Experiences in the use of Automatic 3-D Distress Evaluation System for pavement monitoring in Argentina

By

Eng. Gustavo Mezzelani

ITYAC S.A. – Rosario, Argentina

in collaboration with all the ITYAC Pavement Evaluation Staff:

F. Piazza, L. Bresciani, L. Prieto, M. Rodriguez,

F. Campora, S.Valdivia, I. Lopez Zamora, G. Zayas

N. Poncino, A. Pugliessi, B. Alfei, J.P. Raffaelli, H. Terraneo, D. Cainelli, P. J. Martinez

THE ARGENTINE REPUBLIC

PE 2019

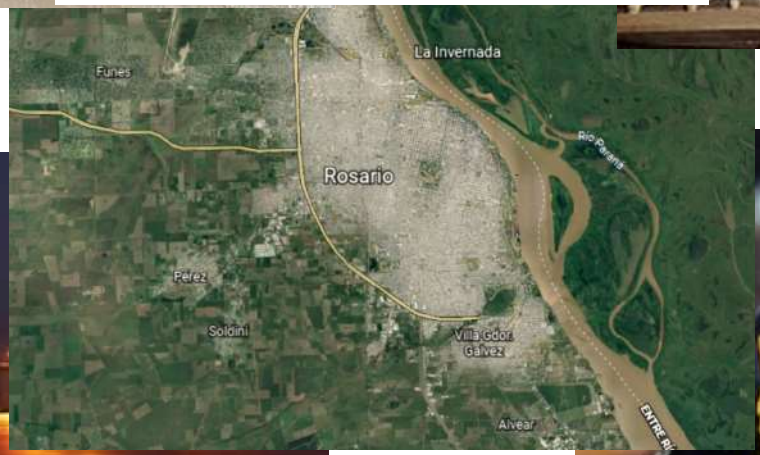
RPUG Road Profile Users' Group

Rosario, Argentina

PE 2019

RPUG Road Profile Users' Group

Rosario, Argentina



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OUTLINE

- THE COMPANY
- OVERVIEW OF PAVEMENT EVALUATION IN ARGENTINA
- FIRST EXPERIENCES IN THE USE OF AUTOMATIC 3-D DISTRESS EVALUATION SYSTEM: SPIDER™
- SURFACE INDICATORS ANALYSIS AND COMPARISON
- SOME ISSUES TO BE CONSIDERED …
- FINAL CONCLUSIONS

www.ityac.com.ar
Rosario, Argentina

ITYAC
POR EL BUEN CAMINO

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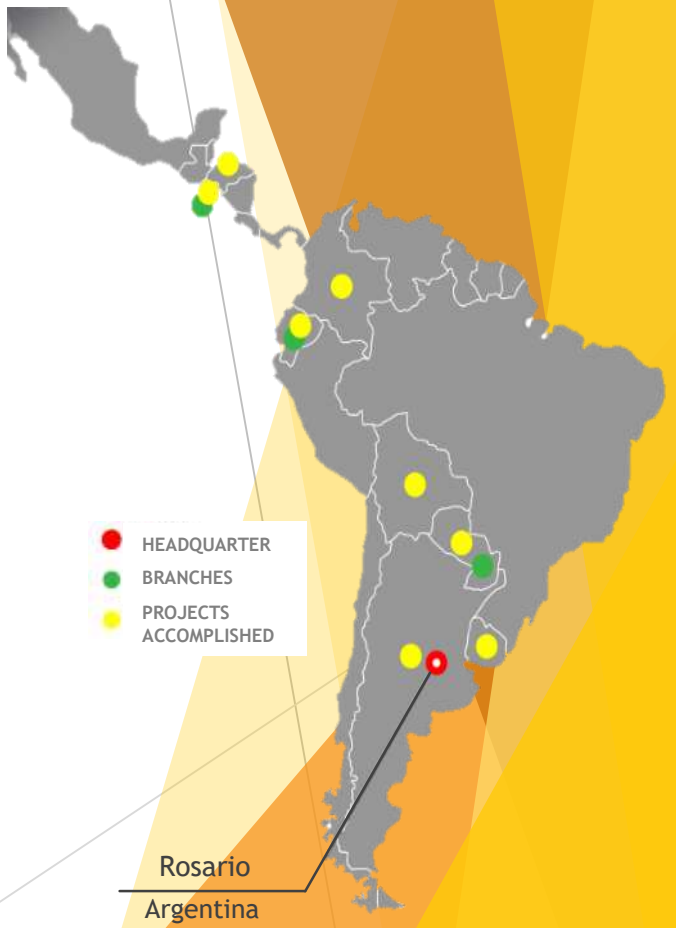
39 YEARS AT THE SERVICE OF ENGINEERING



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PAVEMENT EVALUATION

+ 30.000 km Structural of Pavement Evaluation

Light Weight Deflectometer
PRIMA 100

Super Heavy Weight Deflectometer
PRIMAX 3000

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PAVEMENT EVALUATION

+ 30.000 km Structural and Functional Pavement Evaluation

+ 10.000 km Friction and Macrotexture Measurements

Grip Tester Mk2 D-Type

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PAVEMENT EVALUATION

+ 30.000 km Structural and Functional Pavement Evaluation

+ 10.000 km Friction and Macrotexture Measurement

+ 90.000 km Digital Road Inventory

+ 120.000 km Roughness and Rutting Measurement

ASTRA™ Multifunction System – Laserprof IRI and Tx – Ultrasound Transversoprofilometer (TUS)

