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IRI measurements using the LCMS

RPUG 2012

Vision Technology for Inspection of Transportation Infrastructures

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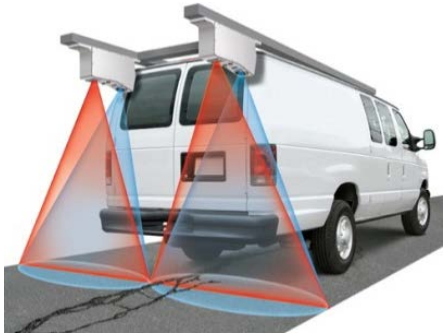
Food Chain



DOTs and Airports

Data Collection Services

System Integrators

Pavemetrics Systems Inc.

Pavemetrics product line

LRMS
- Pavement Rutting

LCMS
- 3D Pavement Imaging
- Pavement Rutting
- Macro-Texture
- Pavement Cracking
- Pavement Roughness
- Road/Airport/Tunnel/Rail Inspection

LRIS
- Pavement Imaging

Pavemetrics

200+ systems in 30+ Countries

Pavemetrics user base

20,000,000 Miles + collected since 1997

- 400 times the entire US Interstate Highway Network
- 850 times around the world
- 85 trips to the moon
- The entire world road network

TWICE !

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North American LCMS Users

USA

Mandli – (equipment)
ICC – (equipment)
Caltrans (data collection services)
Utah (data collection services)
Kentucky (equipment)
Kansas (equipment)
Tennessee (data collection services)
Nevada (data collection services)
Rhode Island (data collection services)
Illinois (data collection services)
Georgia Tech (equipment)
Virginia Tech (equipment)
US Army Test Tracks (equipment)
University Mass – Lowell (equipment)
PennDOT (equipment)
City of Phoenix, AZ (equipment)

Canada

Fugro-Roadware (equipment)
MTO – Ontario (equipment)
MTQ – Quebec (equipment)
Nova Scotia (equipment)
SNC Lavalin (equipment)
Dessau - LVM (equipment)

LCMS – Certified Technology

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Is NOT a prototype

It is a well used and <u>certified</u> system.

NEMA

TÜV SÜD ISO 9001

INTERNATIONAL CERTIFICATIONS ISO 9001

DEPARTMENT OF HEALTH & HUMAN SERVICES • USA FDA

FC CE

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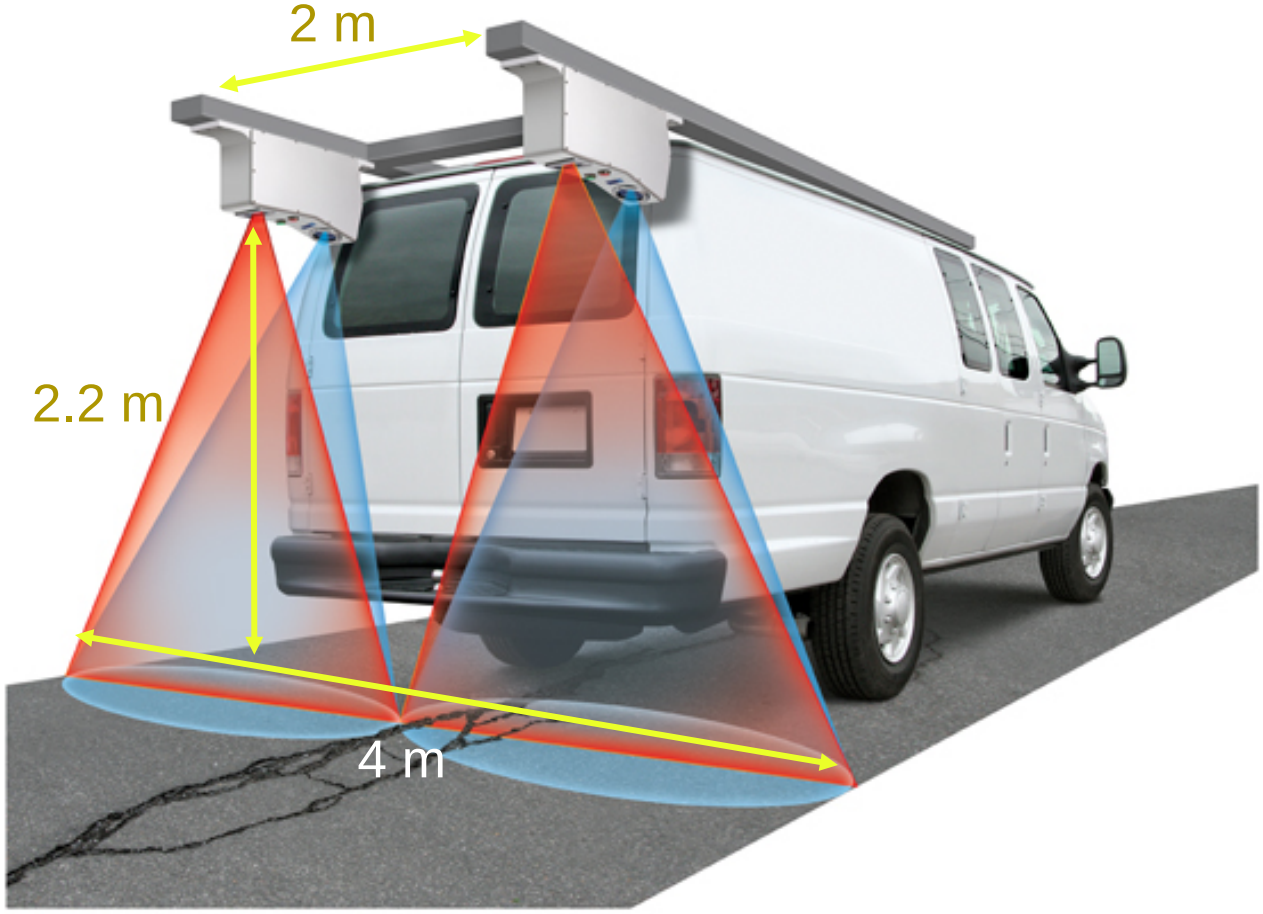
LCMS - System configuration



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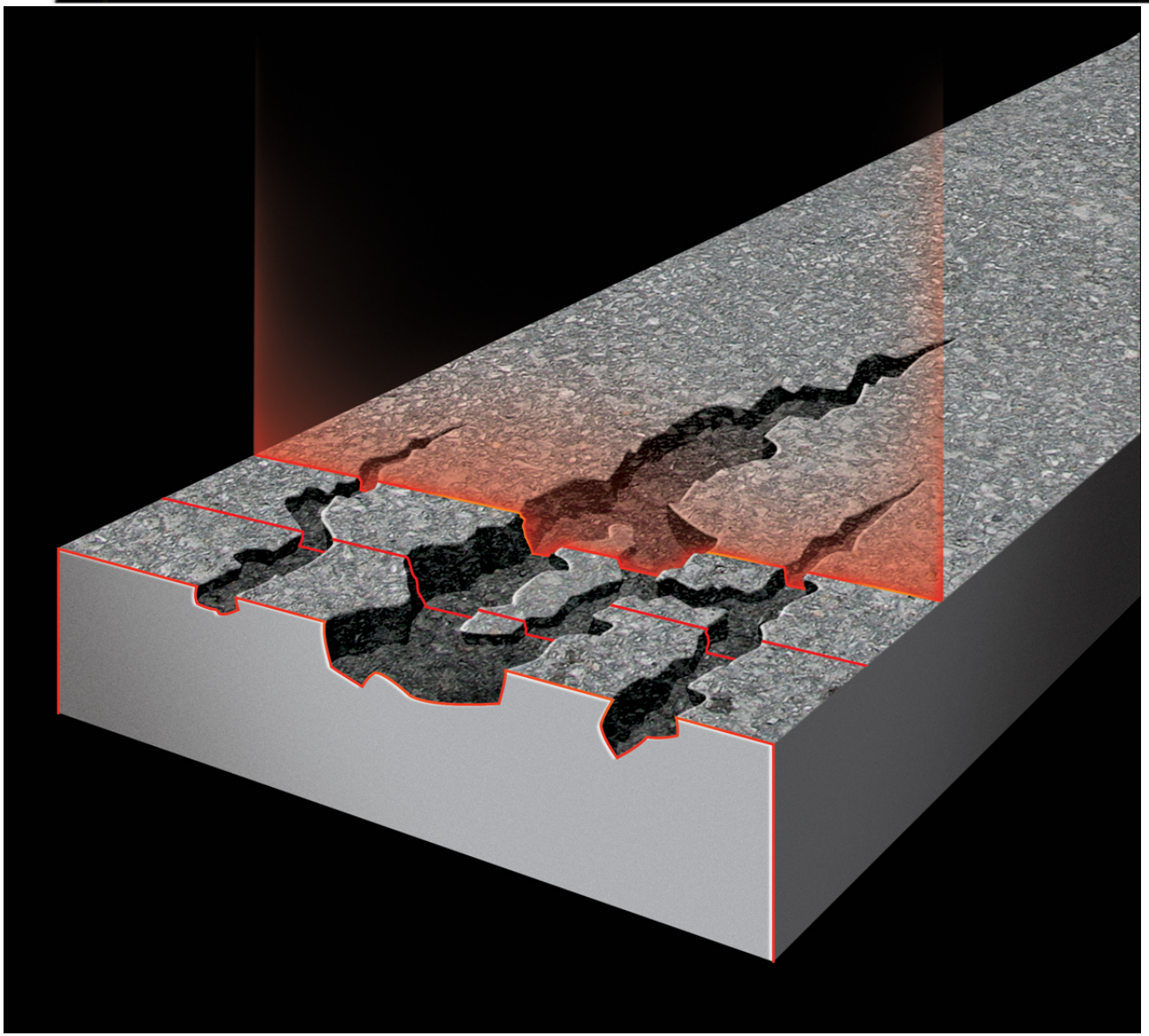
Laser profiling (principle)



