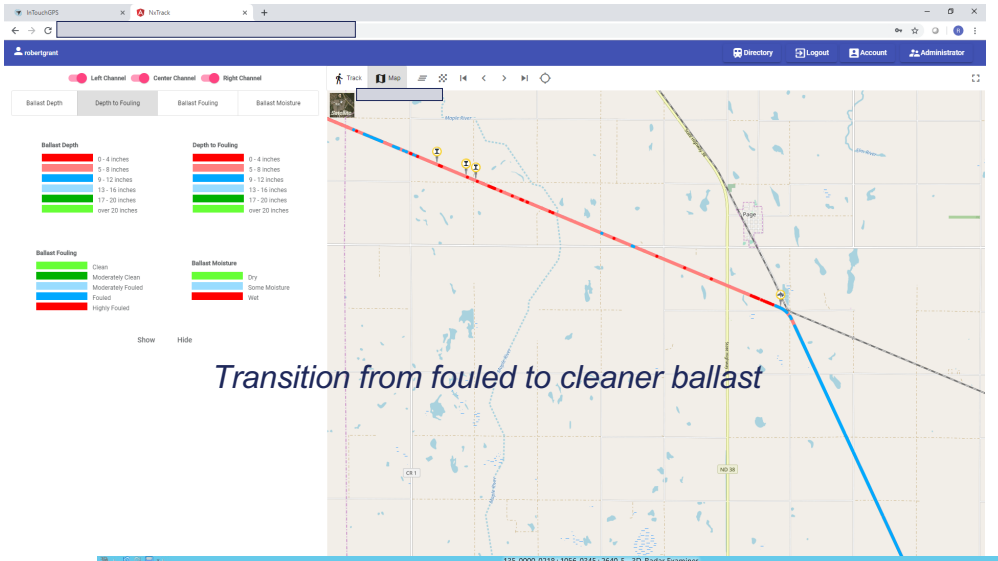
Run Name	Division	Subdivision	Road Master	LS	TN	TT	TC	MP	MPO	Longitude	Latitude
391-628_UP		Unknown						214	4,346	-96.77820352	32.75502976



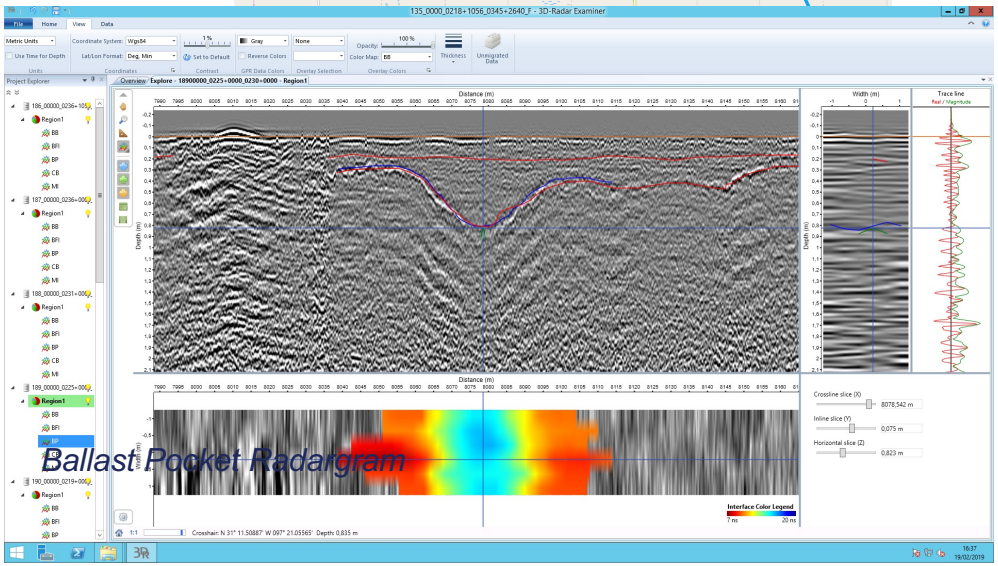


GPR capabilites

- Ballast depth
- Depth to fouling
- Ballast fouling index (Selig)
- Ballast pockets
- Water
- Culvert health check
- Subgrade analysis
- Tie type