Dipstick 2277 - Profiler

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PAVEMENT EVALUATION

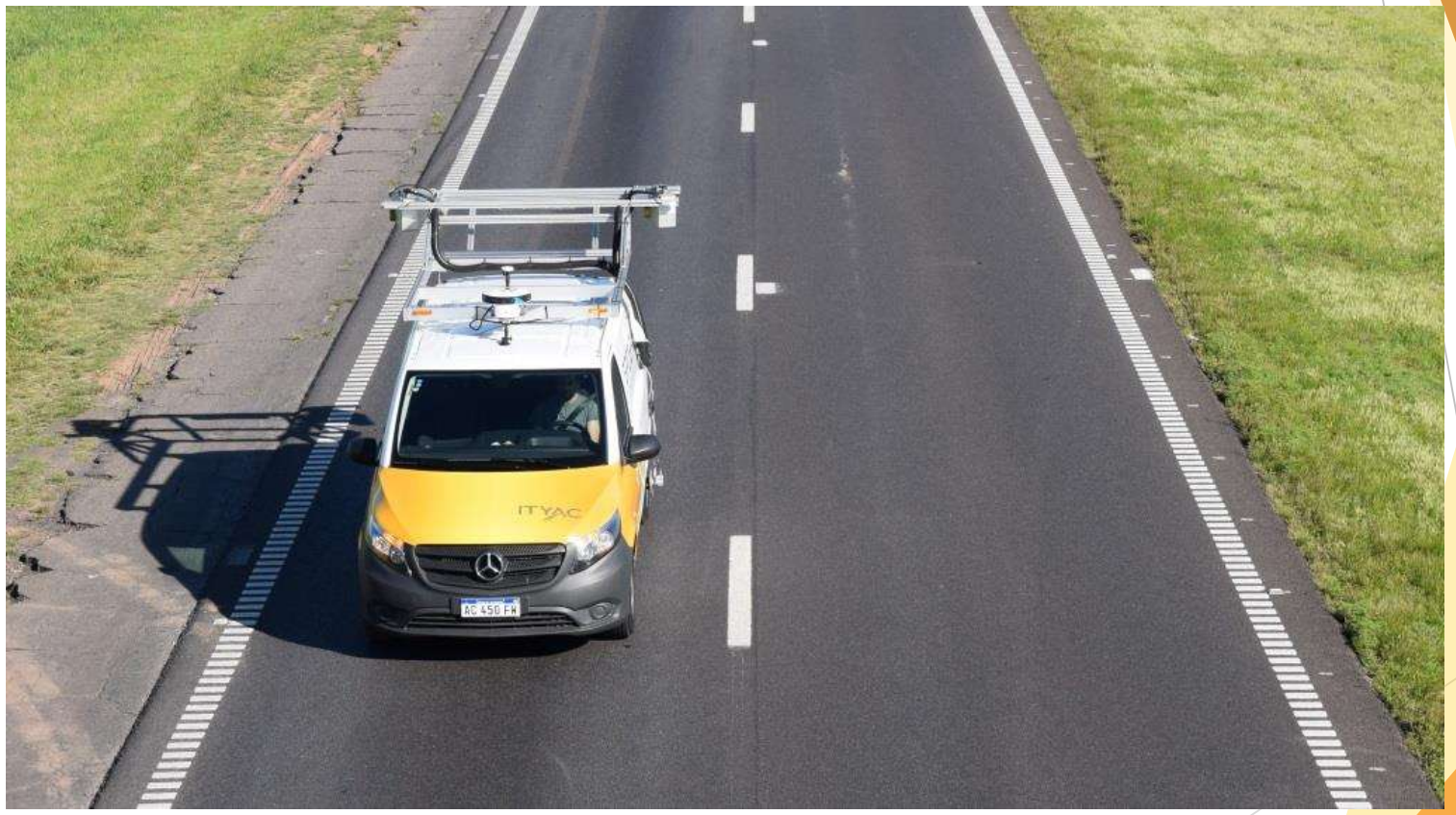
+ 30.000 km Structural and Functional Pavement Evaluation

+ 10.000 km Friction and Macrotexture Measurement

+ 90.000 km Digital Road Inventory

+ 120.000 km Roughness and Rutting Measurement

+ 2.500 km LCMS Measurement –SPIDER™



SPIDER™ Multifunction System – Laser Crack Measurement System (LCMS)

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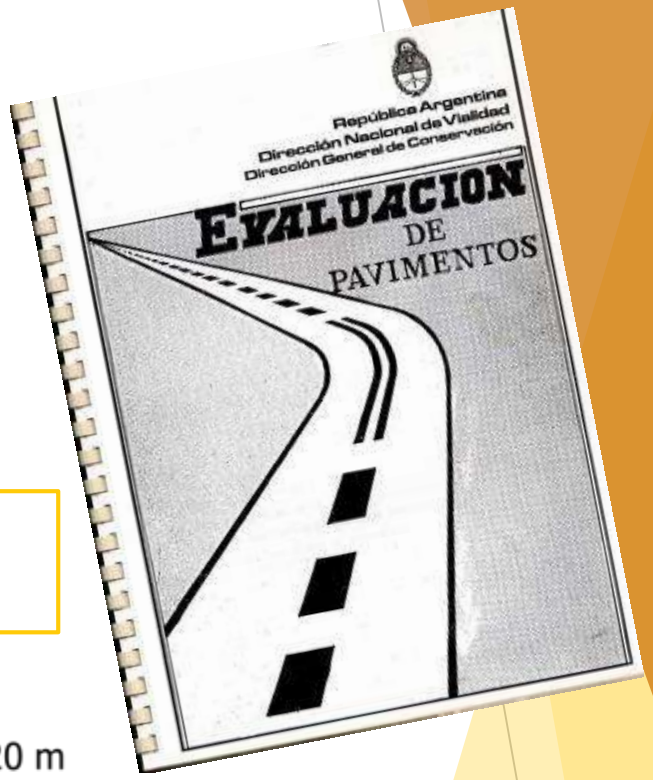
OVERVIEW OF PAVEMENT EVALUATION HISTORY IN ARGENTINA

The 80/90´s:

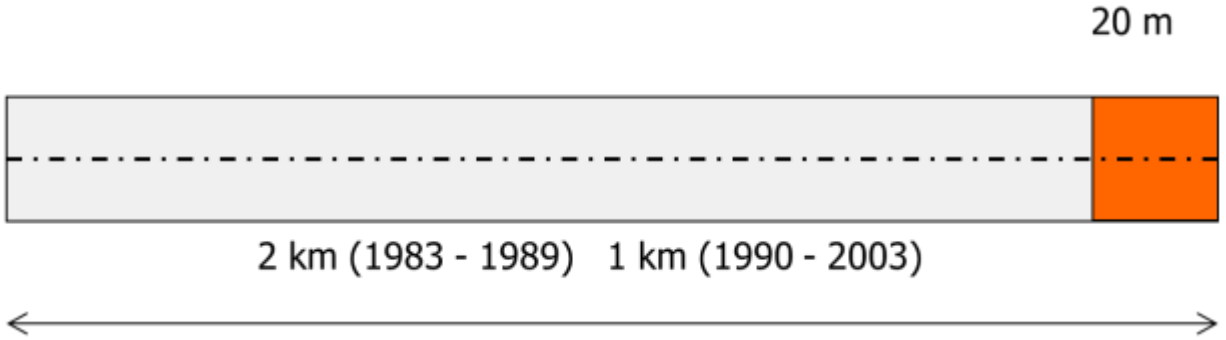
VIALIDAD NACIONAL



Sample Section

$$IE = f\ (LP, TP, C, R/P)$$

$$IE = 10 \times e^{-(a1 \times D1 + a2 \times D2 + a3 \times D3 + a4 \times D4)}$$



IE = 10

IE = 0

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OVERVIEW OF PAVEMENT EVALUATION HISTORY IN ARGENTINA

The 80/90´s:

100 %

Roughness

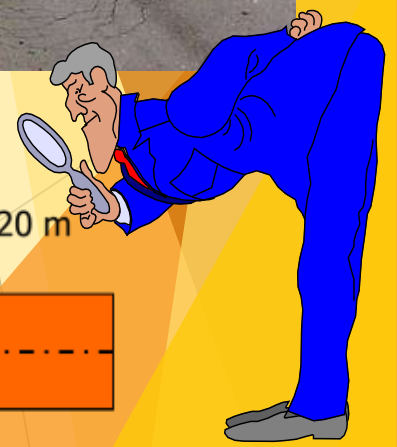
Bump Integrator

1%-2%

Rutting

Straightedge 1,20 m

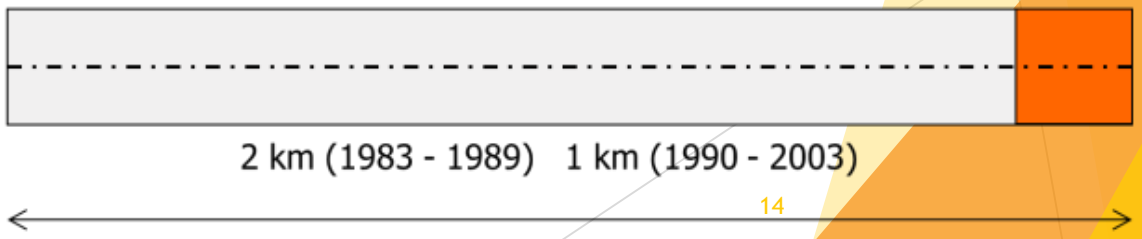
Visual Distress Evaluation



20 m

IE = 10

IE = 0



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OVERVIEW OF PAVEMENT EVALUATION HISTORY IN ARGENTINA

Initial situation (80/90's)

PAVEMENT CONDITION PRINCIPAL INDICATORS

Longitudinal profile - Roughness	Rutting- Transverse profile	Cracking	Ravelling and Potholes	Macrotexture	Friction	Deflections
						
100 %	1-2 %	1-2 %	1-2 %	1-2 %	1-2 %	punctual

IE 2%

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OVERVIEW OF PAVEMENT EVALUATION HISTORY IN ARGENTINA

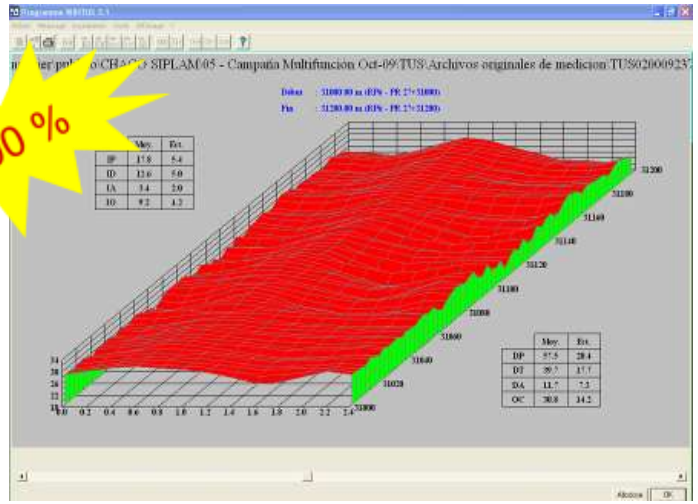
The 00´s

Acquisition of new equipment and incorporation of new technologies

HIGH PERFORMANCE TURNS INTO A MUST

Distress Evaluation
High quality cameras

100 %



Rutting
TUS (Ultrasonic Sensor)

100 %

Roughness
Laserprof

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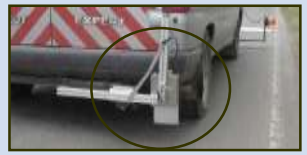
OVERVIEW OF PAVEMENT EVALUATION HISTORY IN ARGENTINA

The 00's...up to 2018

PAVEMENT CONDITION PRINCIPAL INDICATORS

Longitdinal profile - Roughness	Rutting	Cracking	Ravelling and Potholes	Macrotexture	Friction	Deflections
						
100 %	1-2 %	1-2 %	1-2 %	1-2 %	1-2 %	punctual
						
100 %	100 %	1-2 %	1-2 %	100 %	100 %	Semi continuous

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OVERVIEW OF PAVEMENT EVALUATION HISTORY IN ARGENTINA

YEAR 2018

According to new “PPP” contracts, the National Agency has launched an ambitious equipment plan and has updated the specifications for the different pavement status parameters.

VIALIDAD NACIONAL

Ministerio de Transporte
Presidencia de la Nación

NOMBRE
FISURACIÓN.
EQUIPO
Equipo de alto rendimiento para la determinación de fisuras.
NORMATIVA DE REFERENCIA
Metodología Vigente de la D.N.V.
TRAMO
Se consideran tramos independientes para cada sentido de circulación: ascendente y descendente. El ancho del tramo es igual al ancho del carril, por lo cual habrá tantos tramos por sentido de circulación como número de carriles en la vía en consideración. Los tramos tendrán una longitud de MIL metros (1000 m). En aquellos casos en que la longitud del tramo resulte inferior, se considerará el mismo como parte del tramo inmediato anterior o posterior.
MÉTODO DE MEDIDA
Se debe calcular la cantidad de metros lineales (m) acumulados de fisuras sin sellar de ancho igual o superior a la exigencia.
FRECUENCIA DE EVALUACIÓN
Mínimo anual.
EXIGENCIA

Metros lineales de fisuras sin sellar		
Período (1) [años]	Ancho fisura	Requisito (2)
0 – 10	Ancho > 3 mm	No se admiten fisuras sin sellar.
10 – 15	Ancho > 2 mm	

(1) Contado a partir de la fecha de TOMA DE POSESIÓN INICIAL.
(2) Independientemente del ancho y longitud de las fisuras, no se admiten patrones de fisuración del tipo “piel de cocodrilo”.

AUTOMATIC DISTRESS DETECTION

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First experiences in the use of Automatic 3-D Distress Evaluation System in Argentina

. . \TM . ultifunction ystem –
. aser rack . easurement ystem (. .)

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PE 2019

First experiences in the use of Automatic 3-D Distress Evaluation System in Argentina

. . \ ™ . ultifunction ystem –

. aser rack . easurement ystem (. .)

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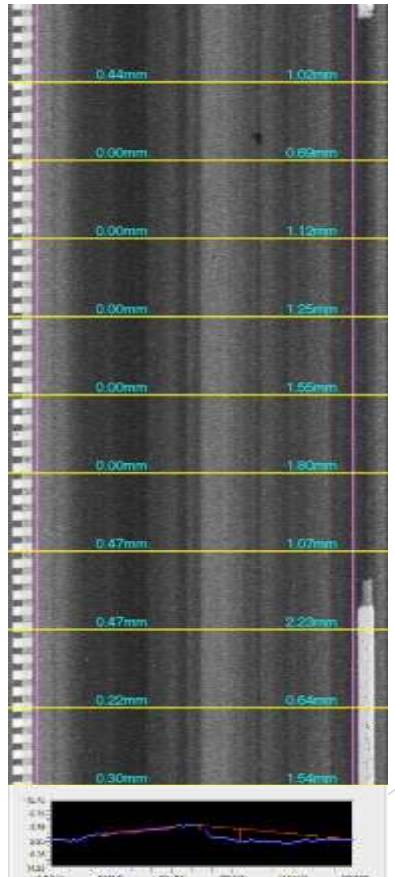
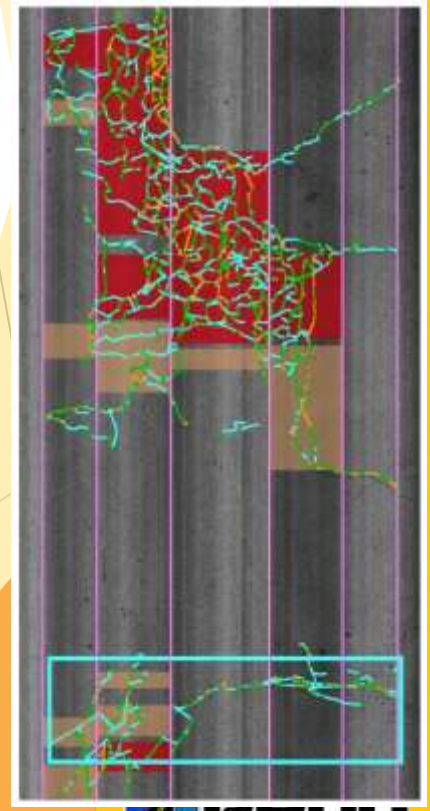
LCMS SPIDER™ FEATURES