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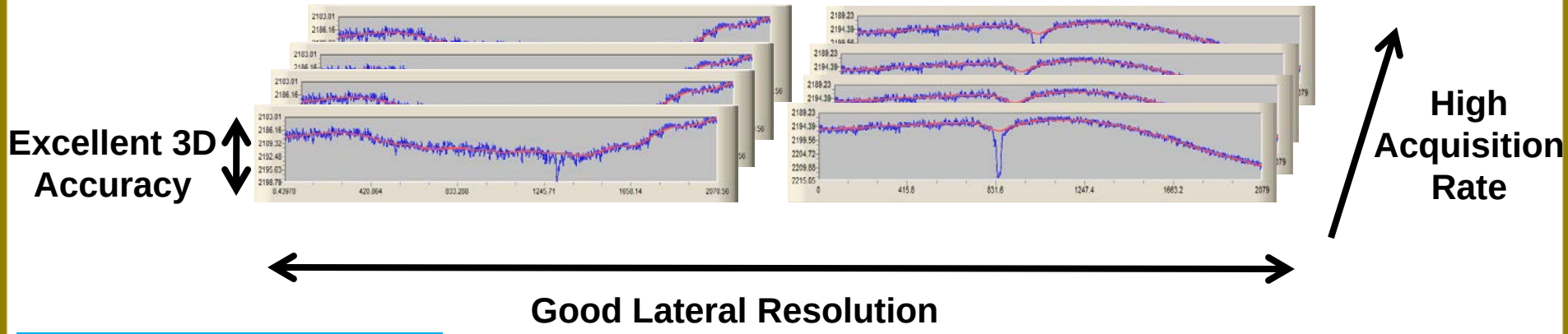
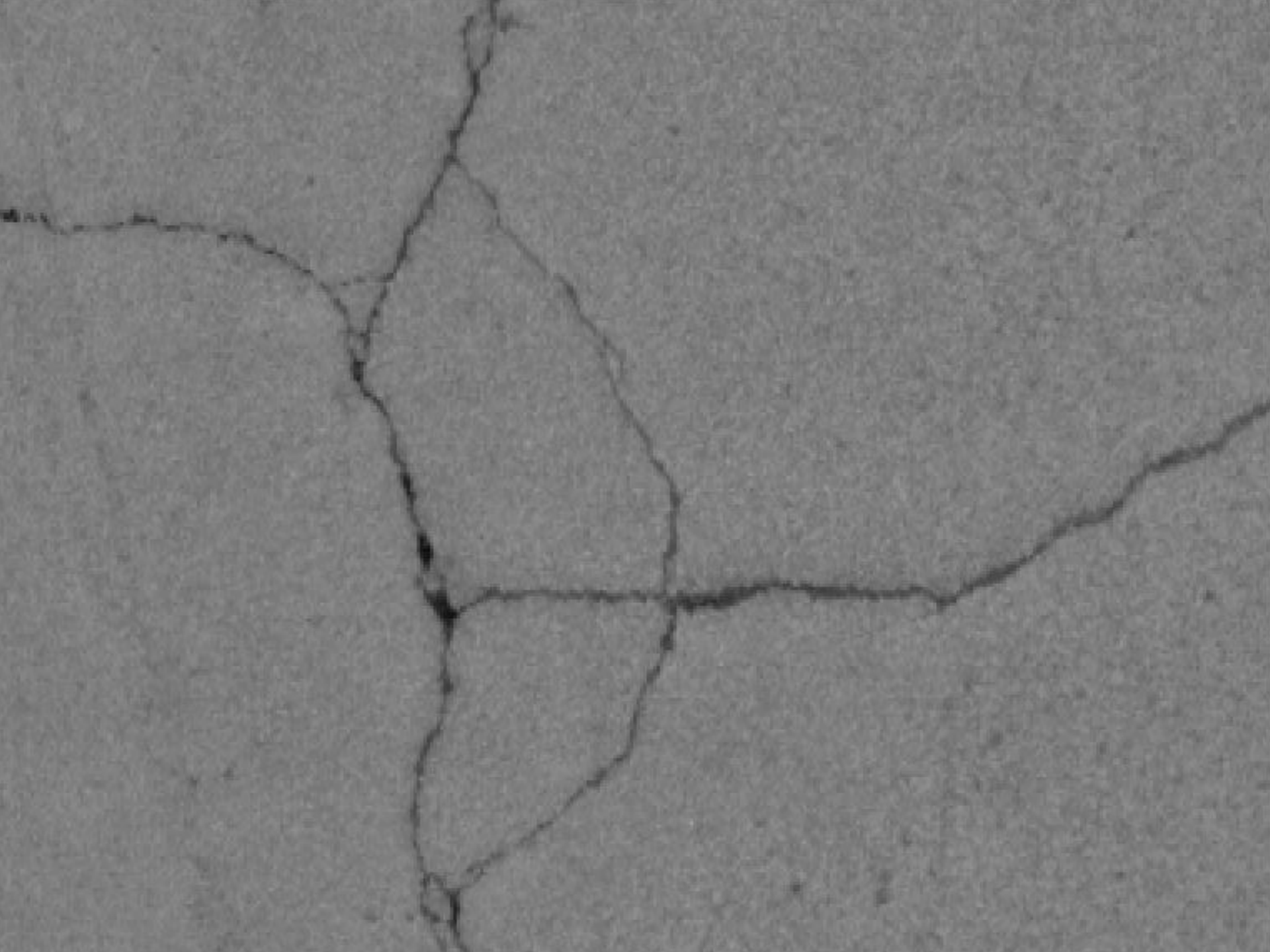
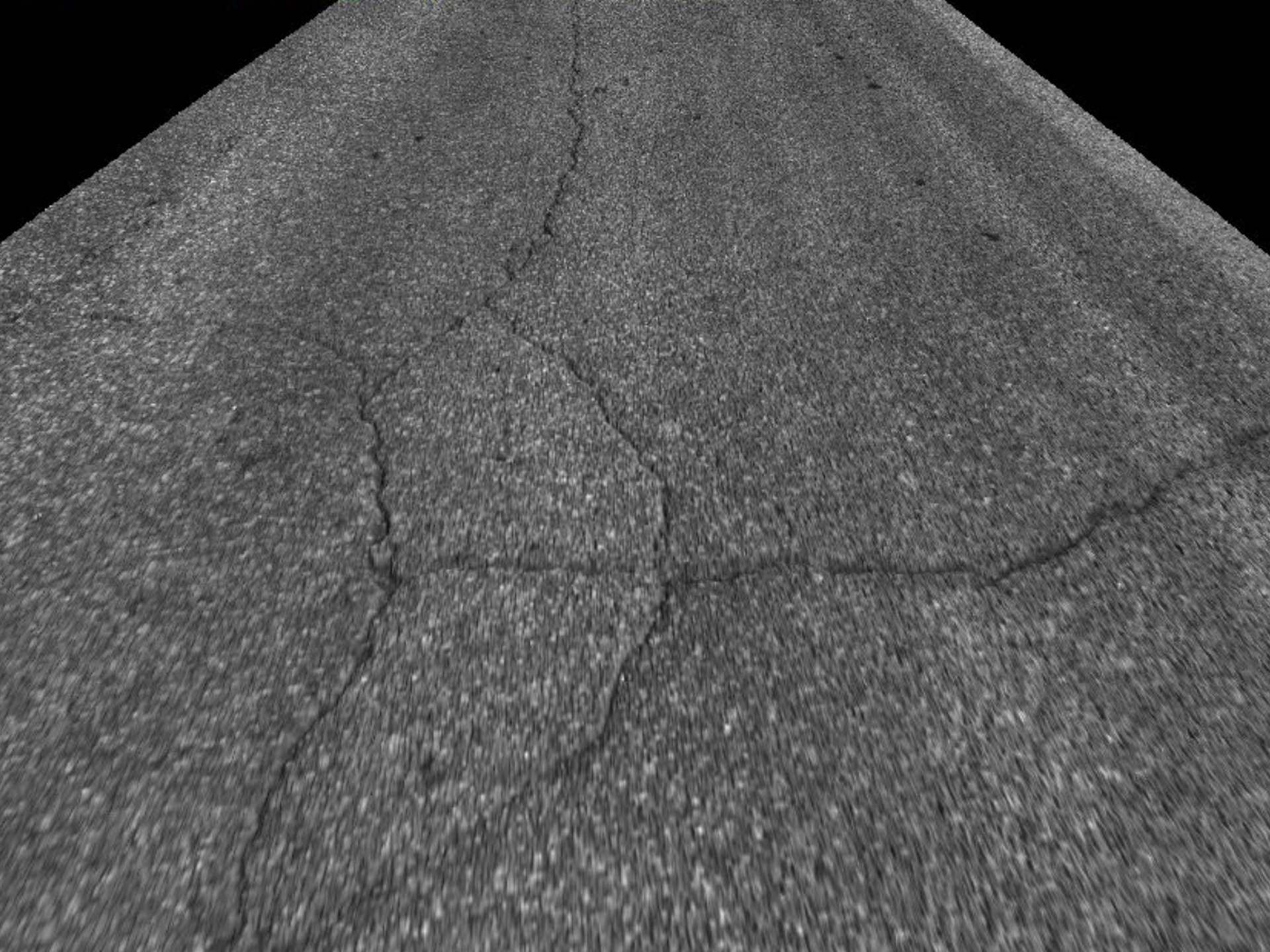
Specifications

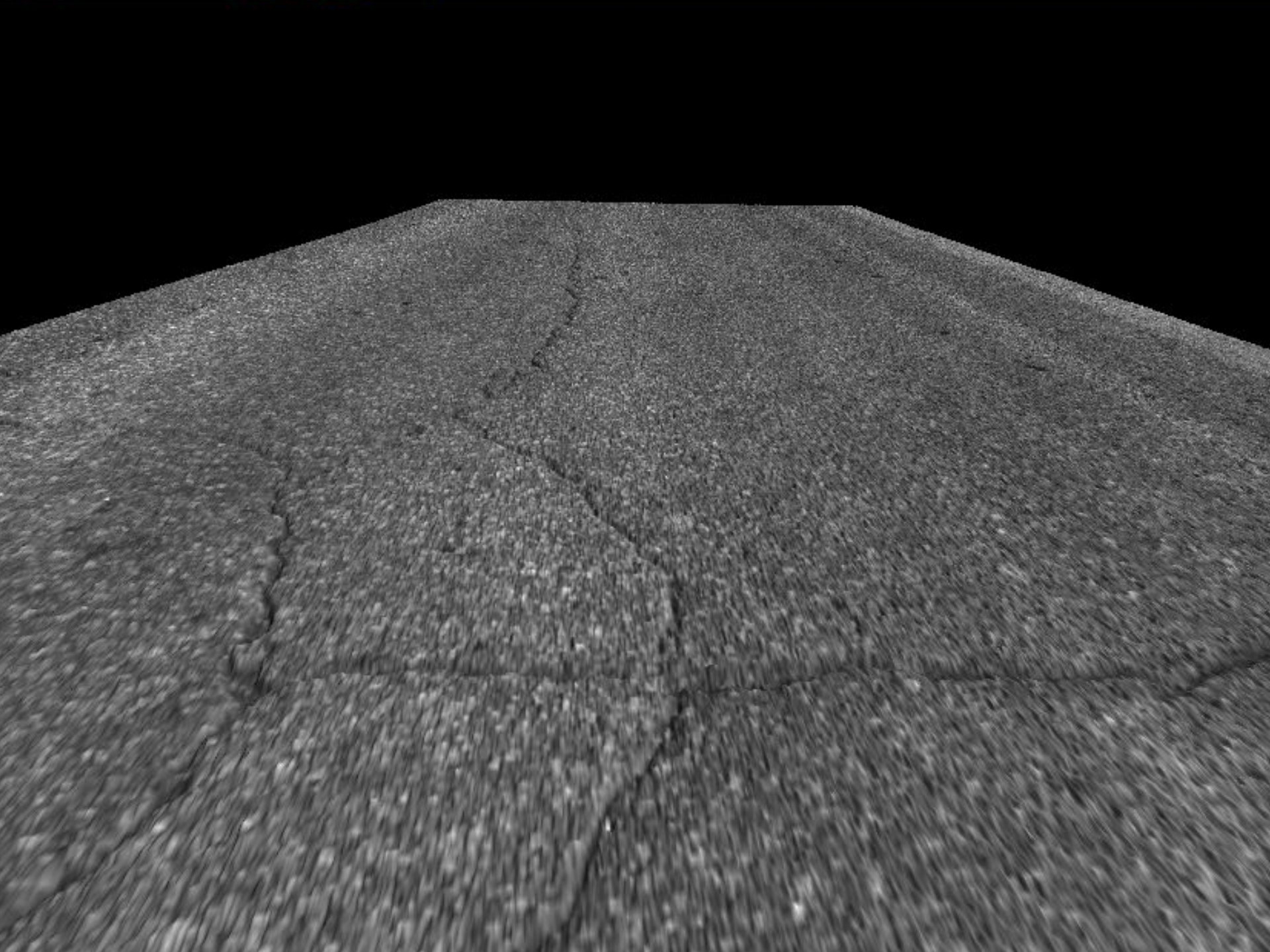
What makes a 3D sensor very good for crack measurement?



LCMS Specifications	
Acquisition Rate	11,200 profiles/s
Range Accuracy	0.5mm
Lateral Resolution	1mm (FOV = 4m)
Nbr of points/sec	45 million 3D and 2D points/s







SOFTWARE
IS
KEY !

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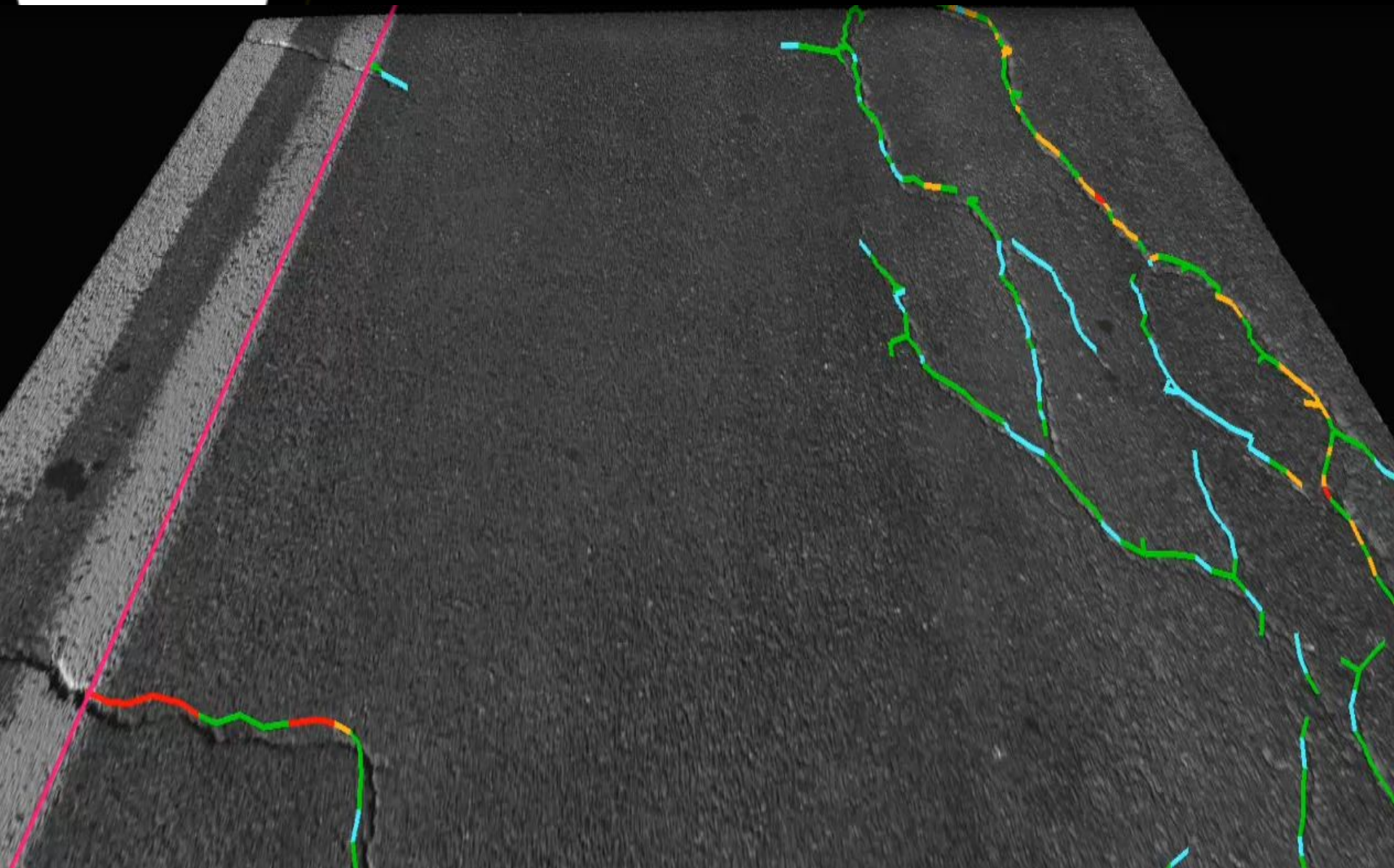
Crack Detection