Transition from fouled to cleaner ballast



Ballast Pocket Radargram

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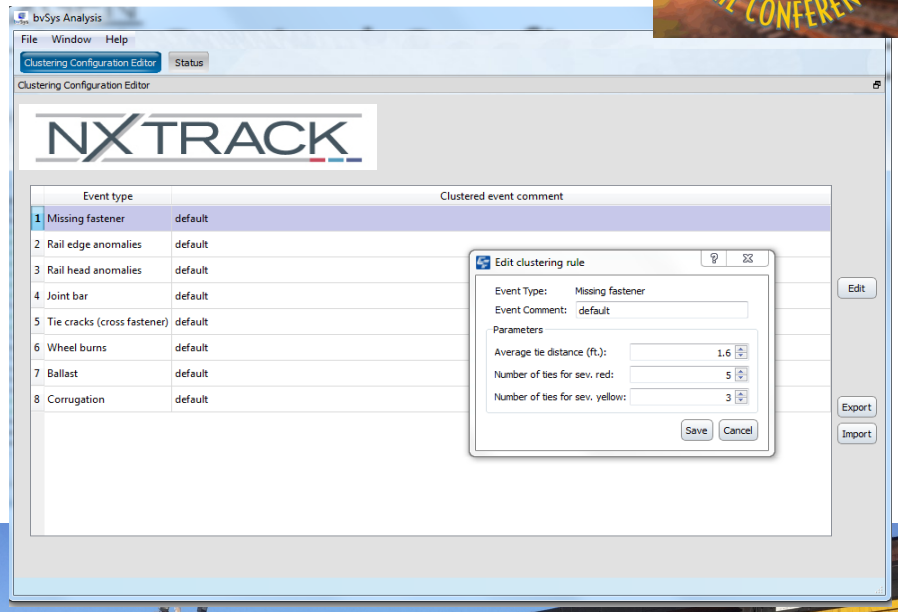
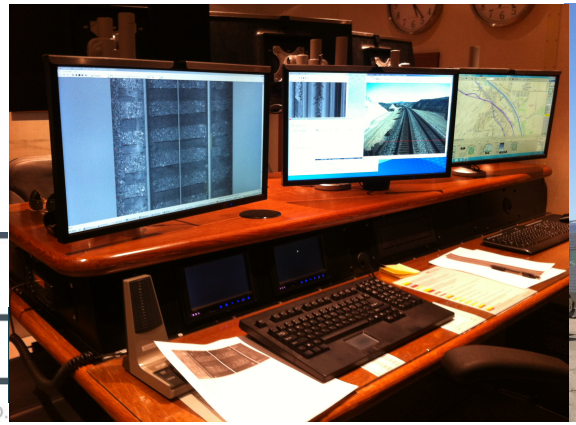
Harnessing GPR and machine vision technologies

- Training machine vision
  - Overcoming false positives
  - Using rules to provide useful information, not just data
    - Clustering algorithms
    - Moving windows
  - Increased productivity – 56.000 Kms per annum with a crew of 3 people and one vehicle





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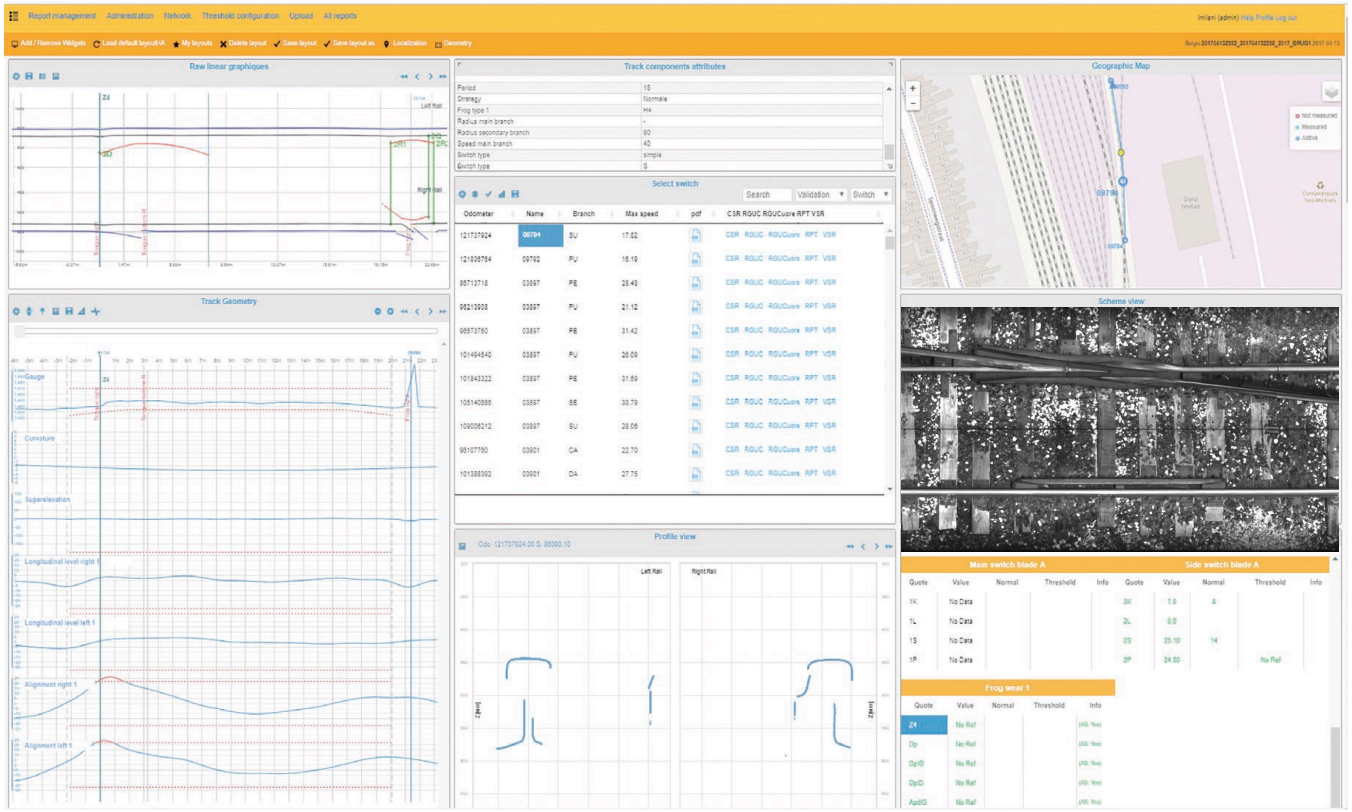
Data fusion to aid defect classification

- Extracting the useful bits
  - Defects, conditions and context
- Ease of access
  - Web enabled platforms, interactive widgits
- Fusing databases
  - Localization and data formats