PRINCIPAL FEATURES

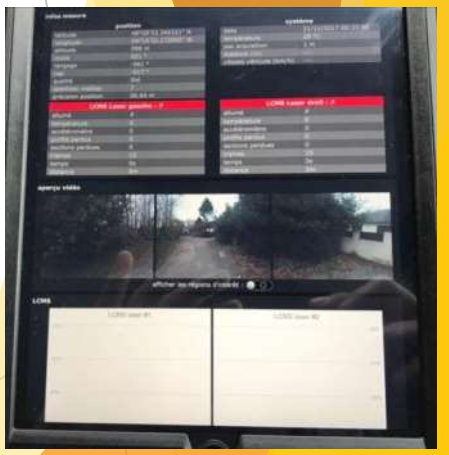
- Longitudinal profile measurements (I.R.I.) – Class I ASTM E950
- Macrotexture (MPD/MTD) in all 5 AASHTO bands
- Rutting measurement (ASTM E1703/ Taut Wire/ Moving straithedege/ Brazilian Method/ 5 Point Rut Depth)
- Automatic pothole and ravelling detection
- Bleeding detection
- Road Geometry
- Automatic cracking detection and measurement (both sealed and unsealed)
- Digital Road Inventory





DIGITAL ROAD INVENTORY

VIAPIX



TABLET

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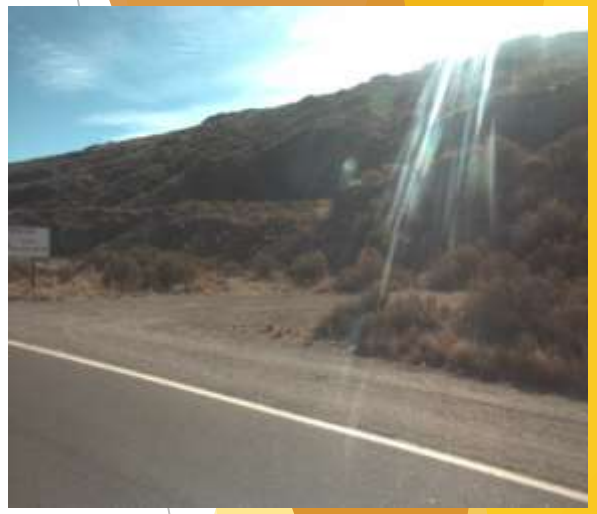
DIGITAL ROAD INVENTORY

PRINCIPAL FEATURES

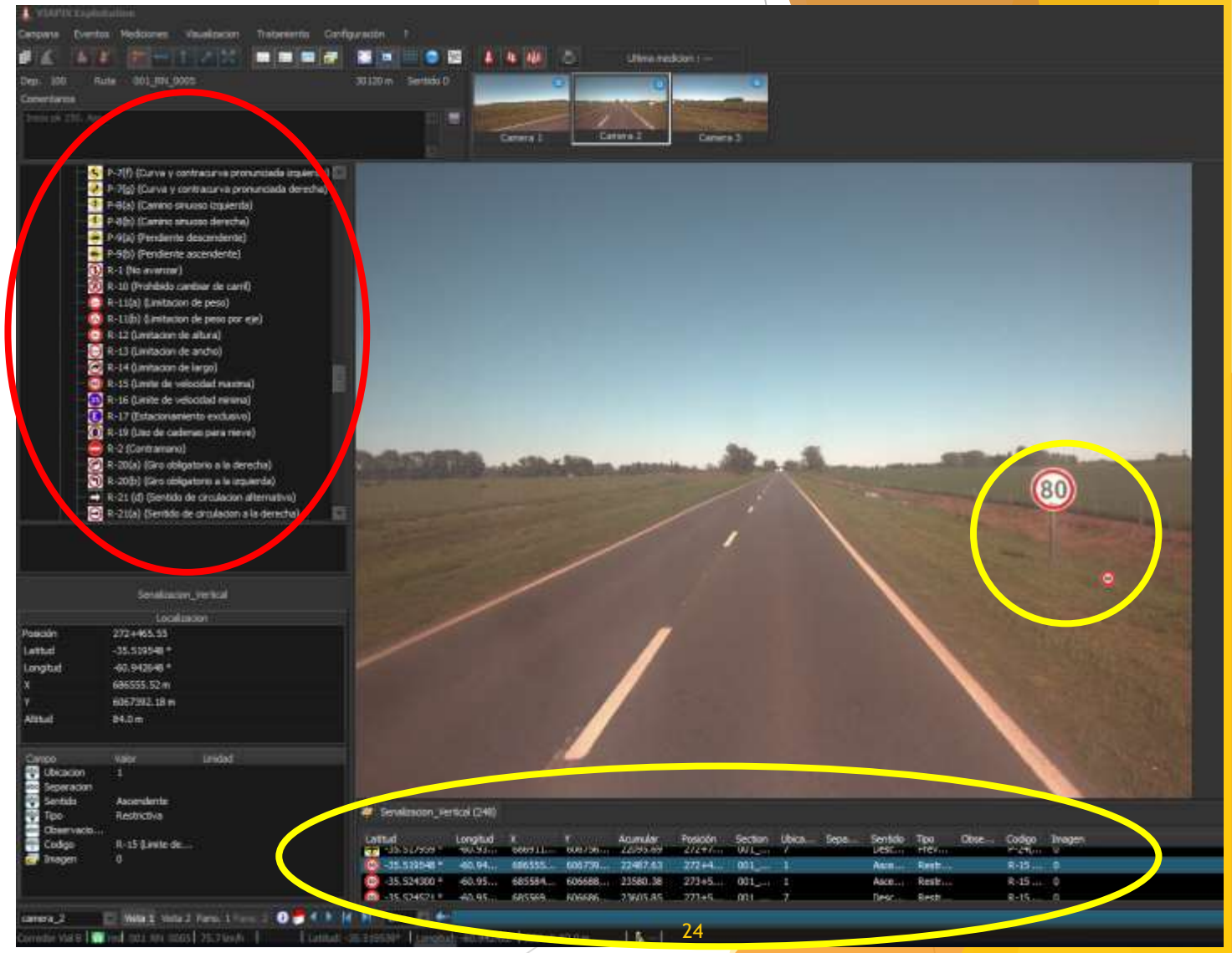
- 3 High Quality Cameras
- Panoramic View (180°)
- Hybrid Navegation System (High Precision GPS / GLONASS / DGPS / Inertial Measurement Unit / DMI)