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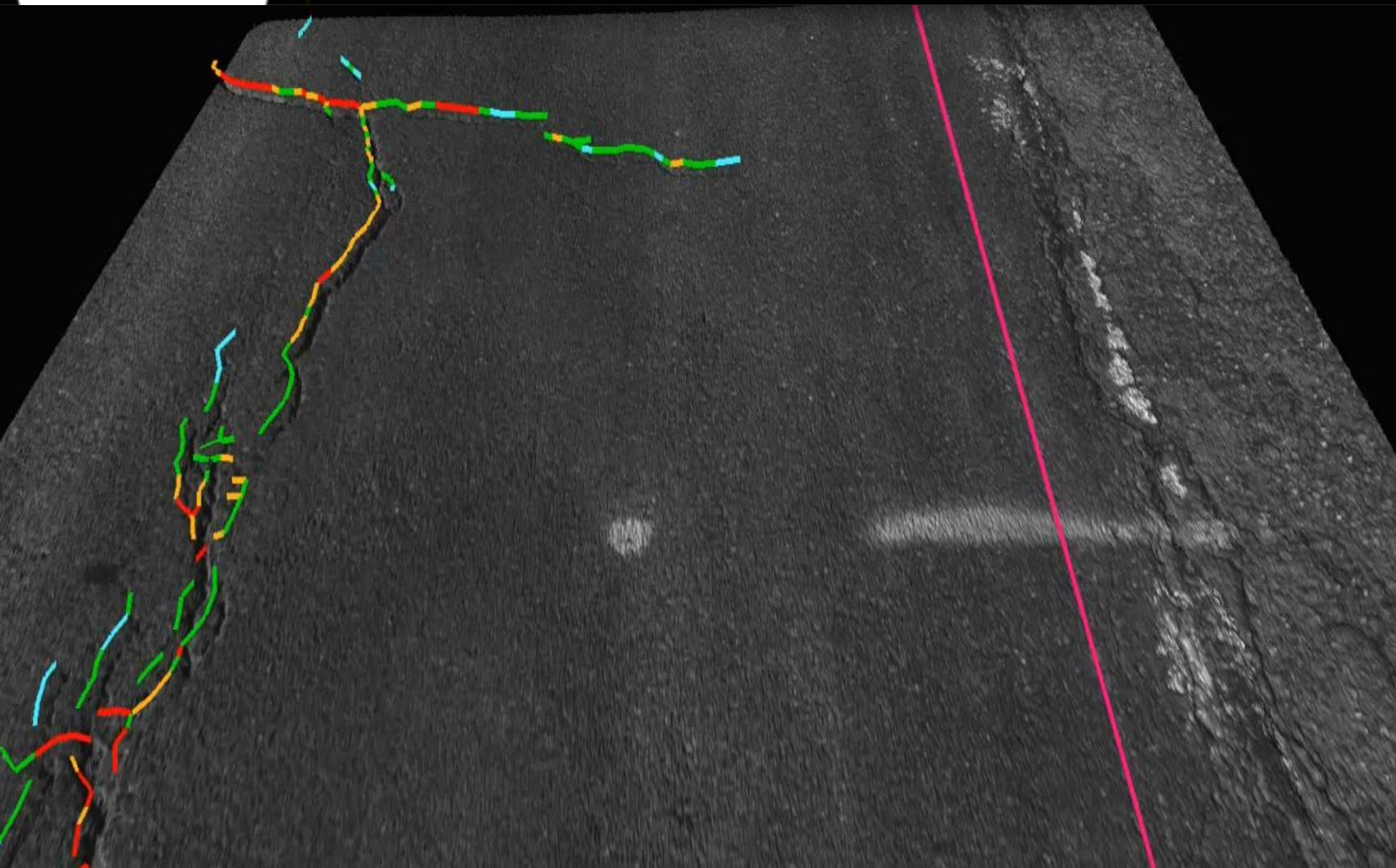
Edge Dropoff Detection



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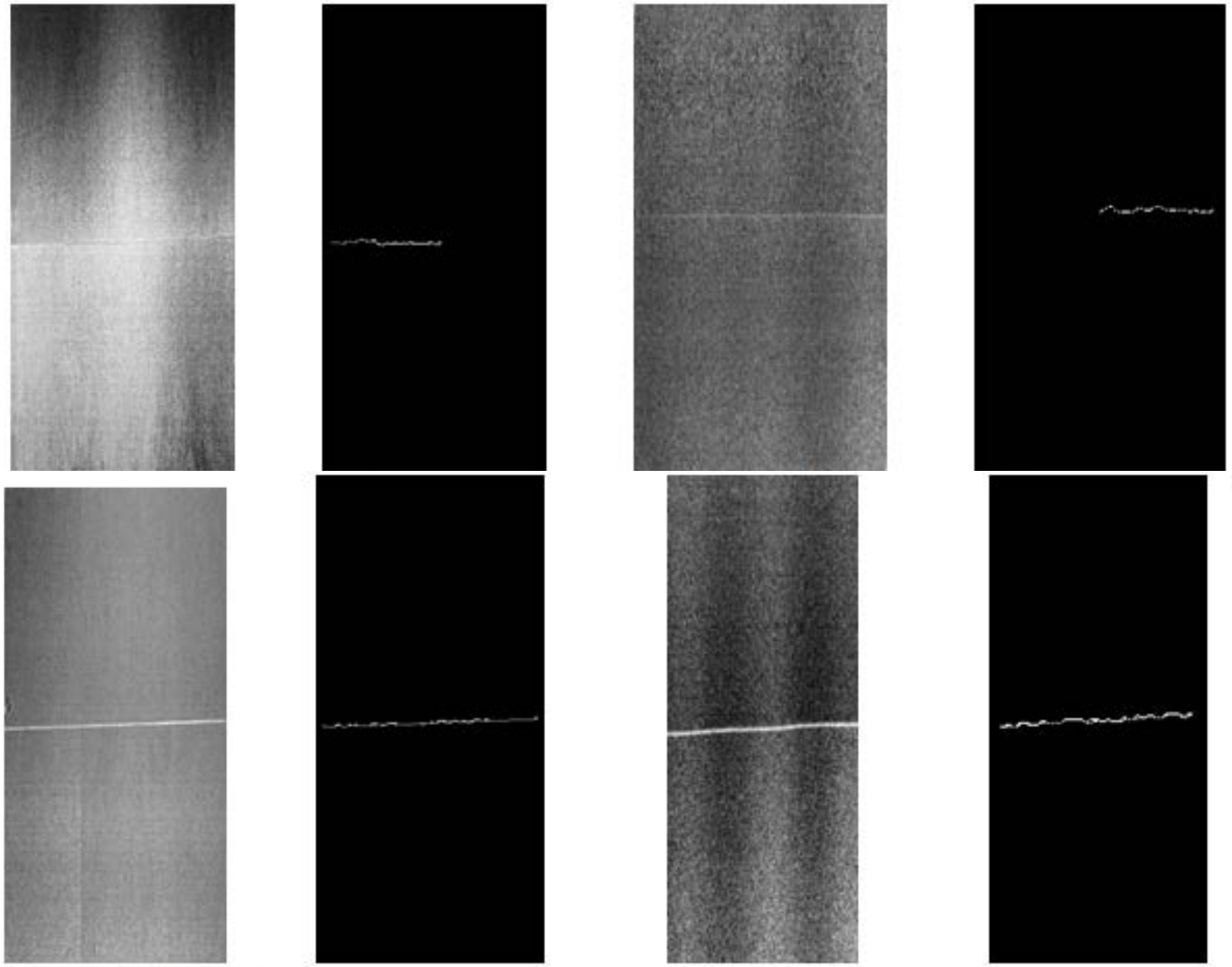
LCMS crack detection tests



(c) 2mm (daytime)

(d) 2mm (night)

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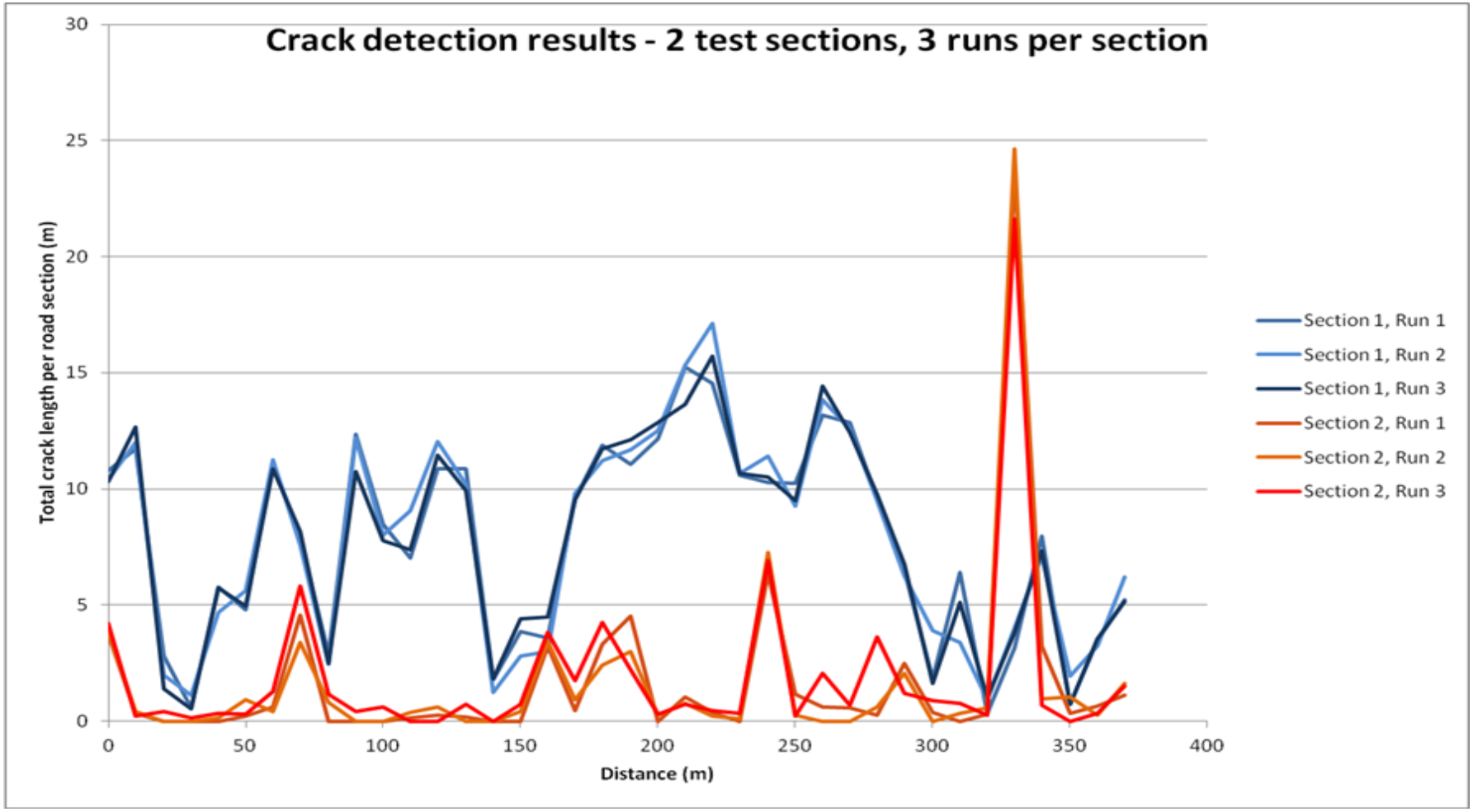
LCMS crack detection repeatability tests