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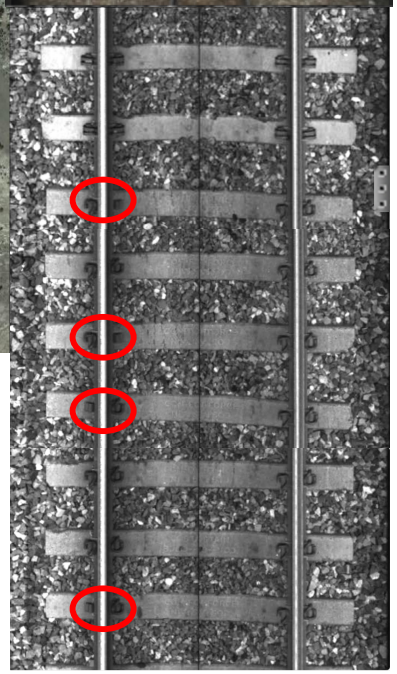
Using data fusion to help classify defects

- Track gauge compared with tie and fastener condition
  - A better understanding of the problem helps the maintenance planner to send out the right repair instructions



Wide gauge defect on concrete ties at a transition from concrete to wooden ties. The location has several missing fasteners.

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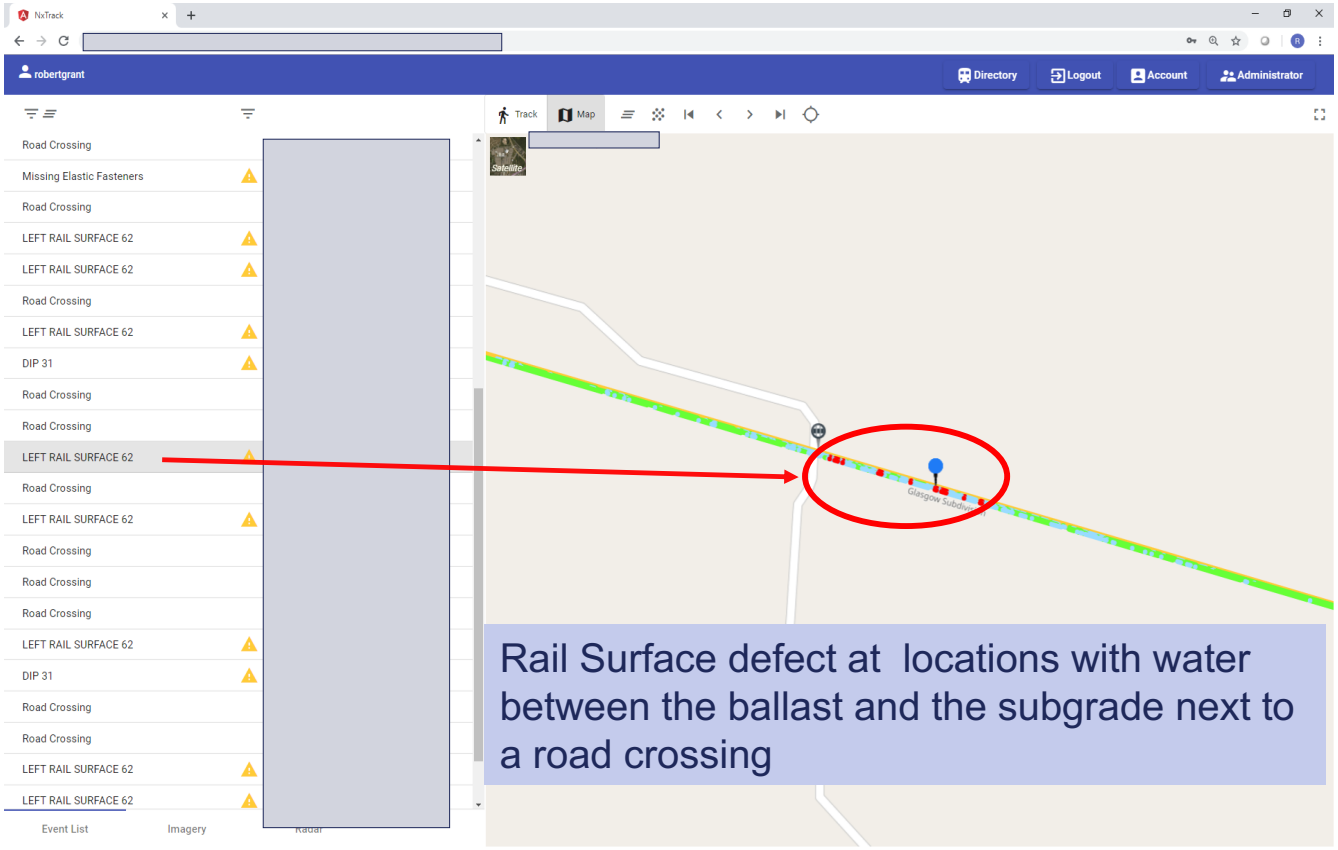
Using data fusion to help classify defects

- Ballast condition and geometry
  - A correlation between ballast fouling and surface geometry is emerging as more data gets analysed