DIGITAL ROAD INVENTORY

TREATMENT SOFTWARE

- Fully Detailed Data Base (including + 4000 different objects)
- Geolocalized Objects (Latitude, Longitude, Altitude, Position)
- Vehicle Mapping Tracking (ArcGIS, Google Earth)



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First experiences in the use of Automatic 3-D Distress Evaluation System in Argentina

P.P.P NATIONAL AGENCY CONTRACT

LCMS – First Experiences in ARGENTINA

PRINCIPAL NATIONAL NETWORK

- Network “B”: 545 km
- Network “C”: 780 km
- Network “E”: 390 km
- Network “F”: 260 km
- Network “SOUTH”: 250 km

TOTAL MEASURED = 2300 kms

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First experiences in the use of Automatic 3-D Distress Evaluation System in Argentina

VIALIDAD NACIONAL

(NATIONAL ROAD AGENCY)
40.000 km in 2019/20 of road inspection (IE)

Ministerio de Transporte
Presidencia de la Nación

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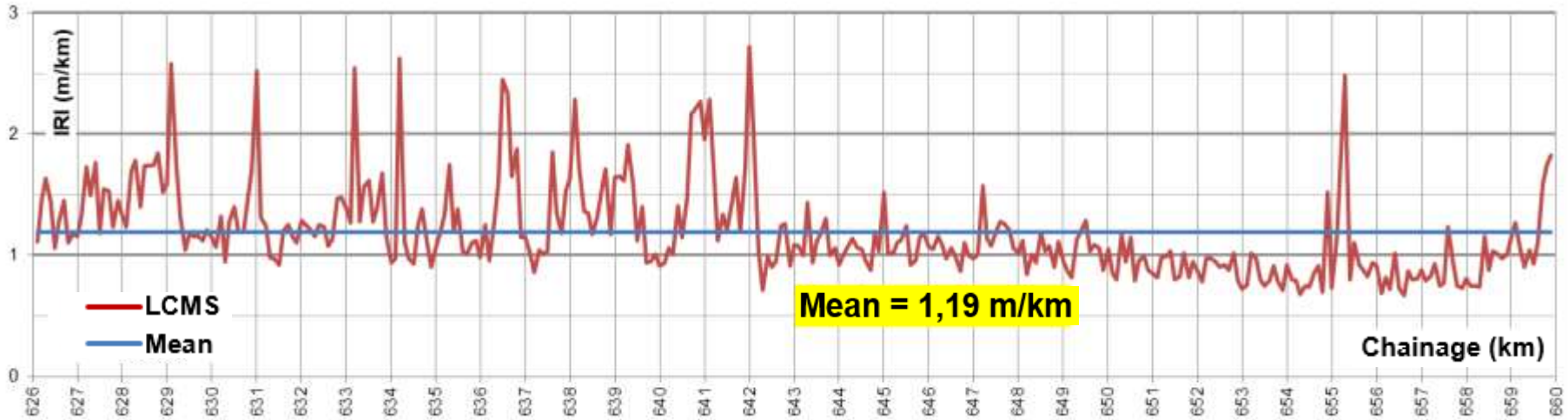
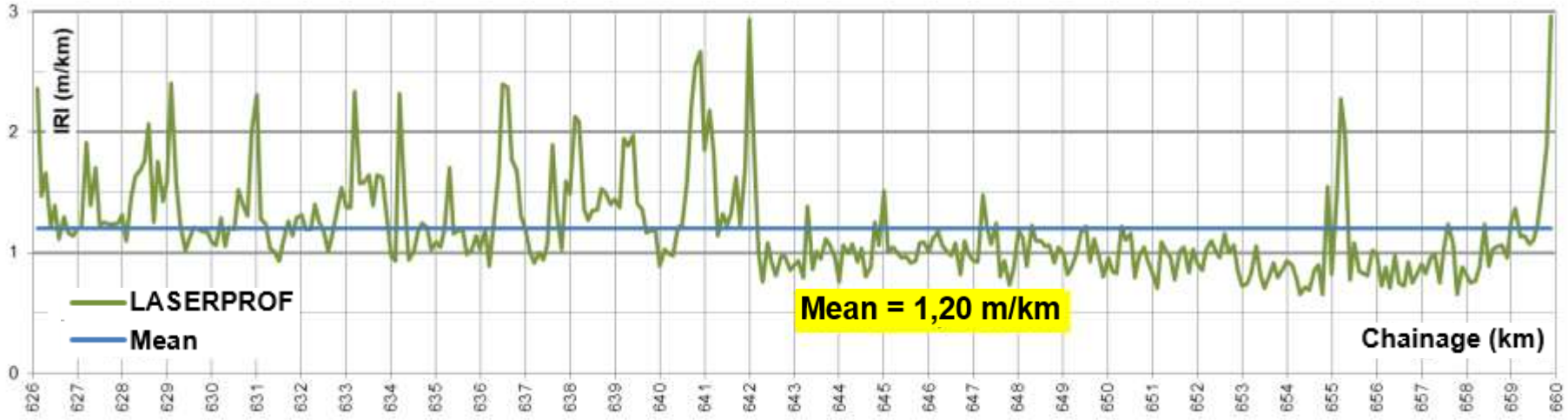
LONGITUDINAL PROFILE (I.R.I.)

Laser Crack Measurement System vs Laserprof

NETWORK "F" – National Road N° 09





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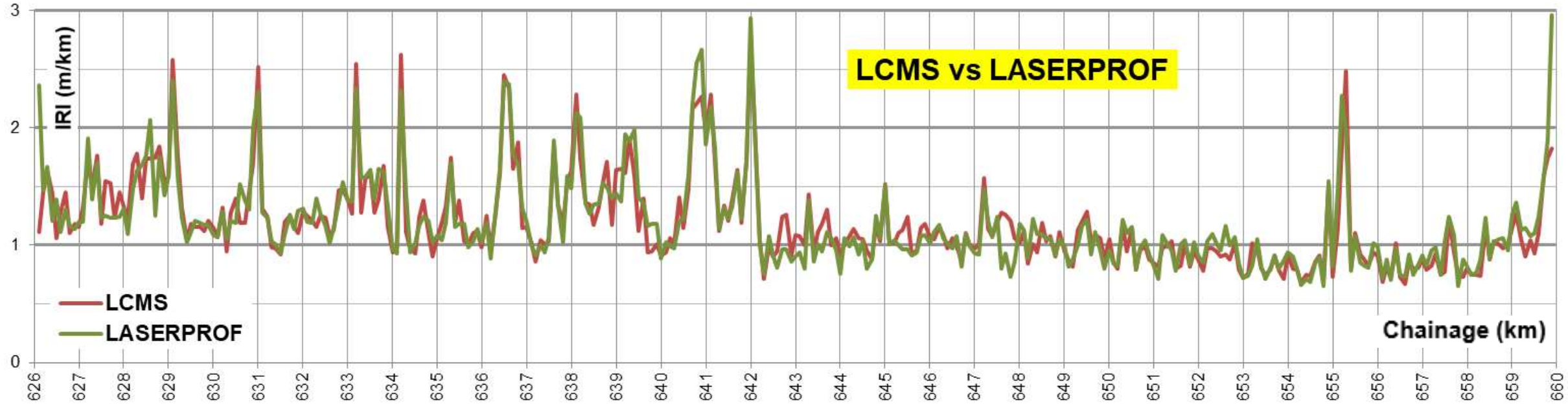
LONGITUDINAL PROFILE (I.R.I.)