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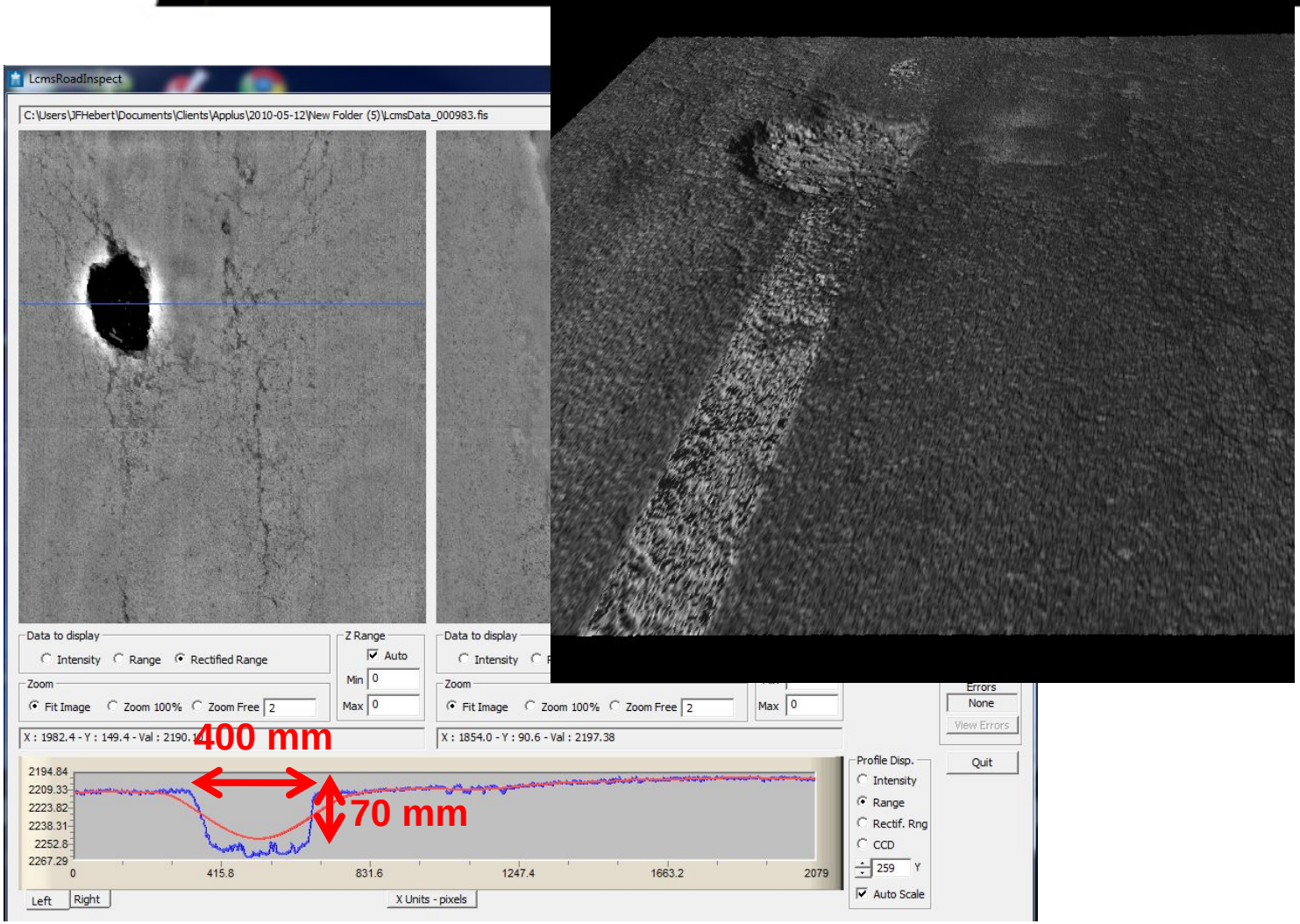
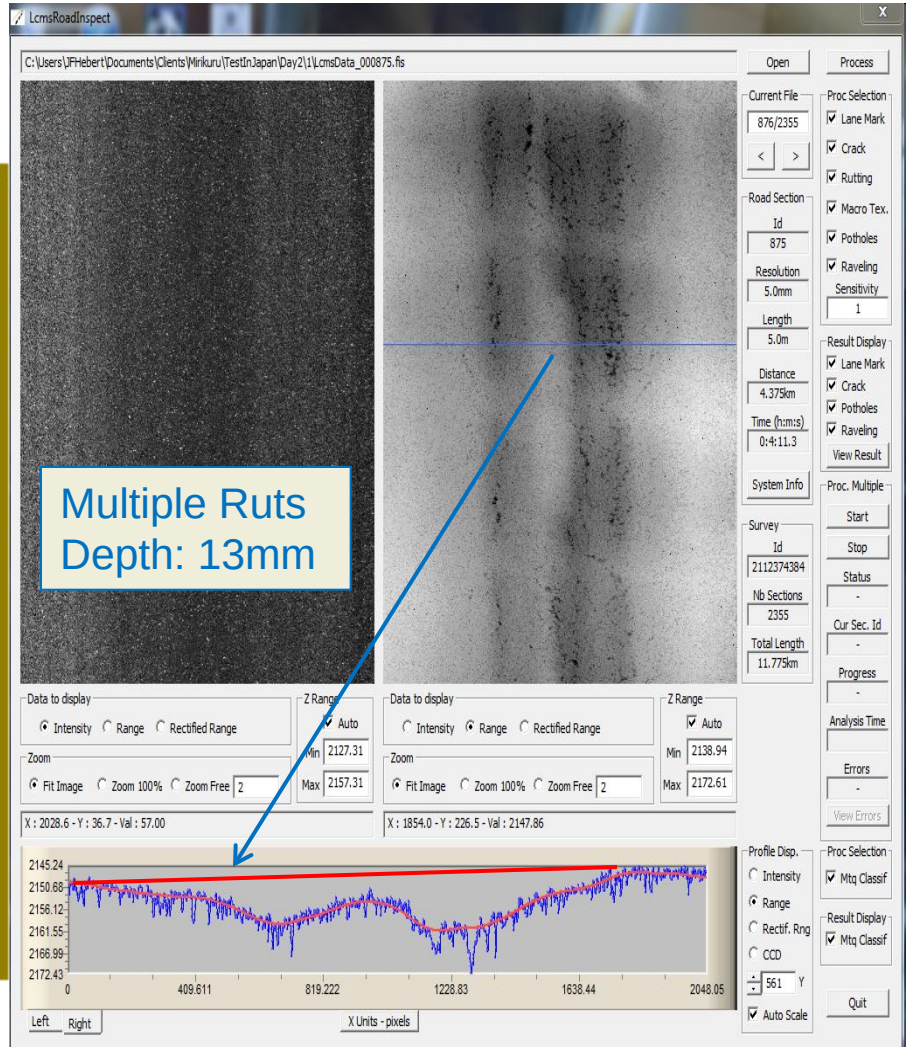
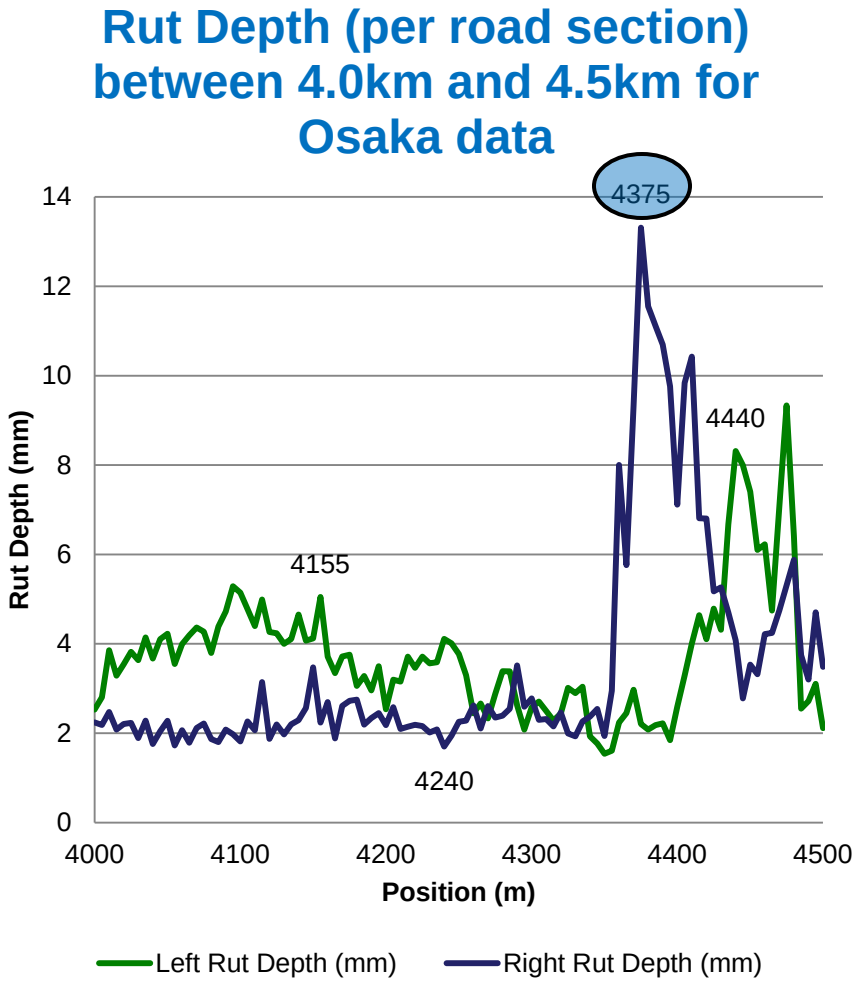
Pothole Detection



Rutting (depth, width, type)





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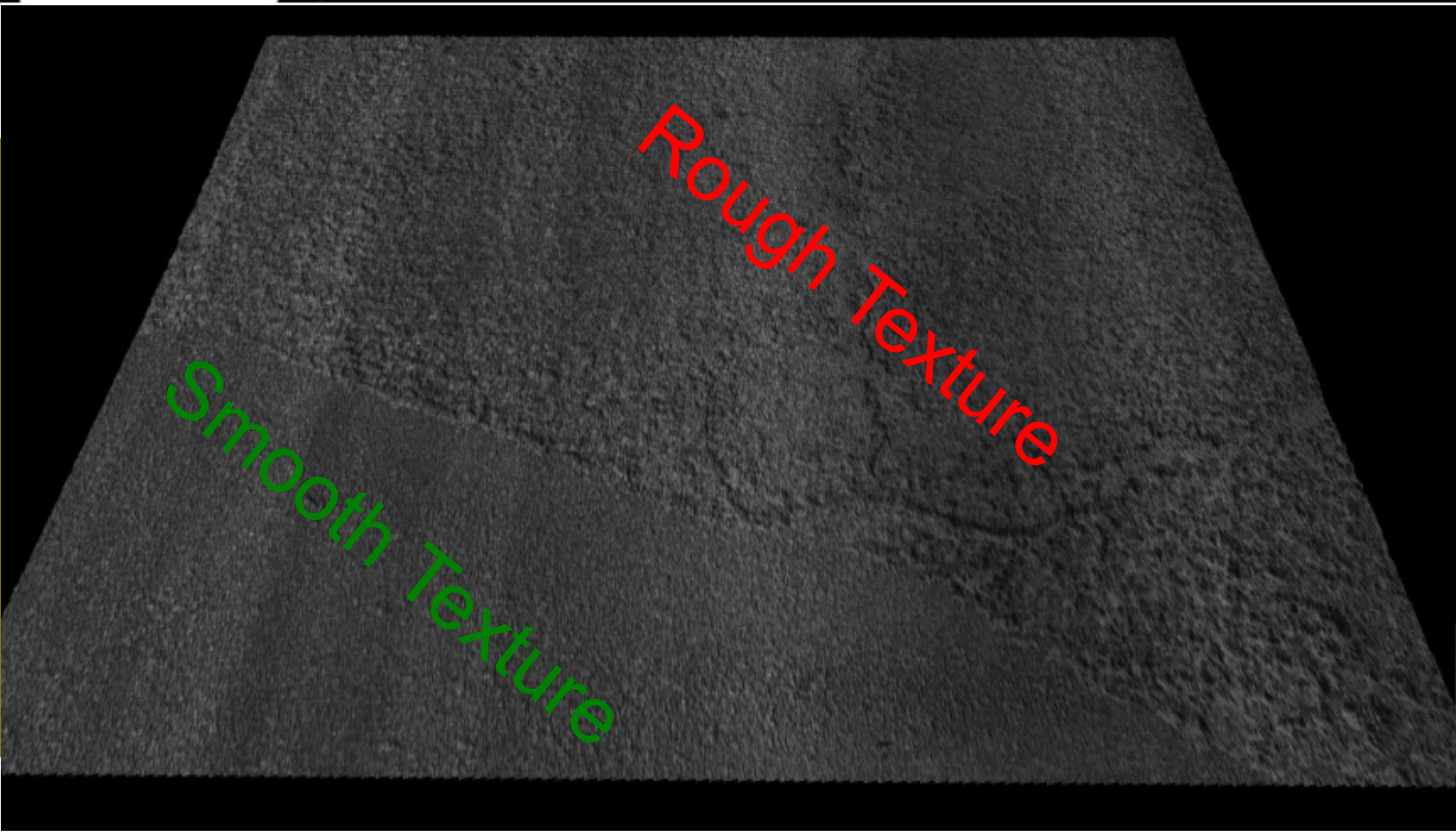
Macrotexture



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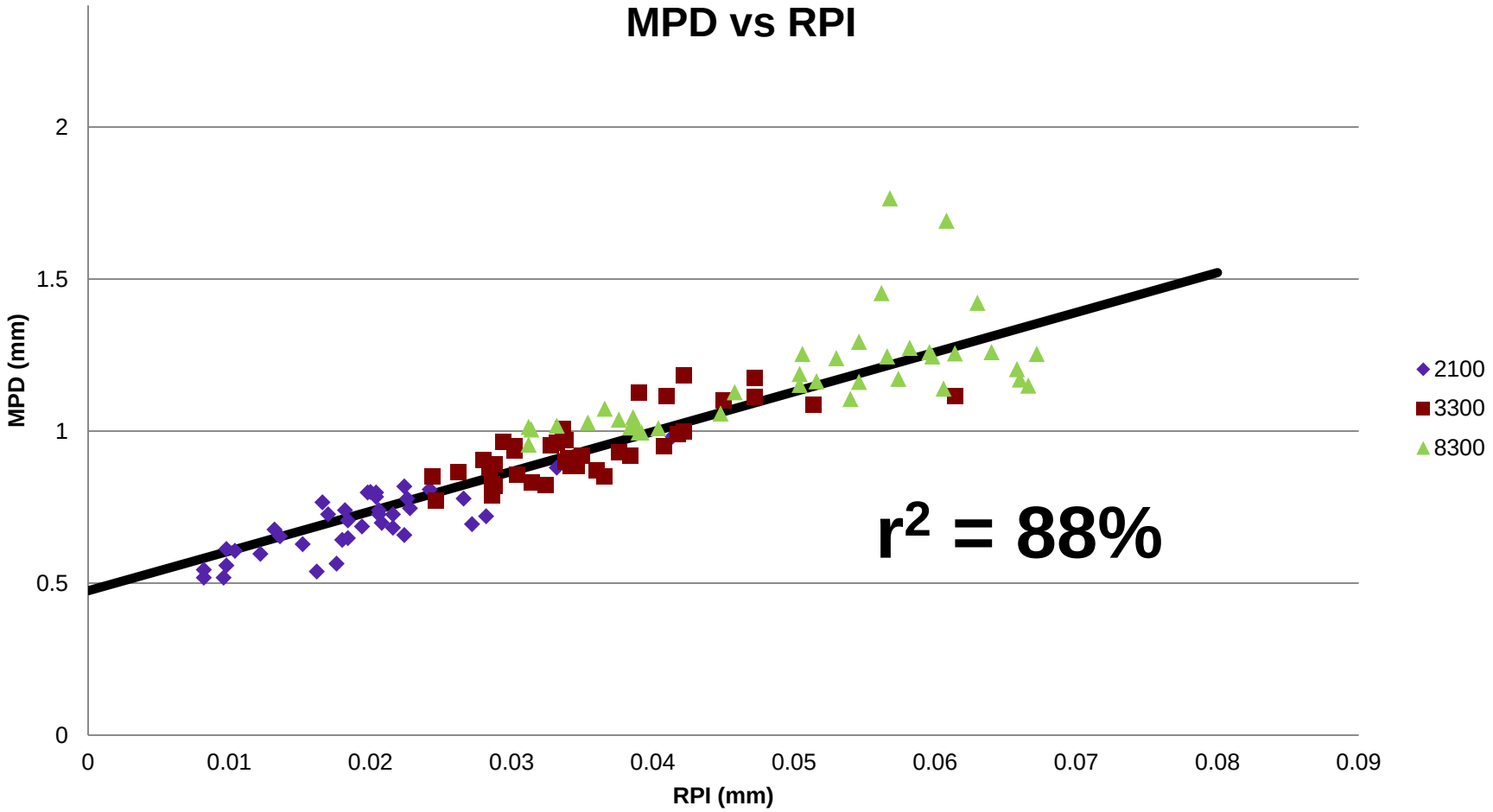
Texture laser MPD Correlation vs LCMS (RPI)