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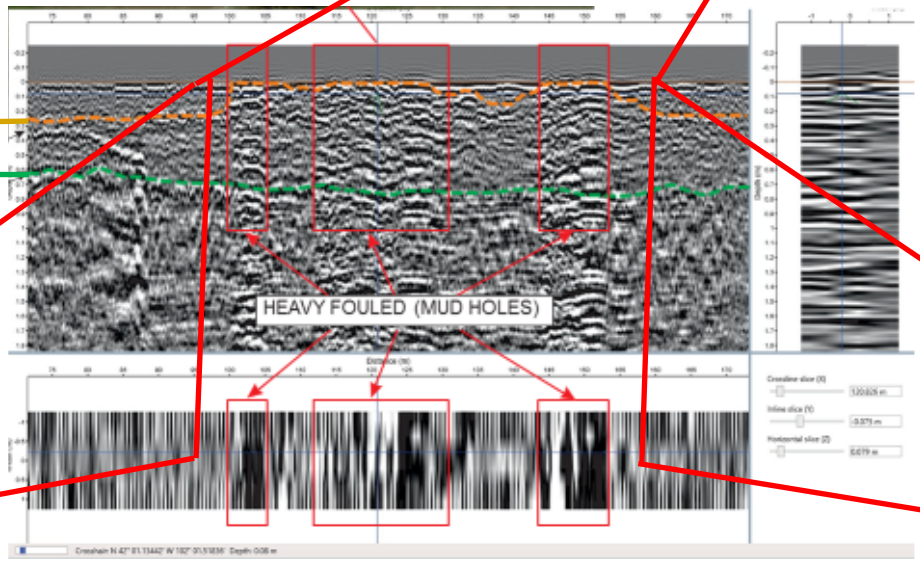
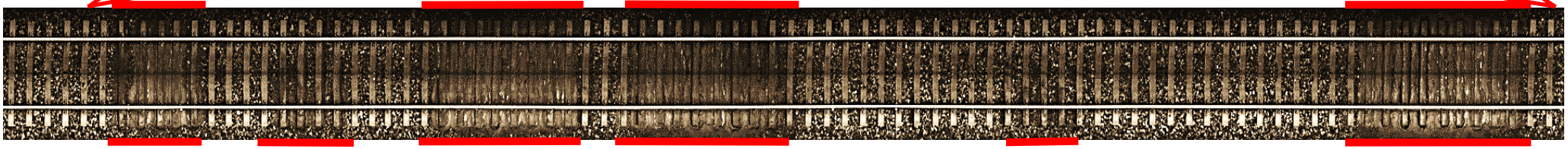
Surface Ballast Fouling and Geometry Exceptions

	Class Tk	MP Feet Length
CROSSLEVEL		
CROSSLEVEL		
DIP 31		
TOP CHORD		



GPR analysis shows surface fouling that extends to the full height of the ballast across the area of interest

This information can be used to accurately plan corrective maintenance such as undercutting and surfacing.



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- Ballast condition compared with track geometry
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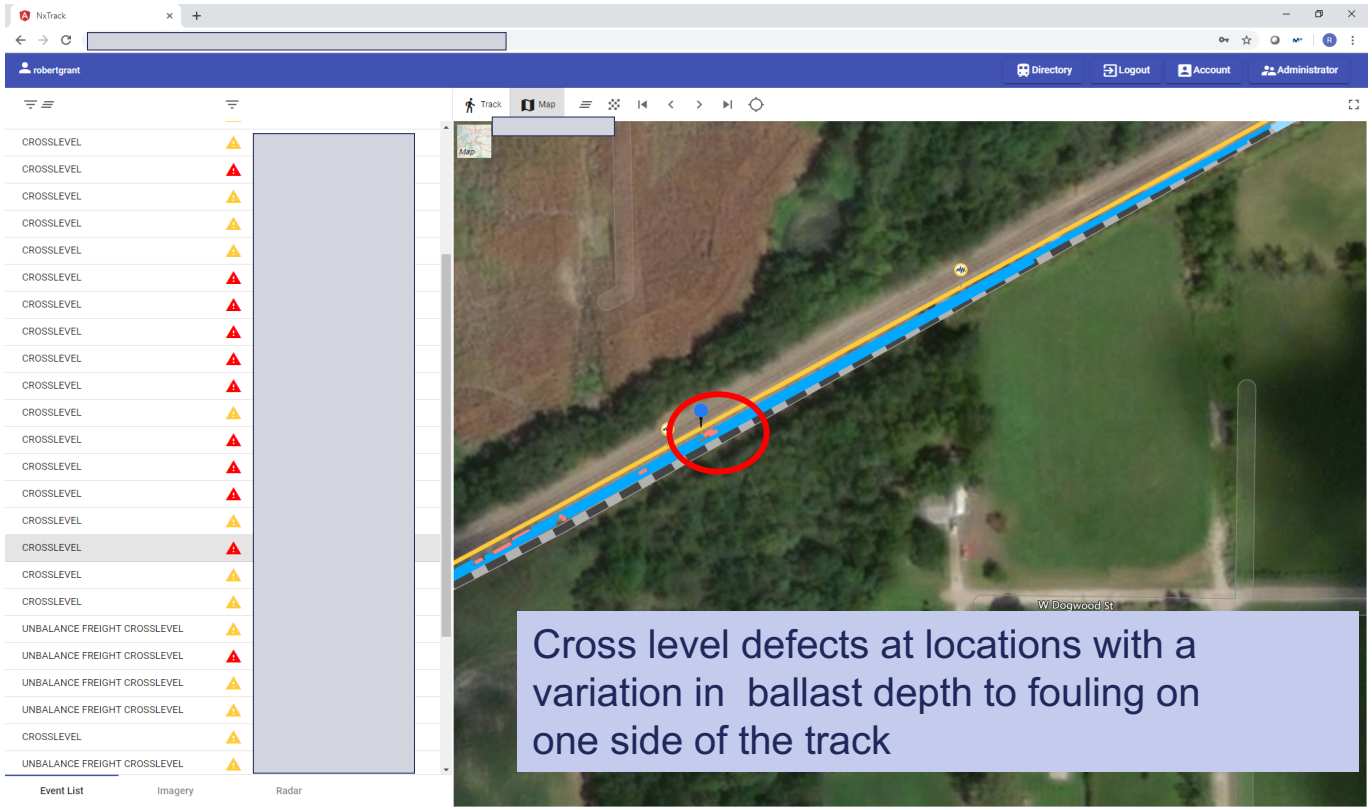