Laser Crack Measurement System vs Laserprof

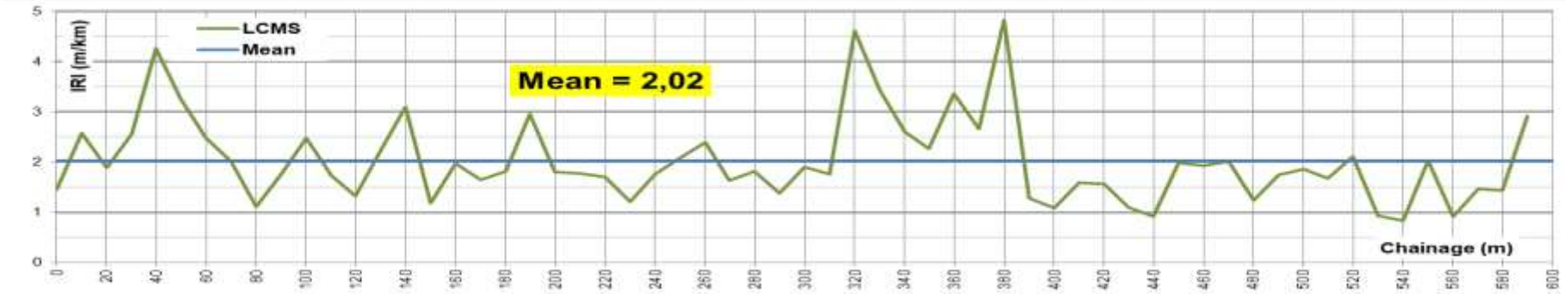
NETWORK "F" – National Road N° 09

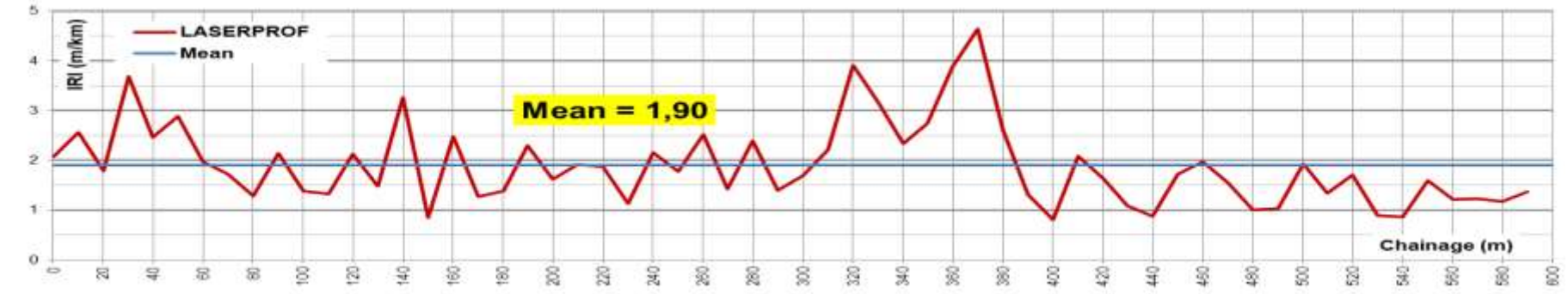


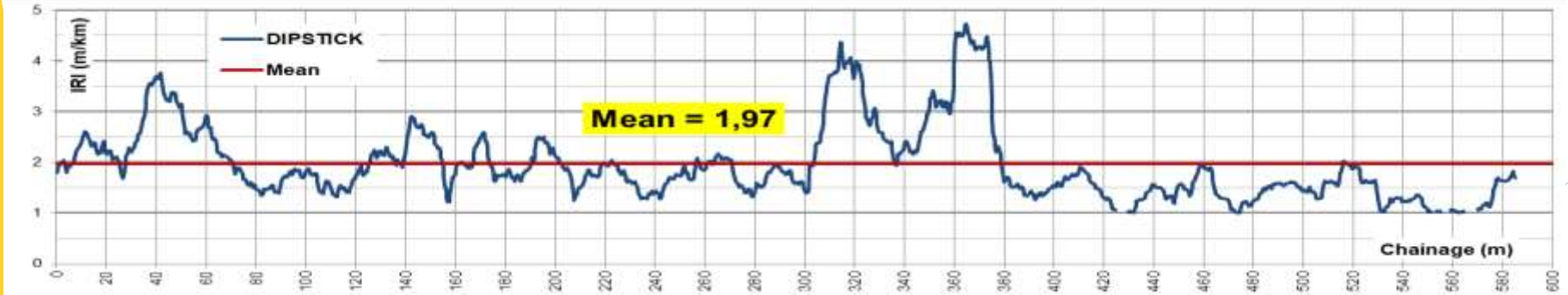
LONGITUDINAL PROFILE (I.R.I.)

LCMS vs Laserprof vs Dipstick

EQUIPMENT SECTION CONTROL TEST







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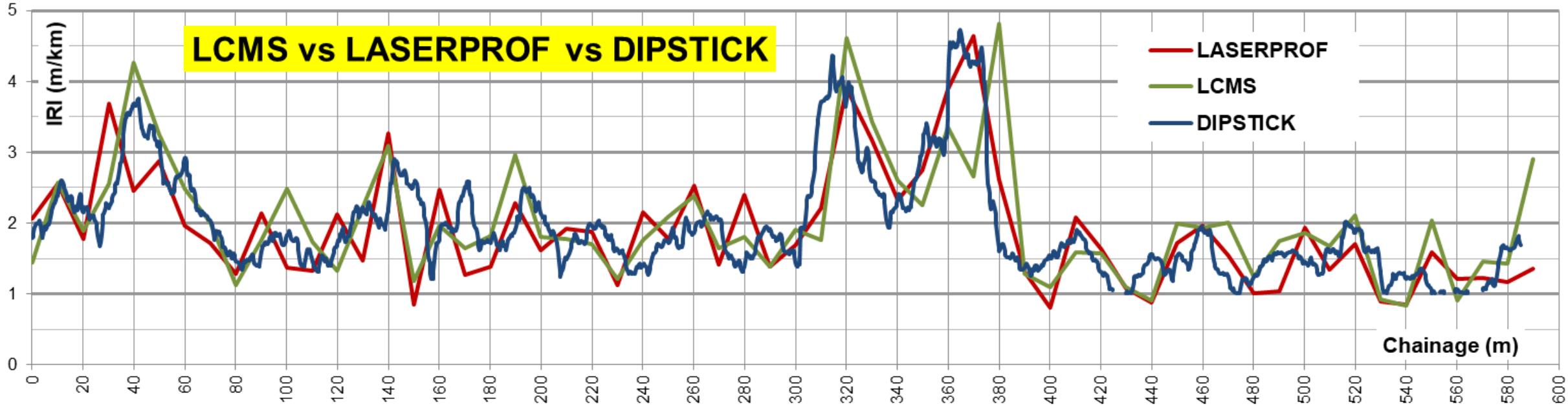
LONGITUDINAL PROFILE (I.R.I.)