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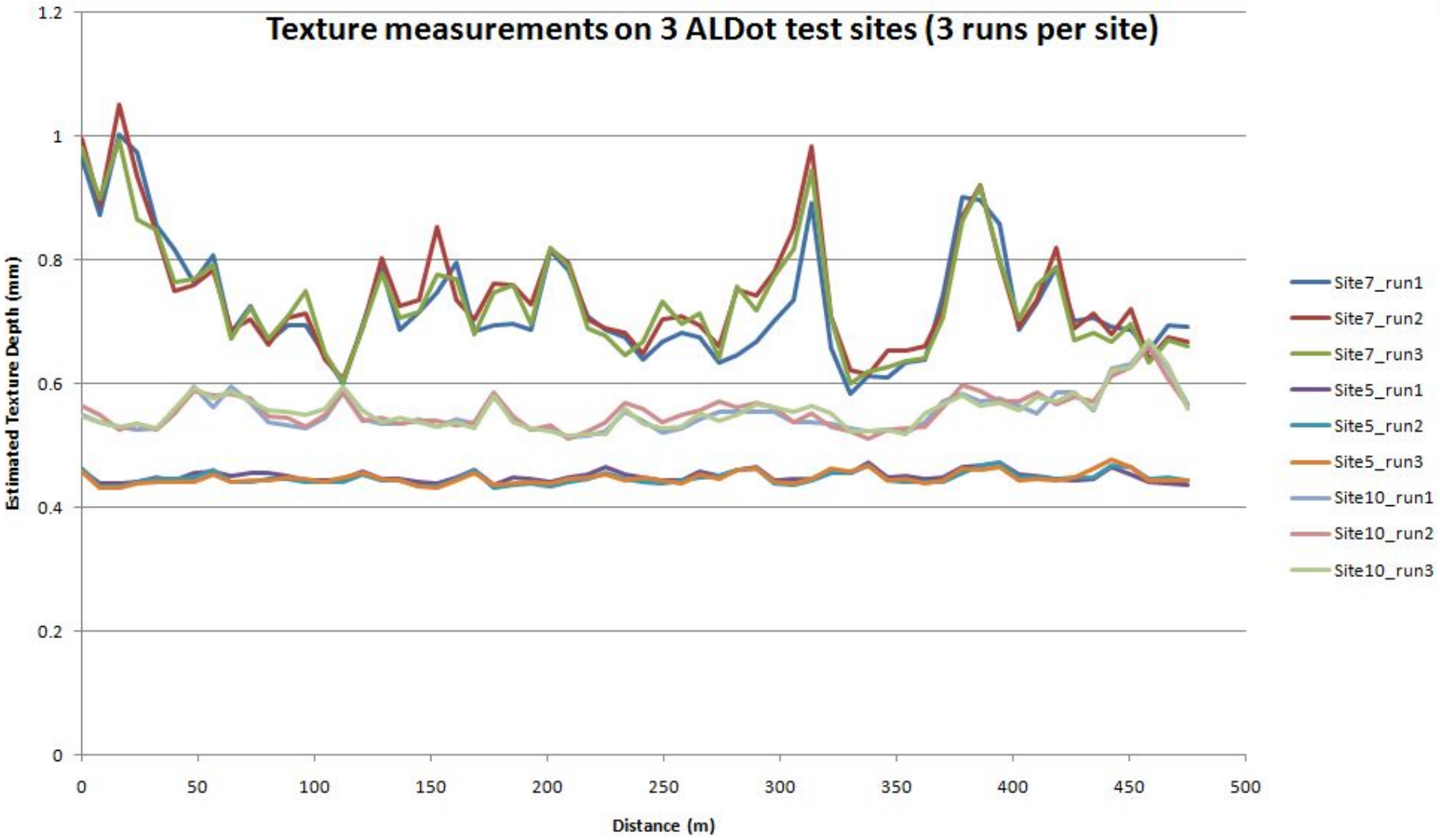
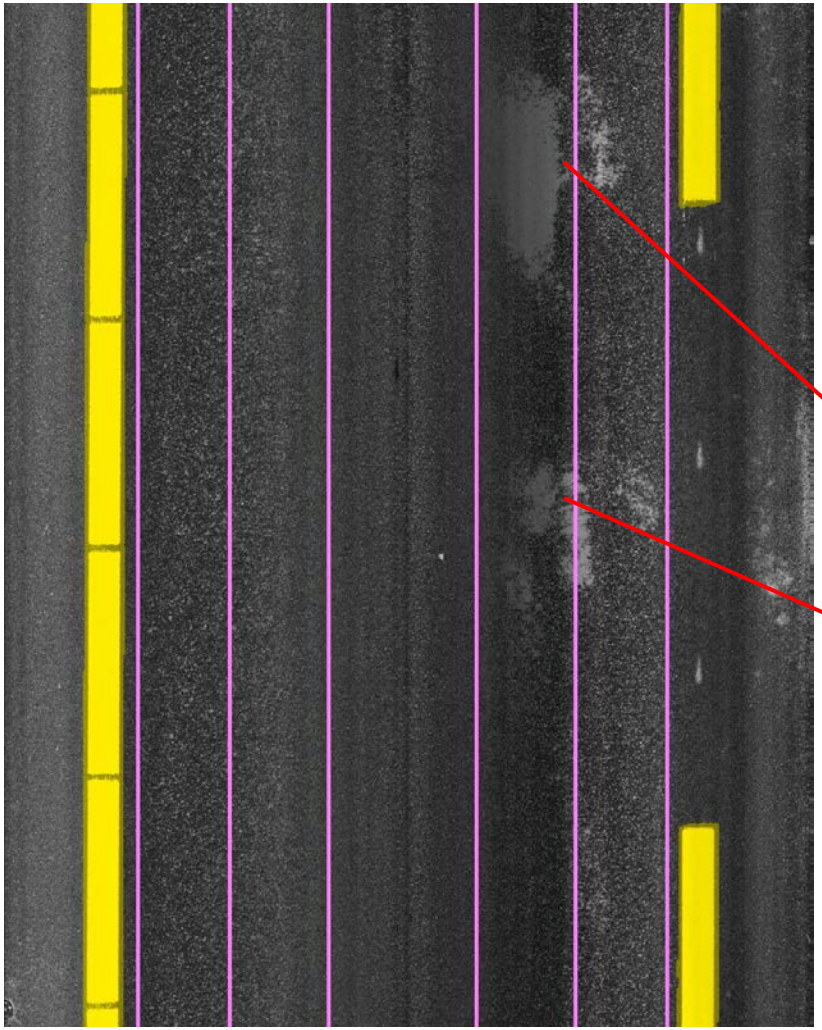
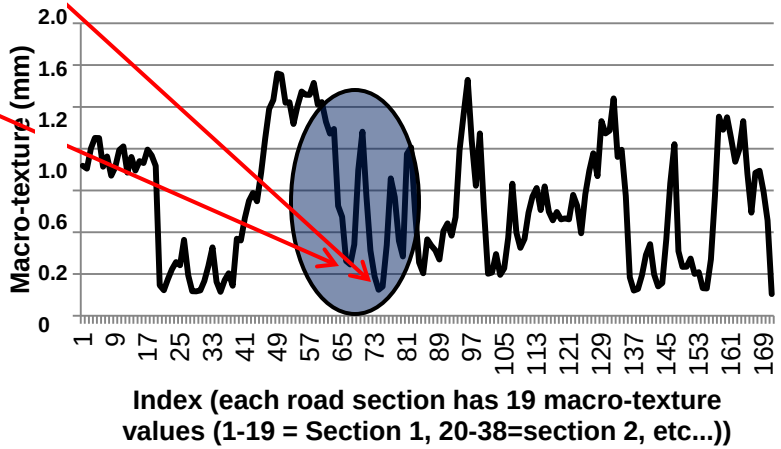
Macro-Texture validation



Bleeding




Macro-texture (mm)
2.0
1.6
1.2
1.0
0.6
0.2
0
1
9
17
25
33
41
49
57
65
73
81
89
97
105
113
121
129
137
145
153
161
169
Index (each road section has 19 macro-texture values (1-19 = Section 1, 20-38=section 2, etc...))

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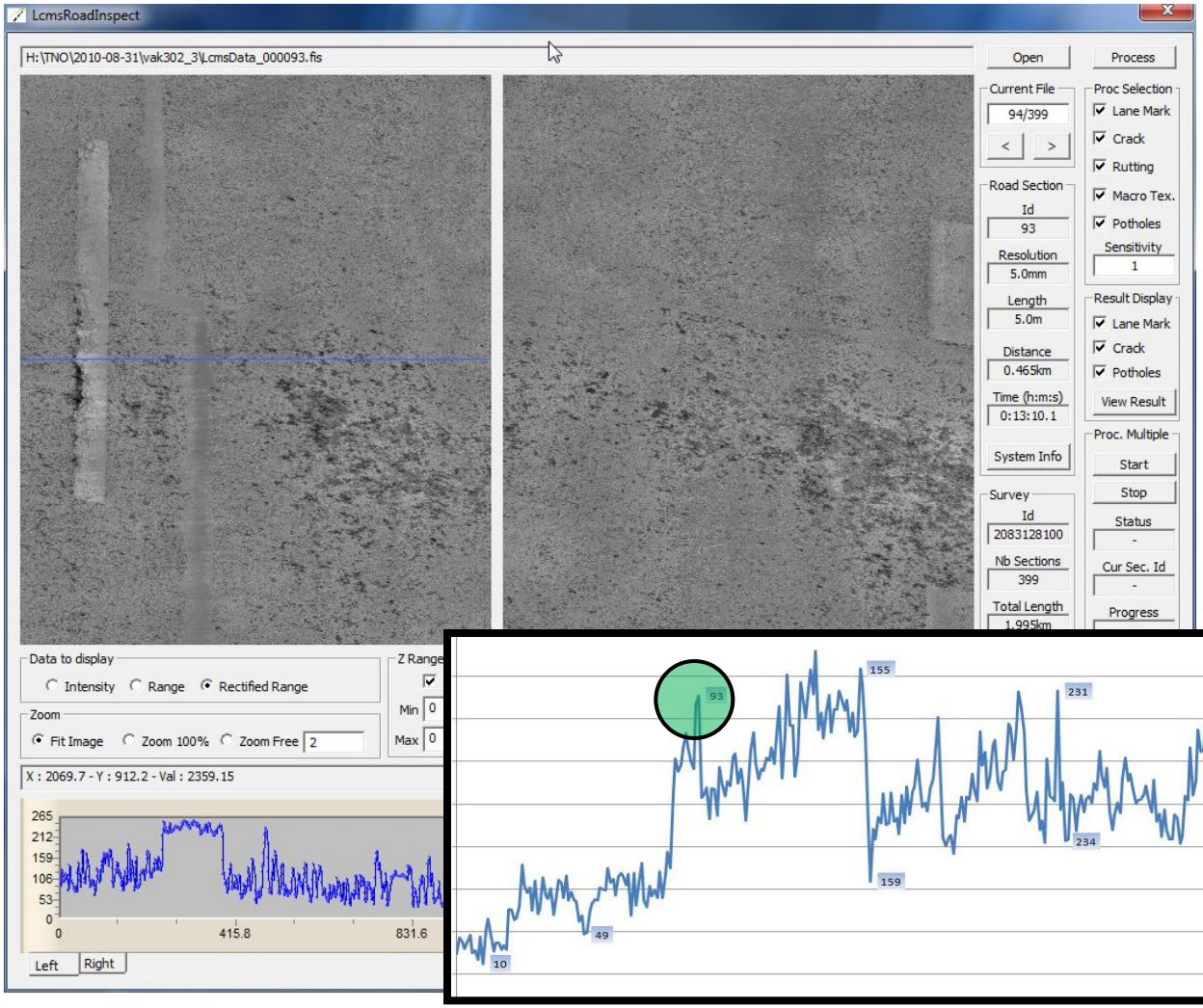
Road Section #93 : Raveling patch



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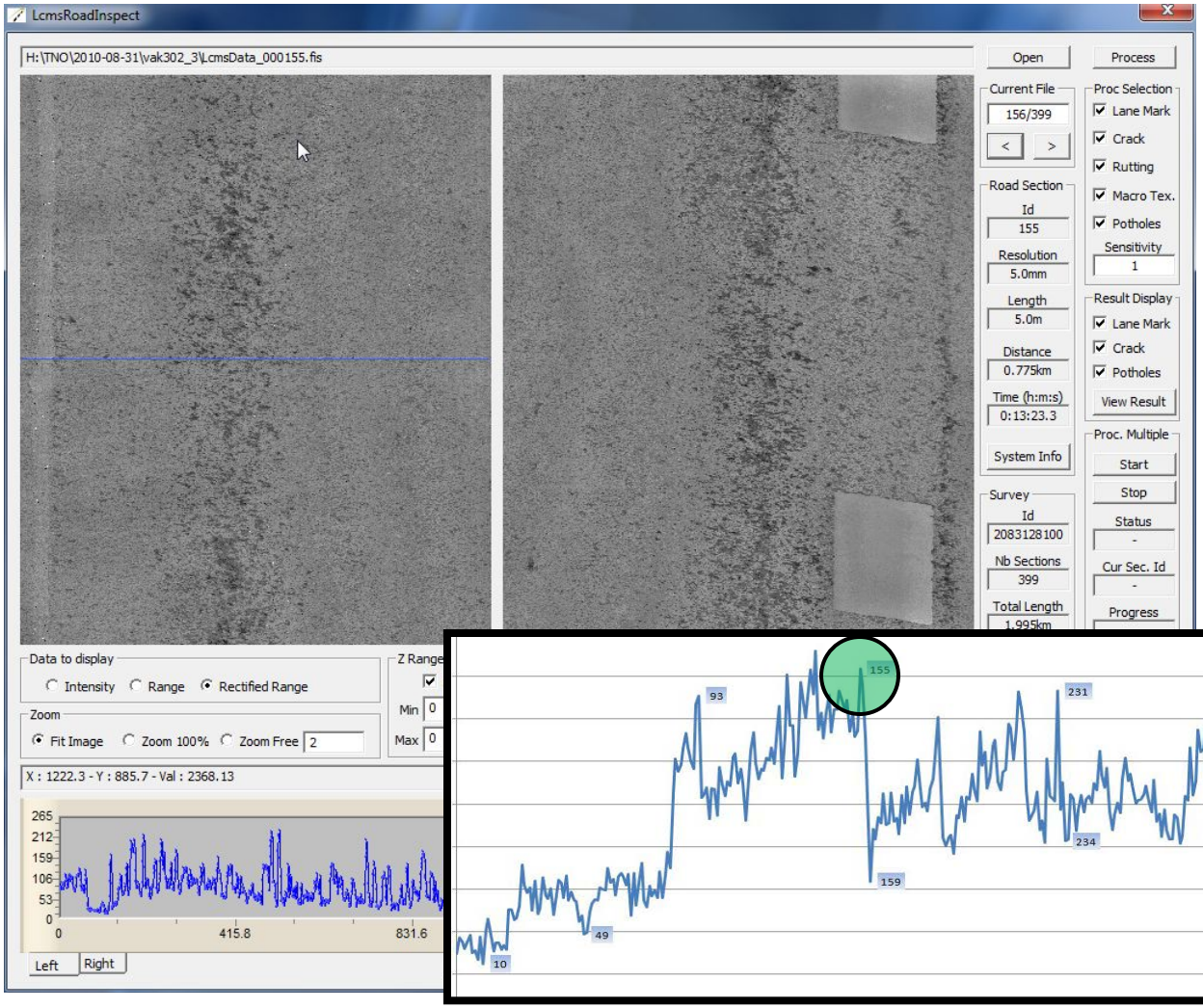
Road Section #155 : Raveling patch