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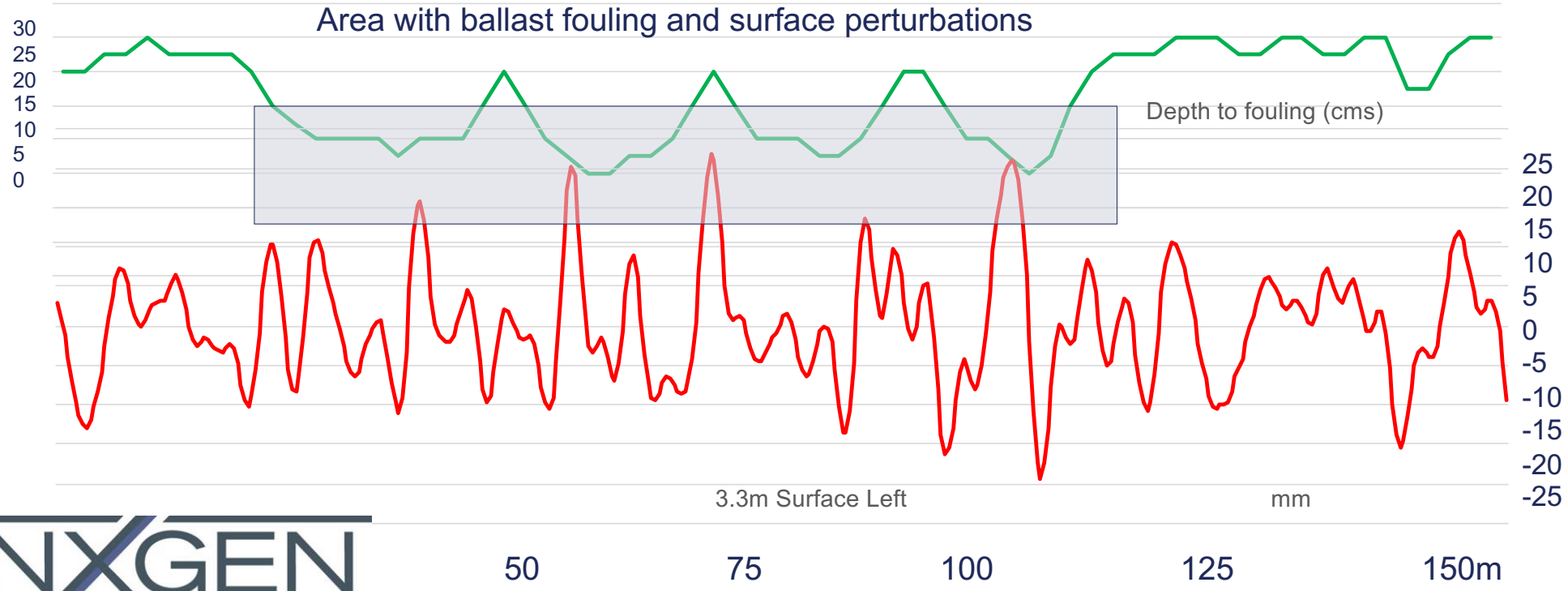
Using data fusion to help classify defects

- Depth to fouling vs Surface Geometry



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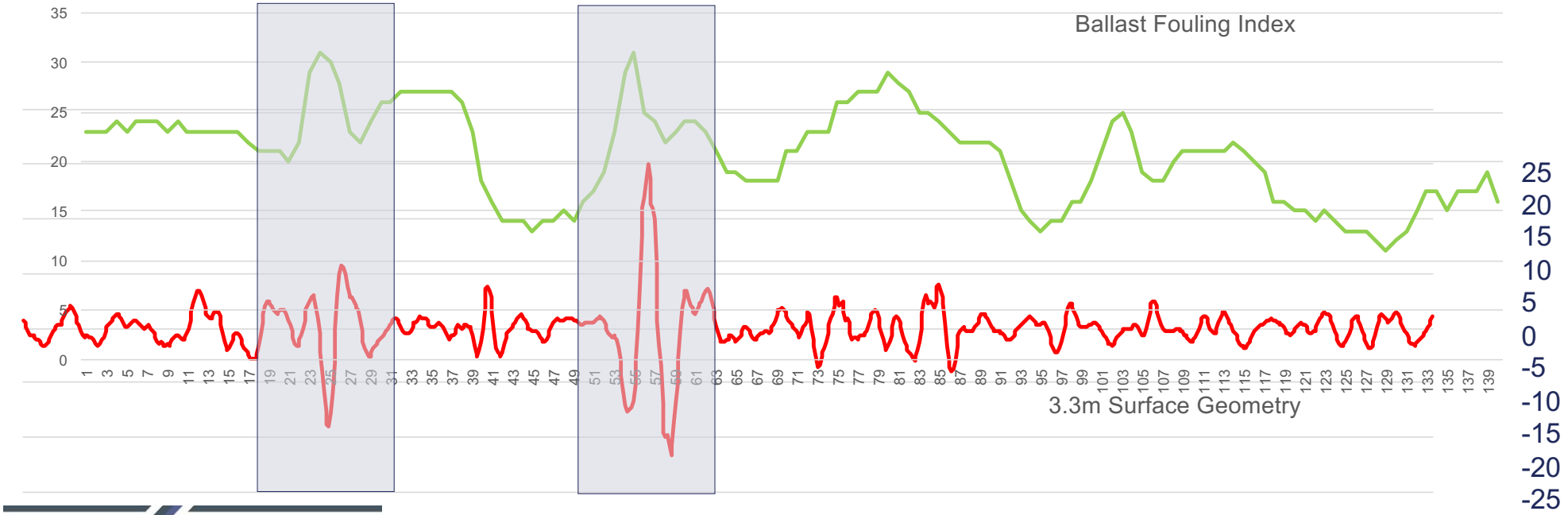
Using data fusion to help classify defects