LCMS vs Laserprof vs Dipstick

EQUIPMENT SECTION CONTROL TEST



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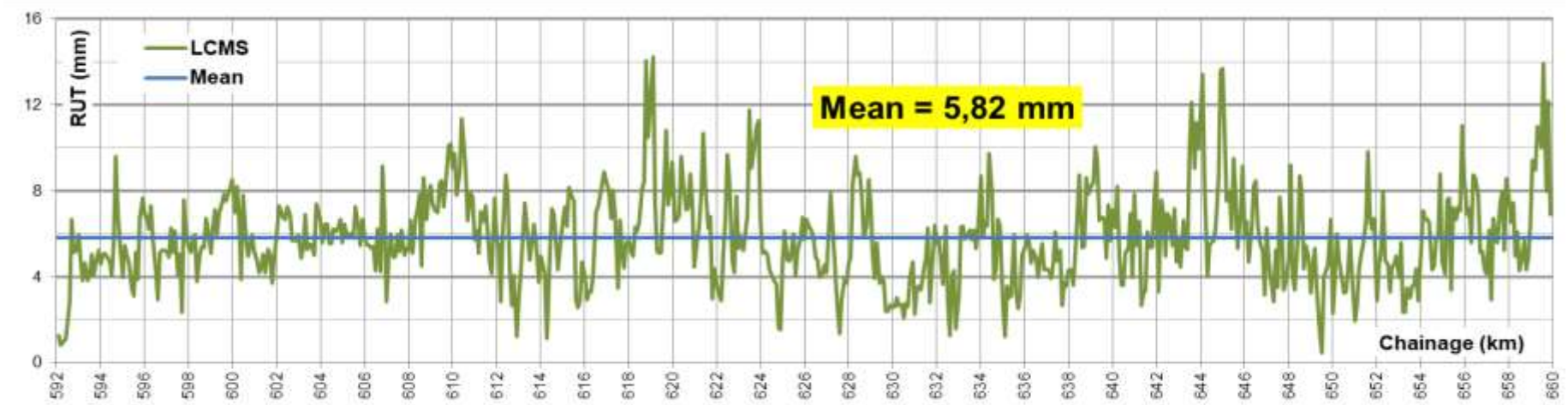
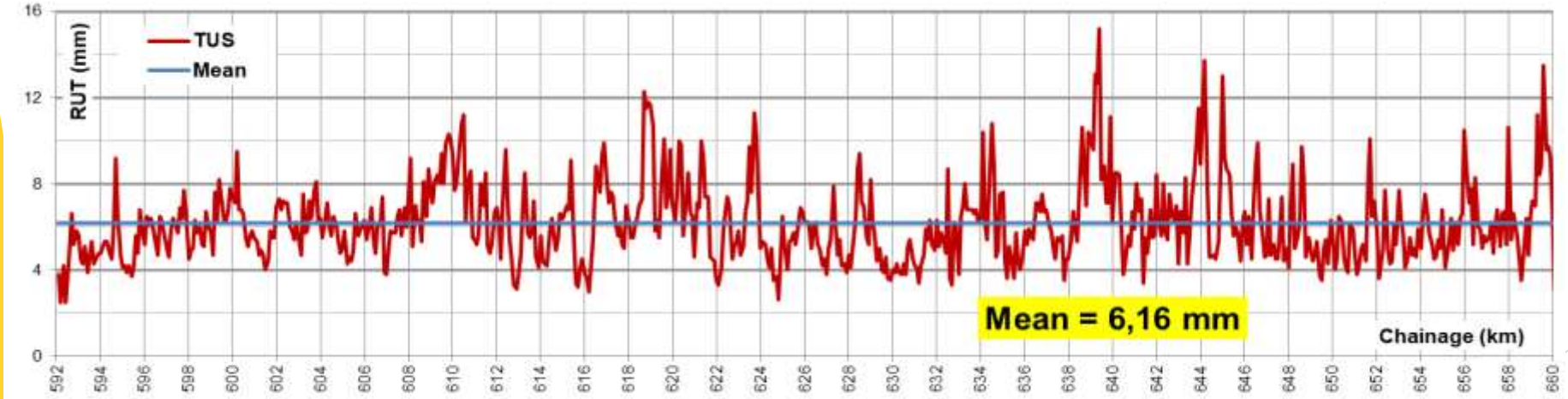
RUTTING