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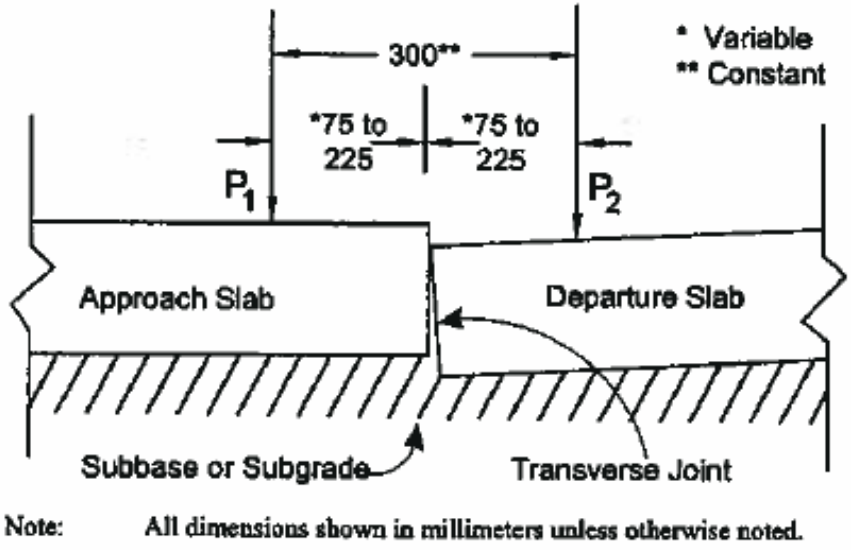
Concrete Roads

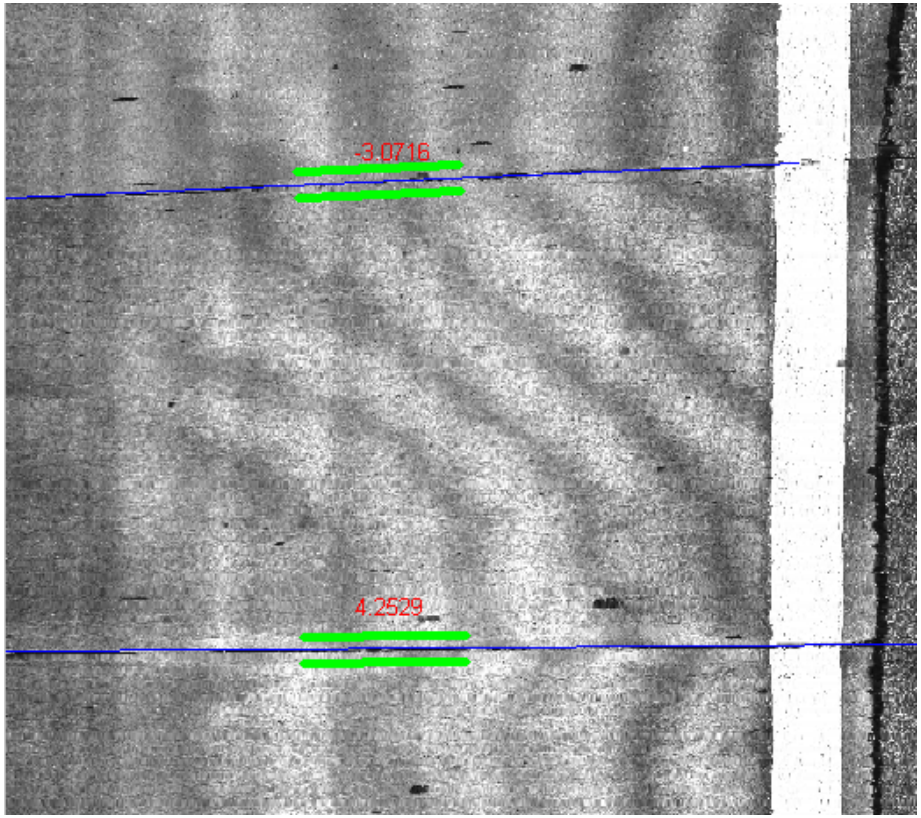
Pavemetrics

Concrete Roads

Joint detection and faulting



Note: All dimensions shown in millimeters unless otherwise noted.



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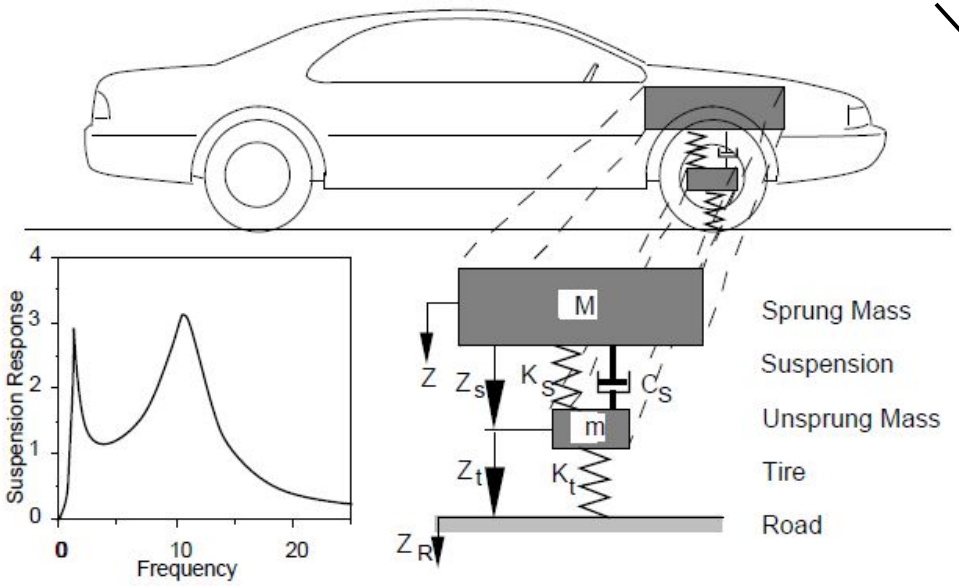
IRI – Longitudinal profile

Longitudinal profile and
International Roughness Index (IRI)



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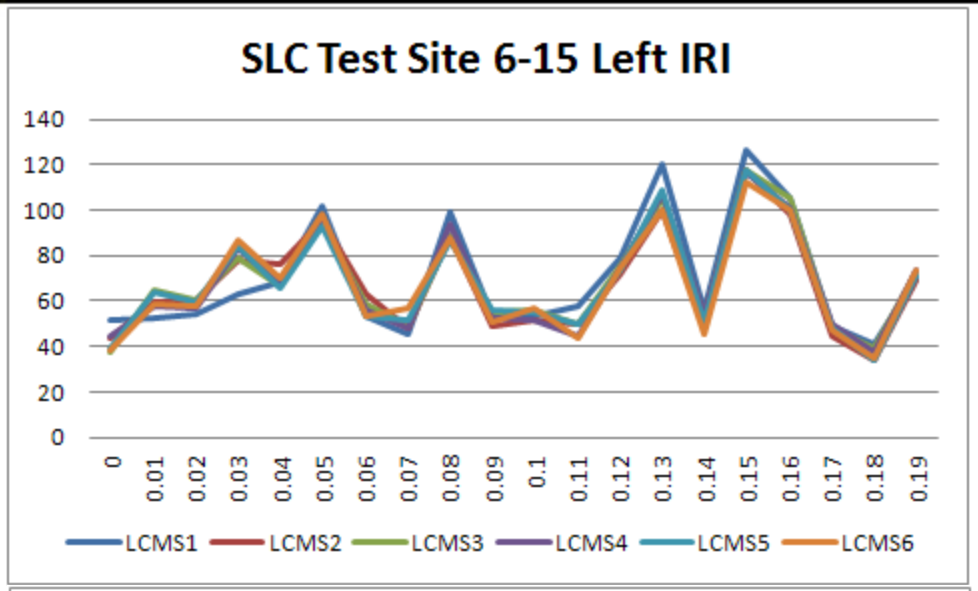
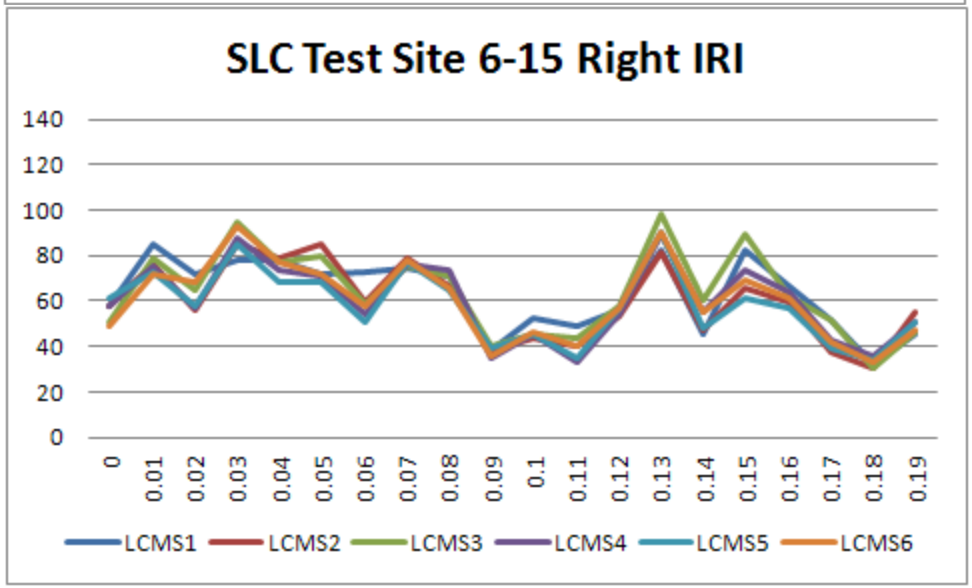
Does it work?
UTAH DOT – Test sites





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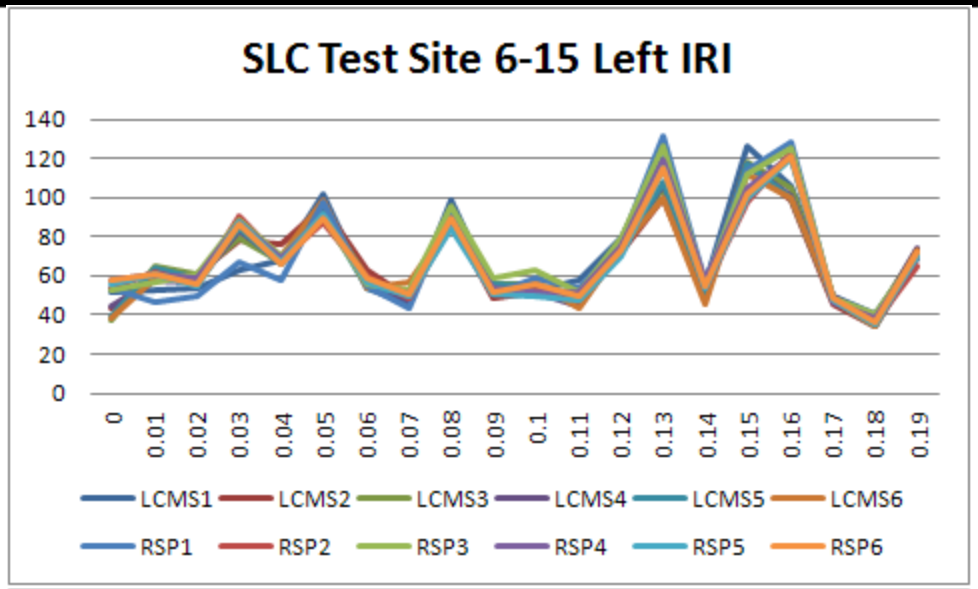
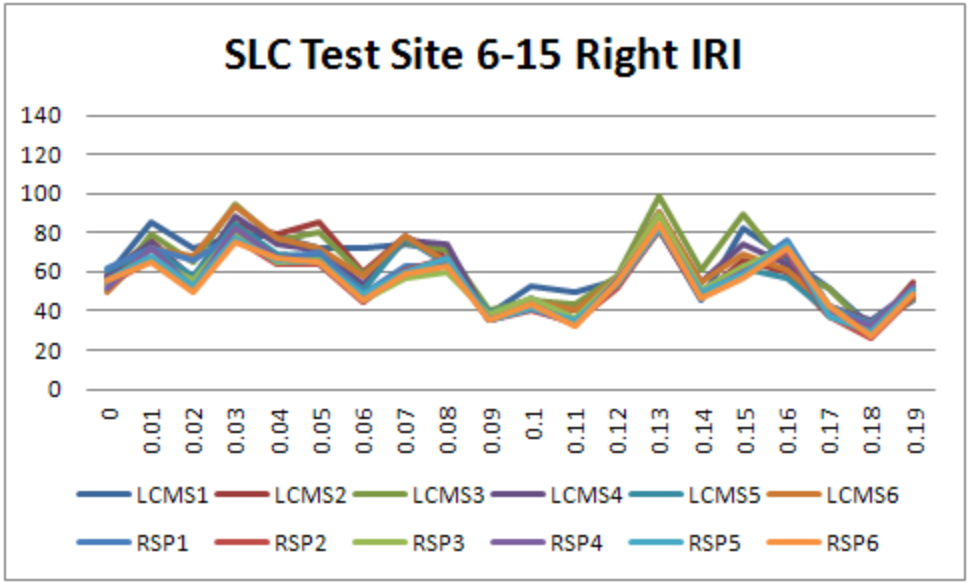
UTAH DOT – Test sites