- Ballast fouling Index vs Surface Geometry



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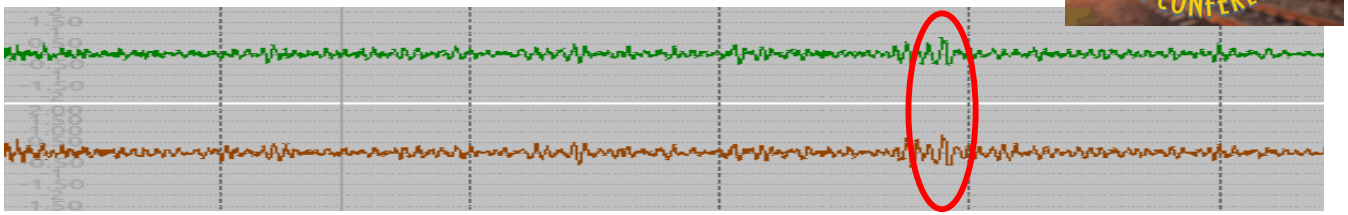
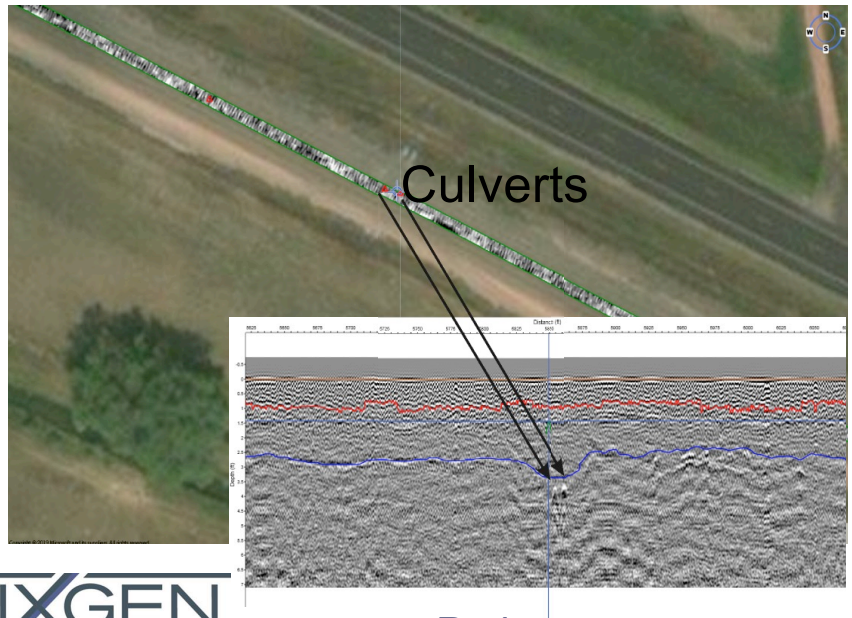
Using data fusion to help classify defects

- Geometry, GPR and culverts





Radargram

Machine vision image

Surface Geometry

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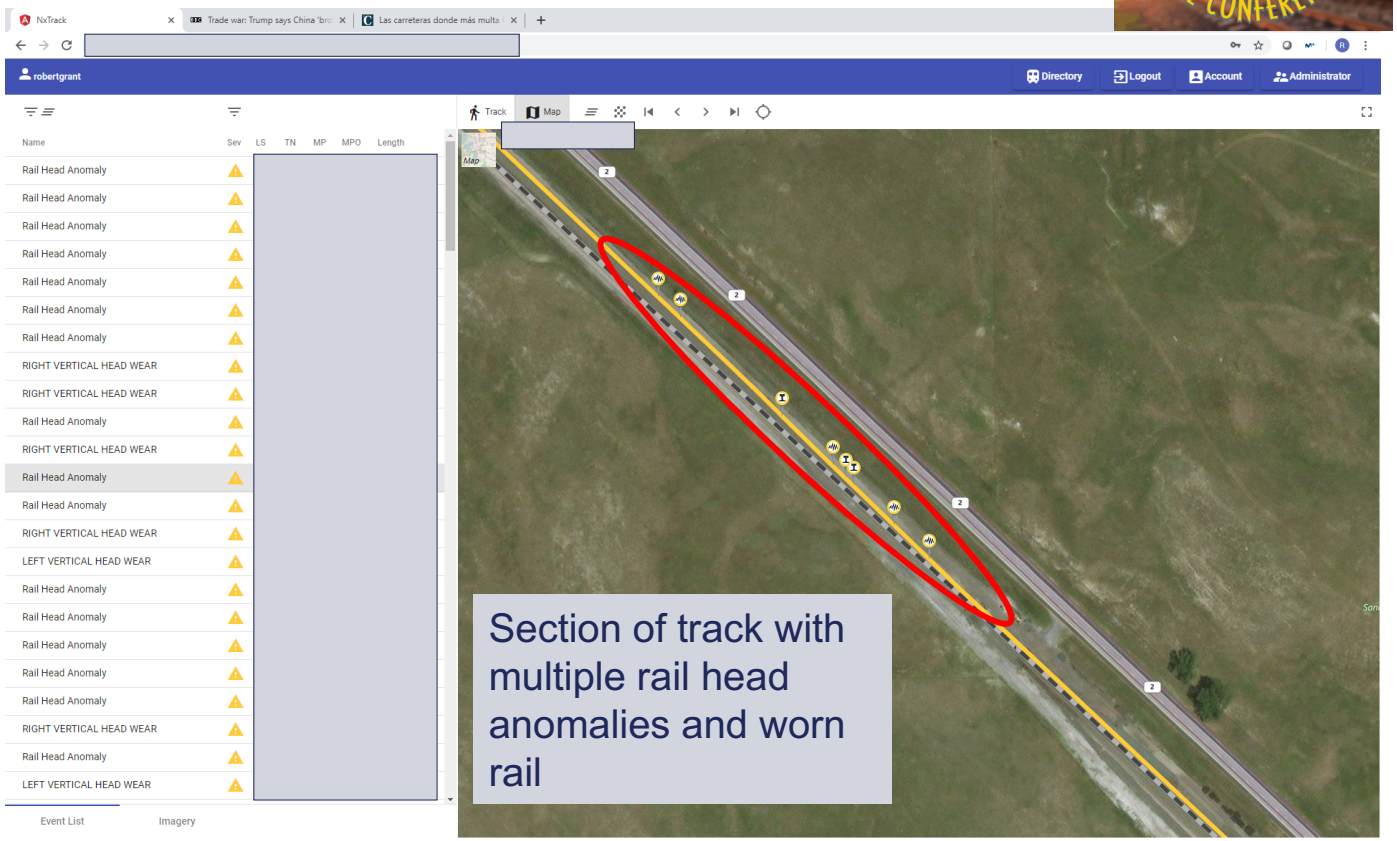
Using data fusion to help classify defects