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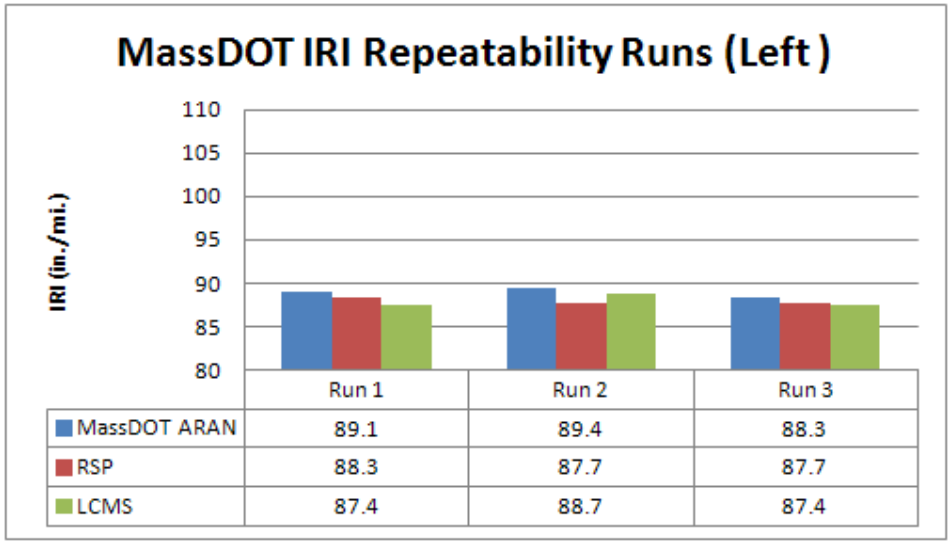
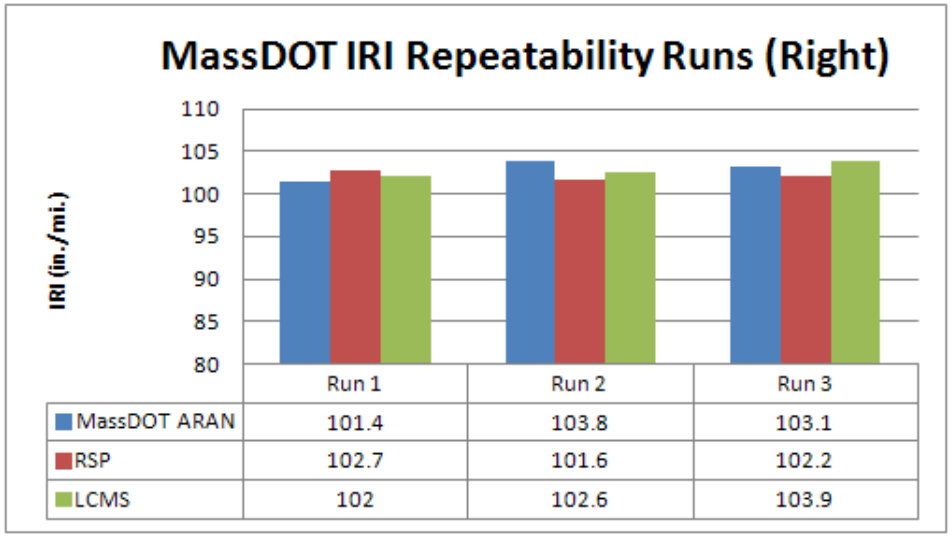
MassDOT



	Run 1	Run 2	Run 3
MassDOT ARAN	89.1	89.4	88.3
RSP	88.3	87.7	87.7
LCMS	87.4	88.7	87.4



	Run 1	Run 2	Run 3
MassDOT ARAN	101.4	103.8	103.1
RSP	102.7	101.6	102.2
LCMS	102	102.6	103.9

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Does it work? LCMS vs Surpro

IRI values calculated for 4 LCMS runs on a 400m validation test track

Run	IRI Left (m/km)	IRI Right (m/km)
1	1.19	1.64
2	1.16	1.51
3	1.19	1.54
4	1.21	1.55
Mean	1.19	1.56
Standard deviation	0.02	0.06
Surpro	1.21	1.54

- IRI values are stable and close to the values obtained with the reference instrument (Surpro).

LCMS passes Profiler certication in PROVAL

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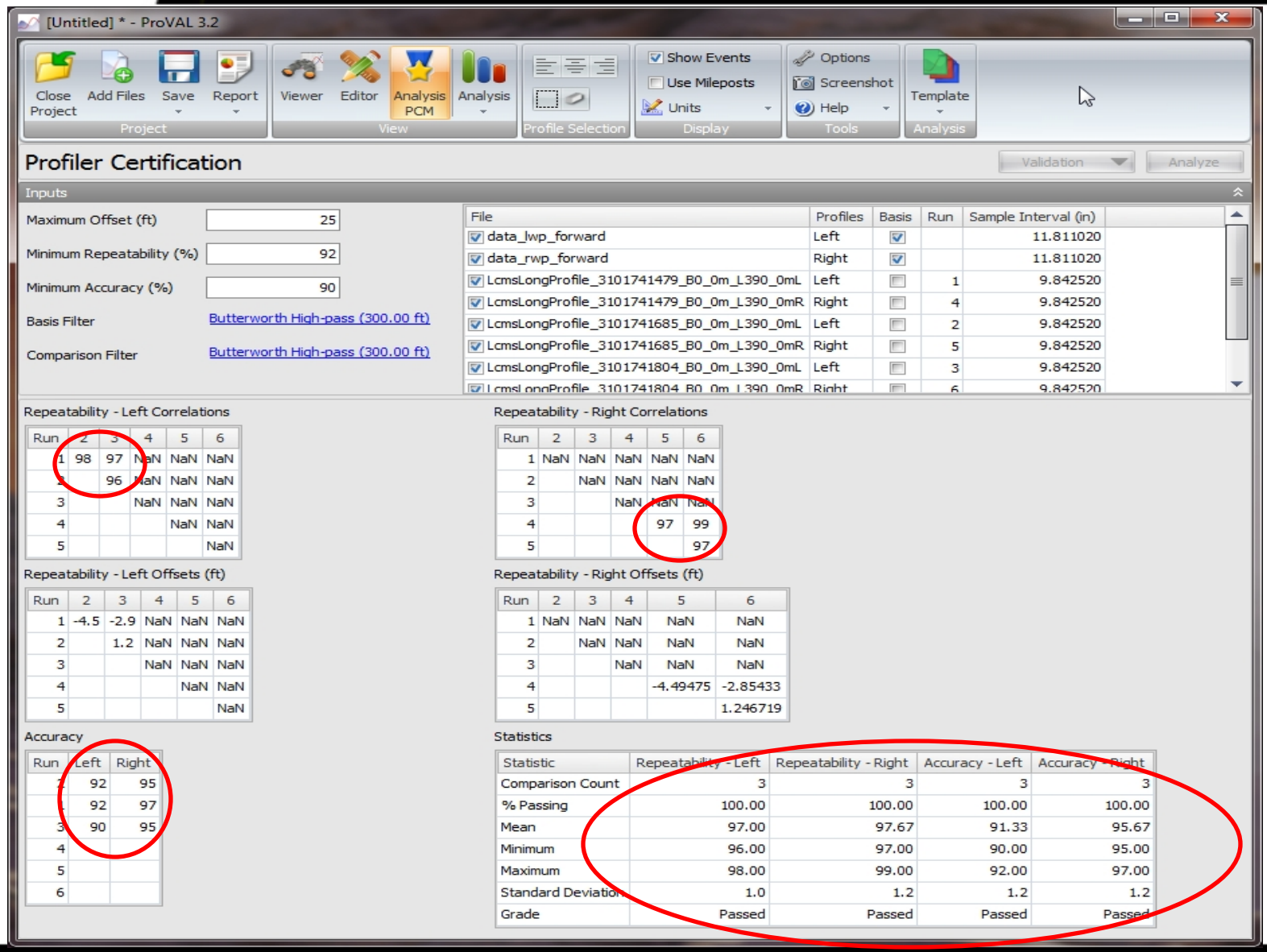

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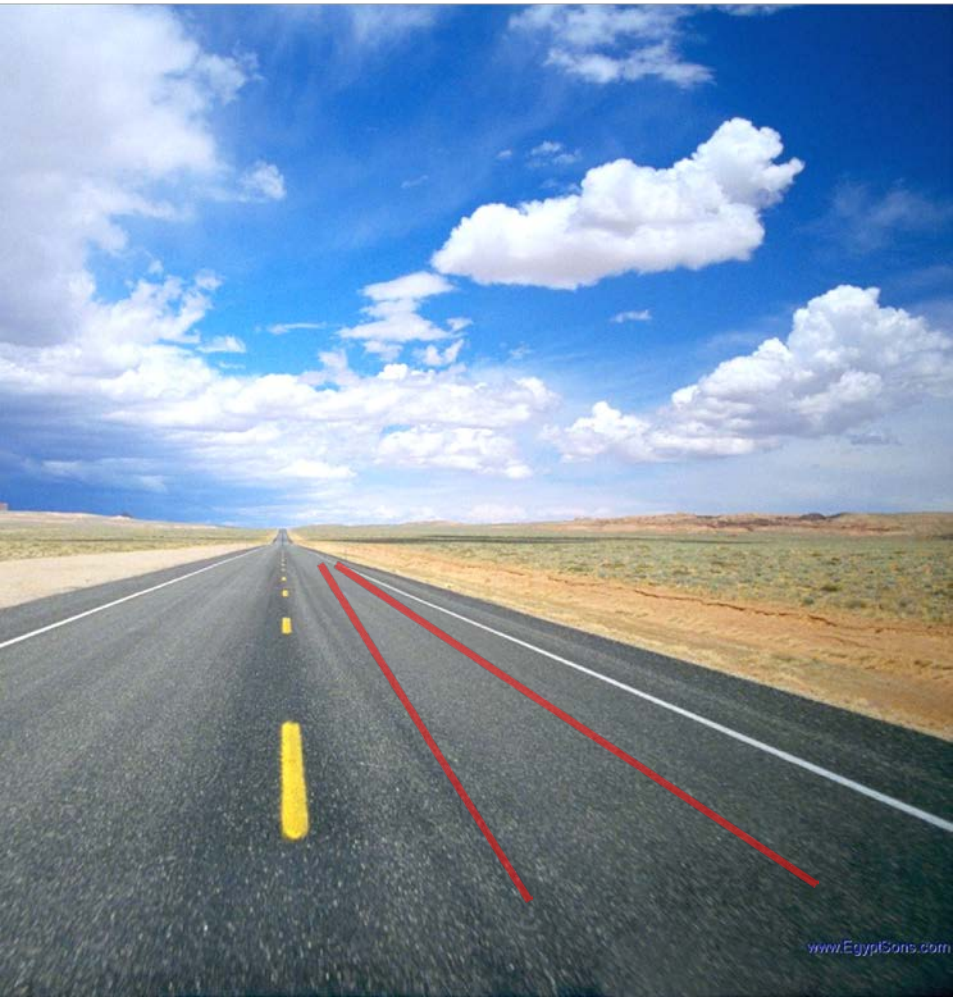
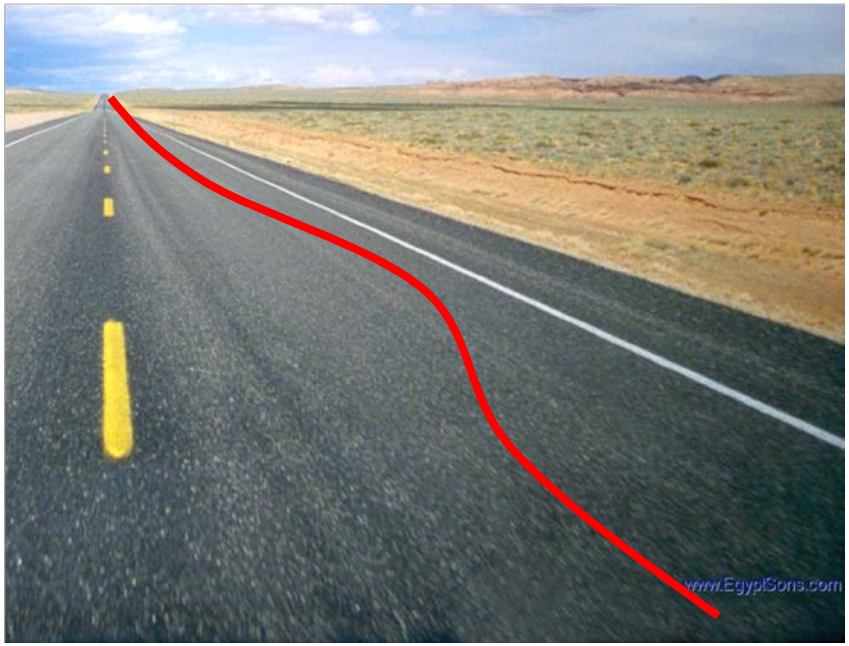
LCMS vs single point IRI

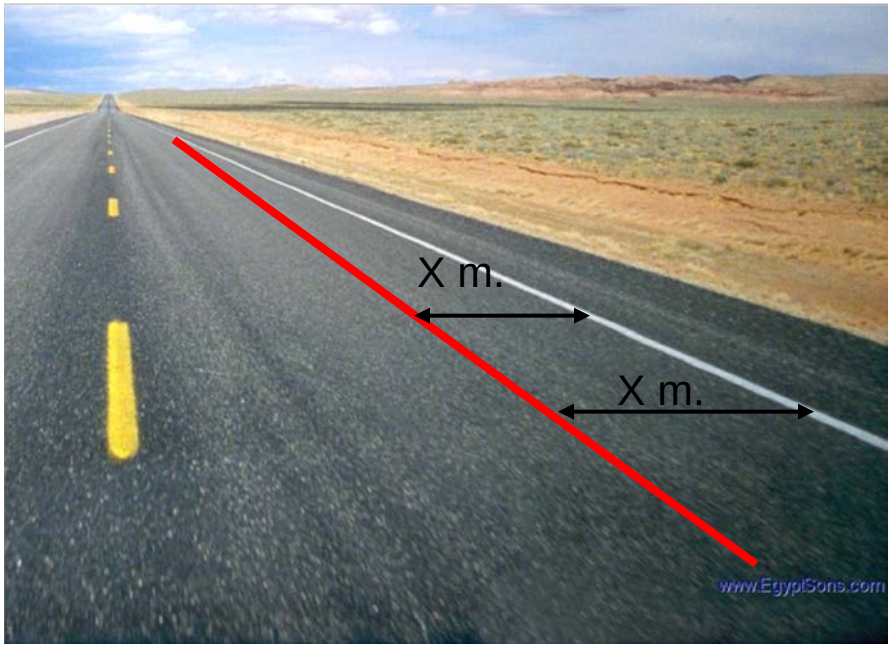


LCMS benefits

- LANE MARKINGS are used to correct profiles and compensate for driver wander.
- Simplifies certification procedures
- Eliminates the need to certify operators



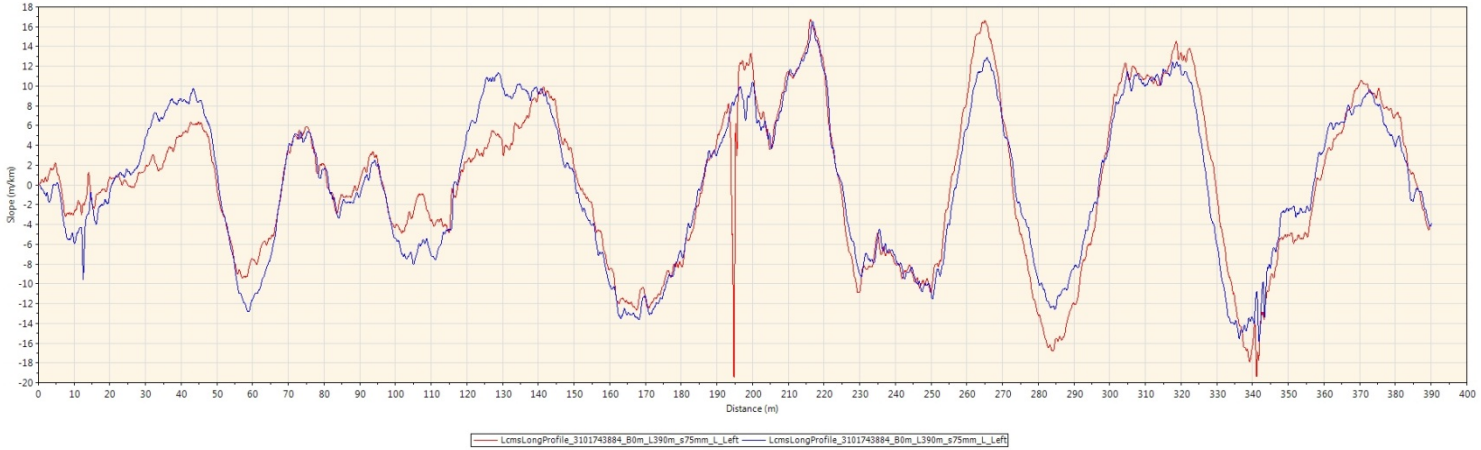
Classic system: Results depend on the trajectory of the vehicle (subject to variation based on driver's ability)



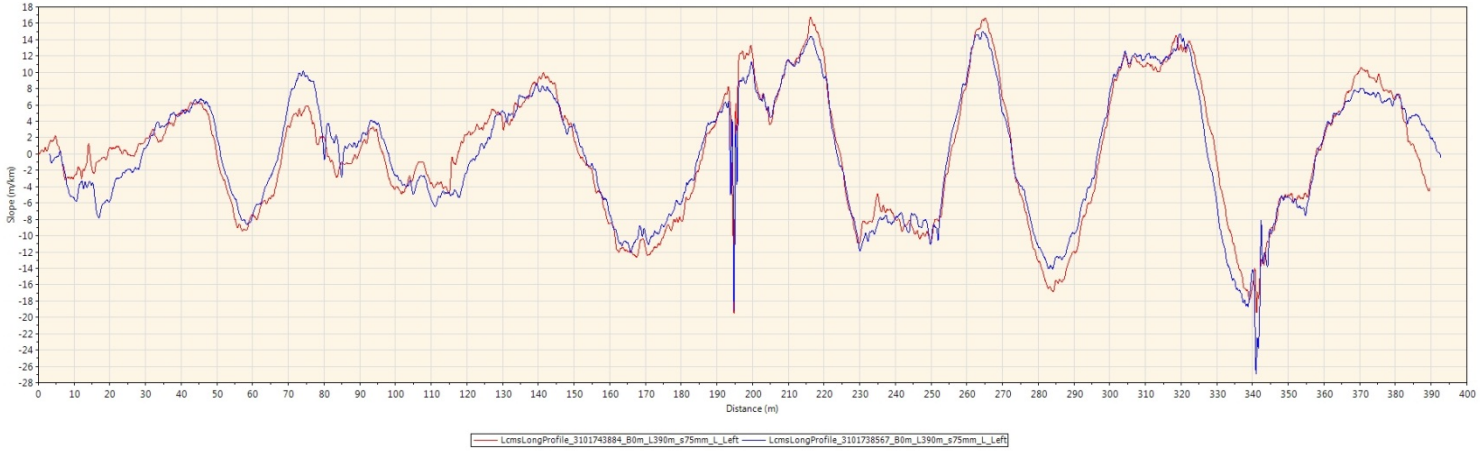
LCMS-IRI system: Erratic trajectory of the vehicle will still result in straight elevation profiles

Results: lane tracking

- Without lane tracking.



- With lane tracking.



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Results: lane tracking

- Driver was asked to zigzag on validation track #1 (400 m).
- Elevation profiles computed with and without lane tracking.

	With lane tracking		No lane tracking	
Run	IRI Left (m/km)	IRI Right (m/km)	IRI Left (m/km)	IRI Right (m/km)
1	1.33	1.50	1.16	1.43
Reference value	1.29	1.47	1.29	1.47
Difference	3.1%	2.0%	10.1%	2.7%

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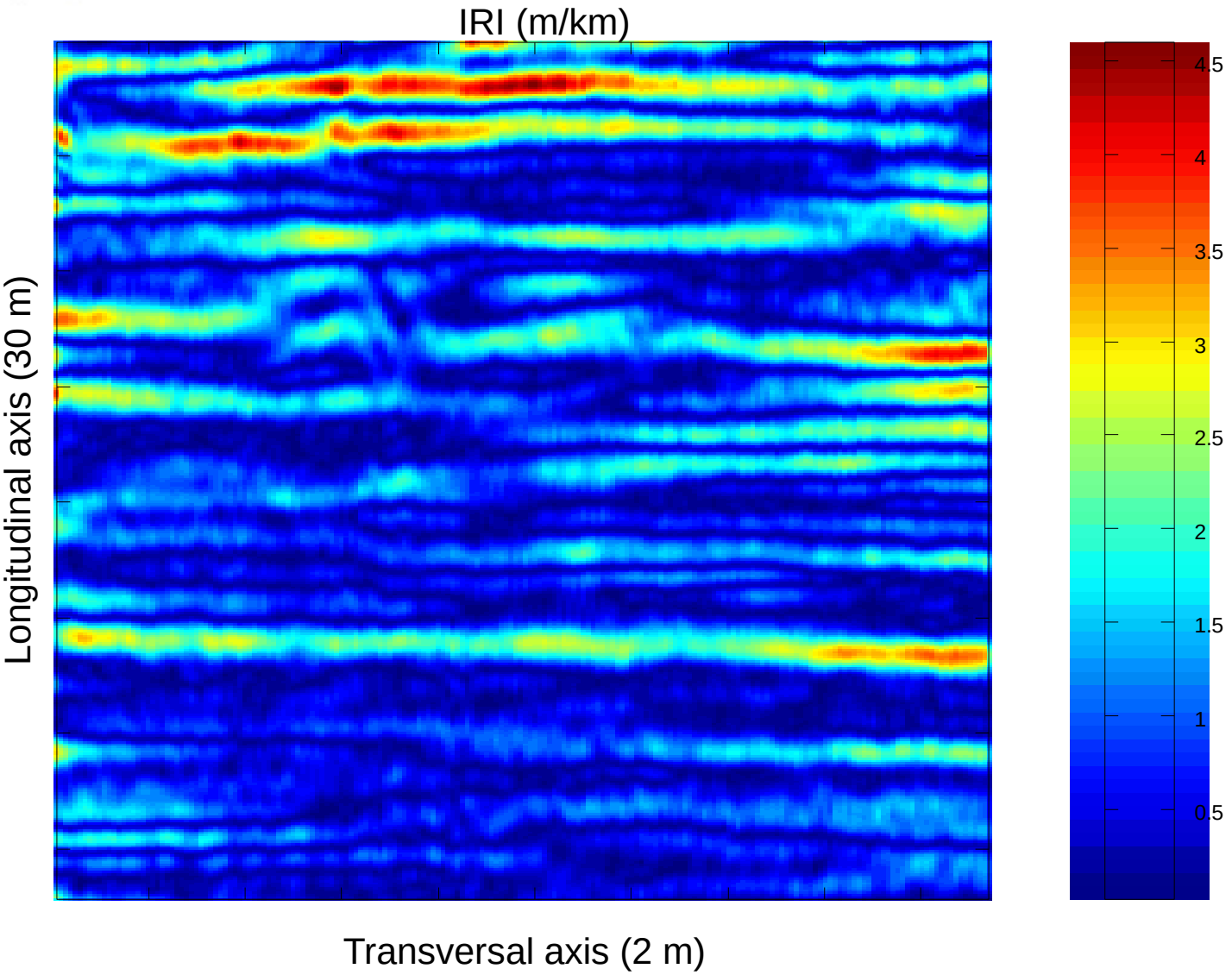
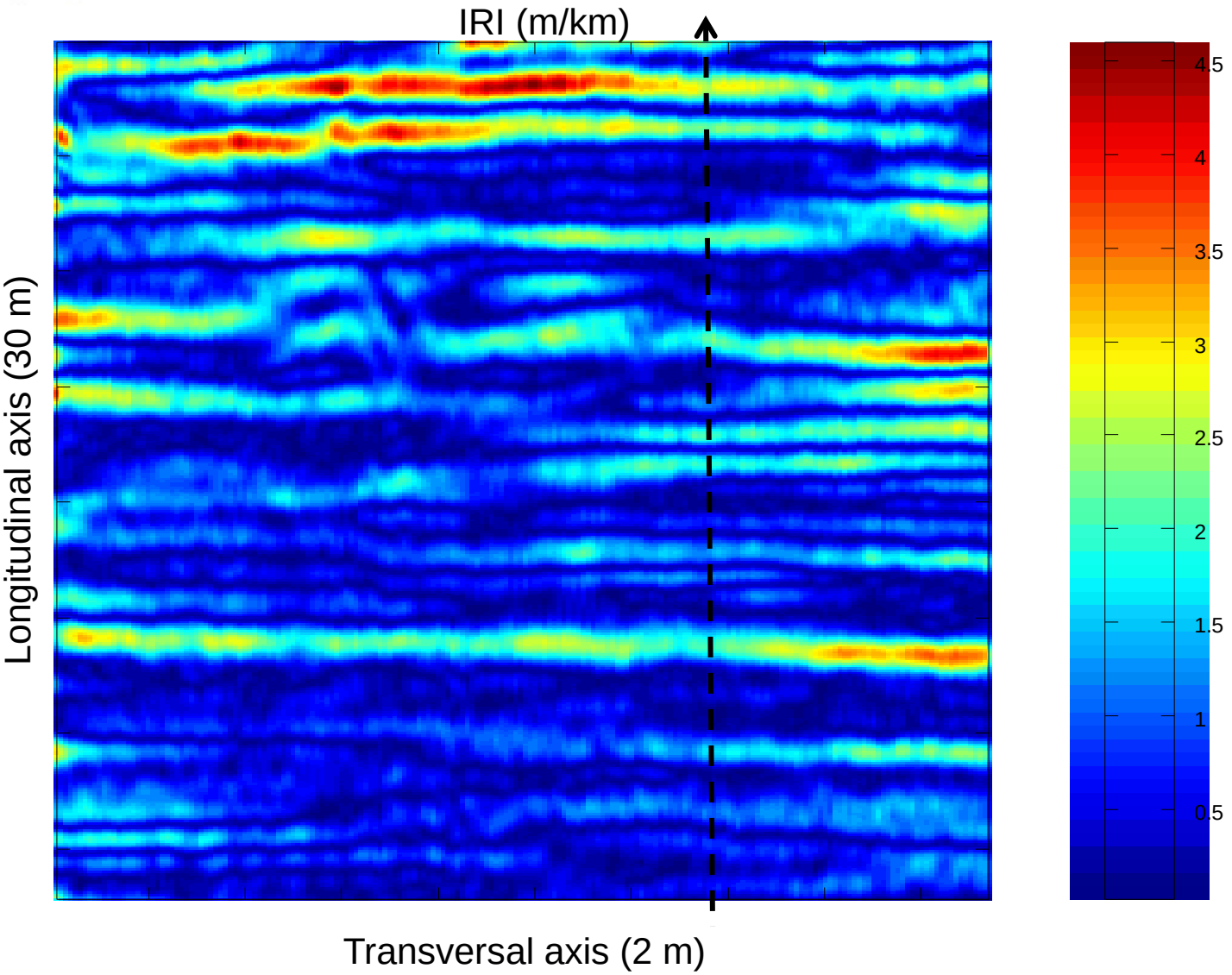
Results: IRI image (2 x 30m)



Pavemetrics

Results: IRI image (2 x 30m)



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Any Questions ?

Thank you.

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