- Rail Surface defects and rail geometry
  - A chain is as strong as its weakest link



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Using data fusion to help classify defects

- Automated analysis of S&C
  - Geometry system to create image of switch under dynamic load and take measurements
  - Machine Vision for fasteners, joint bars, bolts etc..

RFI
DIREZIONE PRODUZIONE

REPORT DIAGNOSTICO GRANDEZZE CARATTERISTICHE DEGLI APPARECCHI DEL BINARIO

SCAMBIO INTERSEZIONE DOPPIO

D.T.P.: FIRENZE — C.d.L.: LV01
Linea: — Tronco: LAVORI LV01 FI SMN
Località: FIRENZE SANTA MARIA NOVELLA — Sede Tecnica: LO1325
Incaricato della misura: CARRELLO DIAGNOSTICO SIM10 — Data rilievi: 07_05_2014
Oggetto della misura: APPARECCHIO DEL BINARIO N. 15A*23B — Sede Tecnica: LO1325-BC-BC09-DEV-D09

CARATTERISTICHE CLASSE

Posto in Opera: 7/16/2010 — Raggio Principale: 0 — Cerniera: ELASTICI
Sigla: S.I. 60 UNI/170/0,12 dp. — Raggio Secondario: 170 — Traverse: CEMENTO
Posa: SX — Velocità sul Ramo Principale: 0 — Manovra: ELETTRICA
Tipo Cuore: MANGANESE INCOLLATO — Velocità sul Ramo Secondario: 30 — Tipo Controrotaia: UIC-33

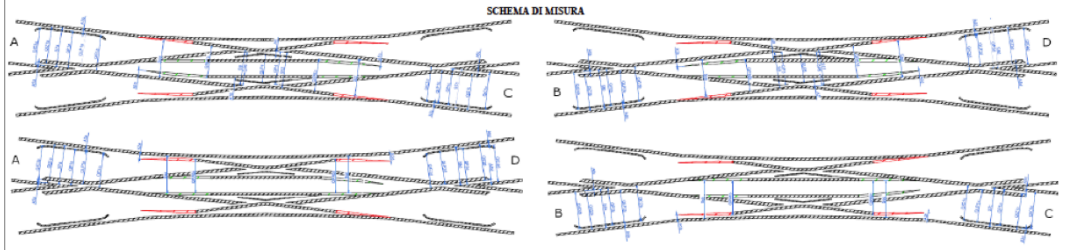
SCHEDA CONTROLLO MISURE

	Quote	Δpmax	Δpmin	GPA2	A2	PIG2
Telaio Aghi A	AP	1448	1444,7	M.R.	138,1	SUP
	Dis.P.R.A.	1340	460		4420	
	Soglia	[1450]	[1433]		[100,150]	
	Quote	Δpmax	Δpmin	GPA1	A1	PIG1
	AS	1455,4	1434,6	1367,7	155,5	SUP
	Dis.P.R.A.	220	2280	3280	0	
	Soglia	[1455]	[1433]	[1377]	[100,160]	
Telaio Aghi B	Quote	Δpmax	Δpmin	GPA2	A2	PIG2
	BP	1448	1444,7	M.R.	138,1	SUP
	Dis.P.R.A.	1340	460		4420	
	Soglia	[1450]	[1433]		[100,150]	
	Quote	Δpmax	Δpmin	GPA1	A1	PIG1
	BS	1455,4	1434,6	1367,7	155,5	SUP
	Dis.P.R.A.	220	2280	3280	0	
	Soglia	[1455]	[1433]	[1377]	[100,160]	
Telaio Aghi C	Quote	Δpmax	Δpmin	GPA2	A2	PIG2
	CP	1448	1444,7	M.R.	138,1	SUP
	Dis.P.R.A.	1340	460		4420	
	Soglia	[1450]	[1433]		[100,150]	
	Quote	Δpmax	Δpmin	GPA1	A1	PIG1
	CS	1455,4	1434,6	1367,7	155,5	SUP
	Dis.P.R.A.	220	2280	3280	0	
	Soglia	[1455]	[1433]	[1377]	[100,160]	
Telaio Aghi D	Quote	Δpmax	Δpmin	GPA2	A2	PIG2
	DP	1448	1444,7	M.R.	138,1	SUP
	Dis.P.R.A.	1340	460		4420	
	Soglia	[1450]	[1433]		[100,150]	
	Quote	Δpmax	Δpmin	GPA1	A1	PIG1
	DS	1455,4	1434,6	1367,7	155,5	SUP
	Dis.P.R.A.	220	2280	3280	0	
	Soglia	[1455]	[1433]	[1377]	[100,160]	

	Quote	S8	GIC2	GIC4	GIZ2	GP2	GLP2	A4	A8	PIG4	PIG8	HCR2	HCR4	ALL2
Cuore Semplice 1	C1P	1434,6	1363	1363,8	1372,3	1391,4	1349,8	42,7	43,1	SUP	SUP	SUP	SUP	NO SUP
	Dis.P.R.C.	100	2040	1640	1180	100	20	100	100					
	Soglia	[1402, 1405]	[1377]	[1377]	[1377]	[1360,1362]	[1353]	[≥0]	[≥0]					
	Quote	S7	GIC1	GIC3	GIZ1	GP1	GLP1	A3	A5	PIG3	PIG6	HCR1	HCR3	ALL1
	C1S	1436	1364,2	1364,6	1375,6	1390,9	1348,3	44,7	43,8	SUP	SUP	SUP	SUP	SUP
	Dis.P.R.C.	100	2040	1660	1140	100	20	220	60					
	Soglia	[1436,1442]	[1377]	[1377]	[1377]	[1360,1362]	[1353]	[≥0]	[≥0]					
Cuore Semplice 3	Quote	S8	GIC2	GIC4	GIZ2	GP2	GLP2	A4	A8	PIG4	PIG8	HCR2	HCR4	ALL2
	C3P	1434,6	1363	1363,8	1372,3	1391,4	1349,8	42,7	43,1	SUP	SUP	SUP	SUP	NO SUP
	Dis.P.R.C.	100	2040	1640	1180	100	20	100	100					
	Soglia	[1402, 1405]	[1377]	[1377]	[1377]	[1360,1362]	[1353]	[≥0]	[≥0]					
	Quote	S7	GIC1	GIC3	GIZ1	GP1	GLP1	A3	A5	PIG3	PIG6	HCR1	HCR3	ALL1
	C3S	1436	1364,2	1364,6	1375,6	1390,9	1348,3	44,7	43,8	SUP	SUP	SUP	SUP	SUP
	Dis.P.R.C.	100	2040	1660	1140	100	20	220	60					
	Soglia	[1436,1442]	[1377]	[1377]	[1377]	[1360,1362]	[1353]	[≥0]	[≥0]					

Cuore Doppio	S9	S10	S11	S12	GIC5	GIC6	GIC7	GIC8	GP5	GP4	GP6	GP8	GLP5	GLP4	A7	A8	A9	A10	A11	A12	A13	A14
2	1436	1436	1436	1436	1364,6	1364,6	1364,6	1364,6	1391,4	1391,4	1391,4	1391,4	1349,8	1349,8	42,7	43,1	42,7	43,1	42,7	43,1	42,7	43,1
Distanza Punta Reale Cuore (Dis.P.R.C.)	100	2040	1640	1180	100	20	100	100	100	2040	1640	1180	100	20	100	100	100	2040	1640	1180	100	20
Soglia	[1436,1442]	[1436,1442]	[1436,1442]	[1436,1442]	[1377]	[1377]	[1377]	[1377]	[1360,1362]	[1360,1362]	[1360,1362]	[1360,1362]	[1353]	[1353]	[≥0]	[≥0]	[≥0]	[≥0]	[≥0]	[≥0]	[≥0]	[≥0]
Verifiche	PIG7	PIG8	PIG9	PIG10	PIG11	PIG12	PIG13	PIG14	HCR5	HCR6	HCR7	HCR8	ALL11	ALL2	ALL3	ALL4	ALL5	ALL6	ALL8	ALL7	ALL8	
Distanza Punta Reale Cuore (Dis.P.R.C.)	SUP	SUP	SUP	SUP	SUP	SUP	SUP	SUP	SUP	SUP	SUP	SUP	SUP	SUP	SUP	SUP	SUP	SUP	SUP	SUP	SUP	

SCHEMA DI MISURA



Example from a switch report showing measurements

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Using data fusion to help classify defects

- Machine Learning
  - The above examples offer opportunities for integrated database systems to learn the relationships between conditions in the track, and the correct remedial action to apply enabling the system to prompt users with the optimal mitigation procedures in each case.
  - The system can also provide historical information about how similar circumstances elsewhere on the network were resolved.
- Successes achieved
  - Safety
    - As more systems like those we have described come on line and are being utilized by class one railroads in North America, derailment numbers caused by track defects have been steadily decreasing.
  - Efficiency
    - Applying the right remedy in the most cost effective manner saves money, and increases network efficiency reducing downtime for maintenance.
    - Just one example: Shoulder cleaning vs undercutting. Knowing where to do each can save huge amounts of time and cost.

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Money spent on testing is a high yield investment