Laser Crack Measurement System vs TUS

NETWORK "F" – National Road N° 09

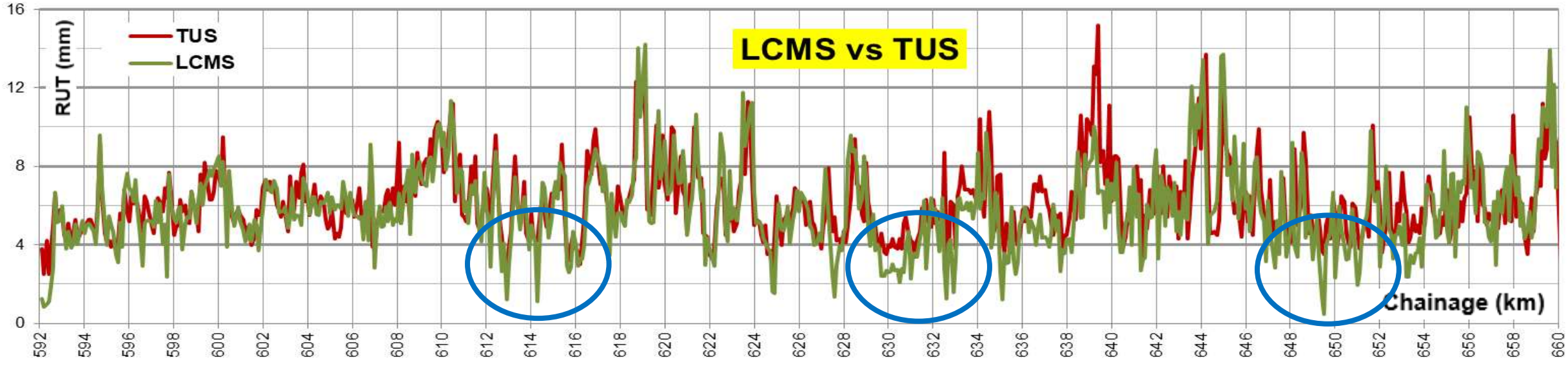


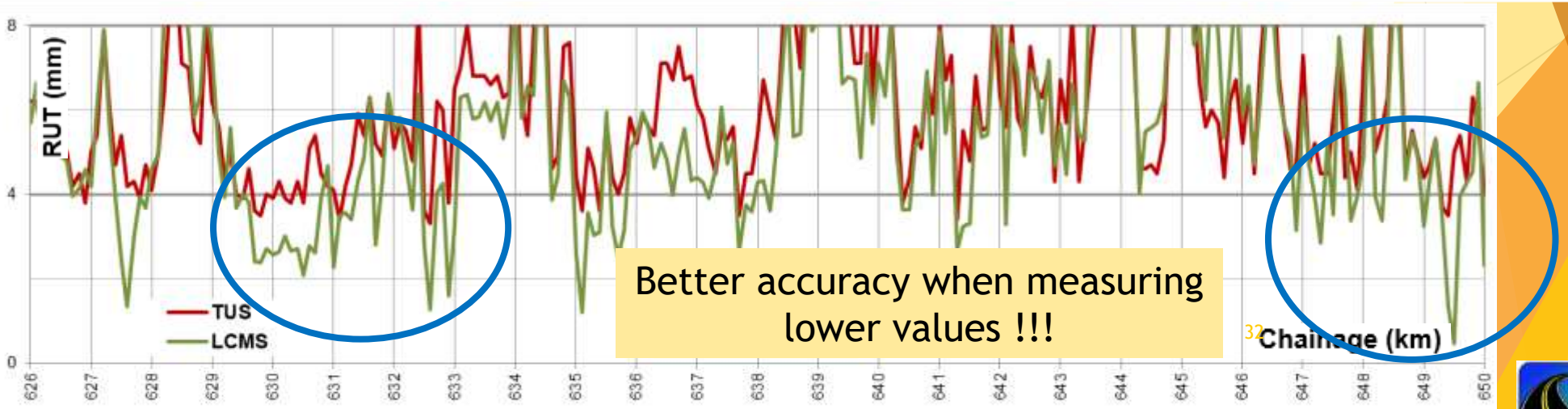


RUTTING

Laser Crack Measurement System vs TUS

NETWORK "F" – National Road N° 09





Better accuracy when measuring lower values !!!

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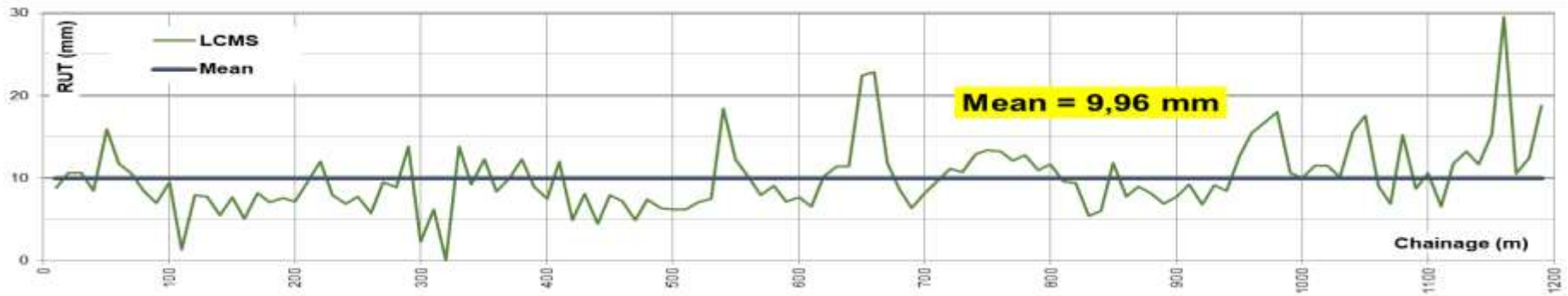
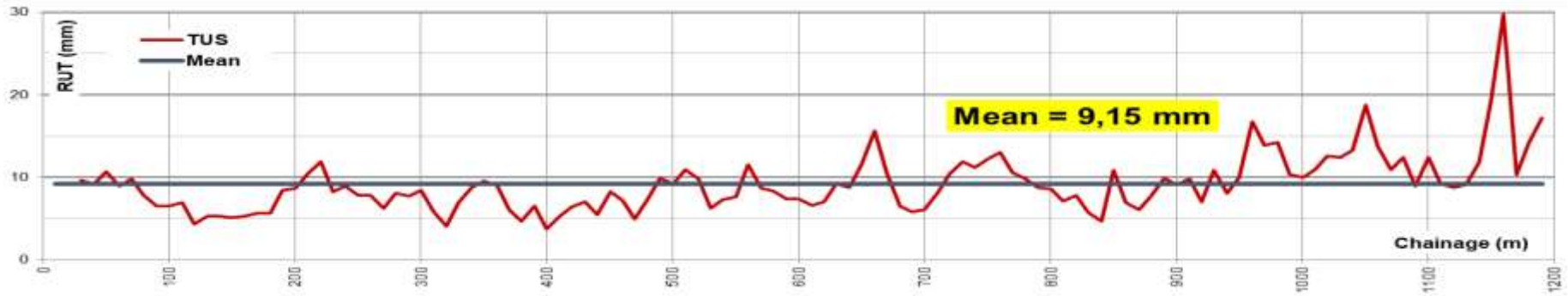
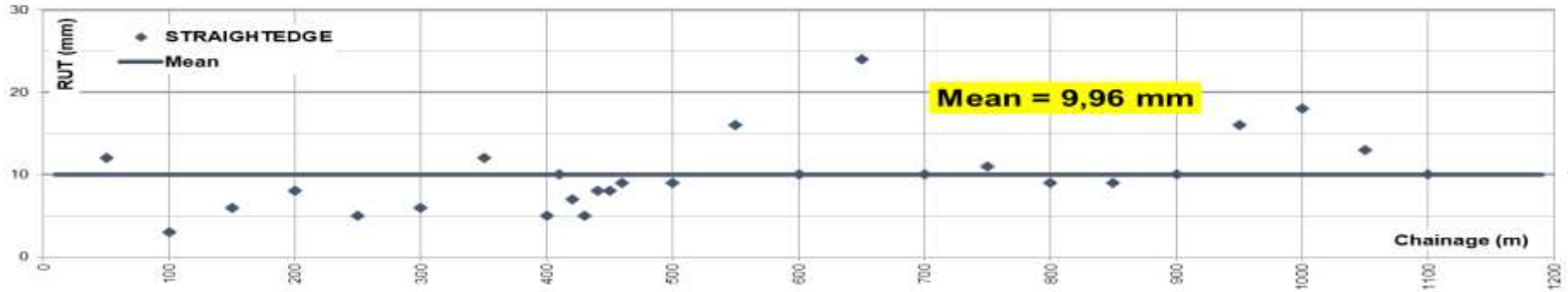
RUTTING

Laser Crack Measurement System vs TUS vs Straightedge 1,20 m

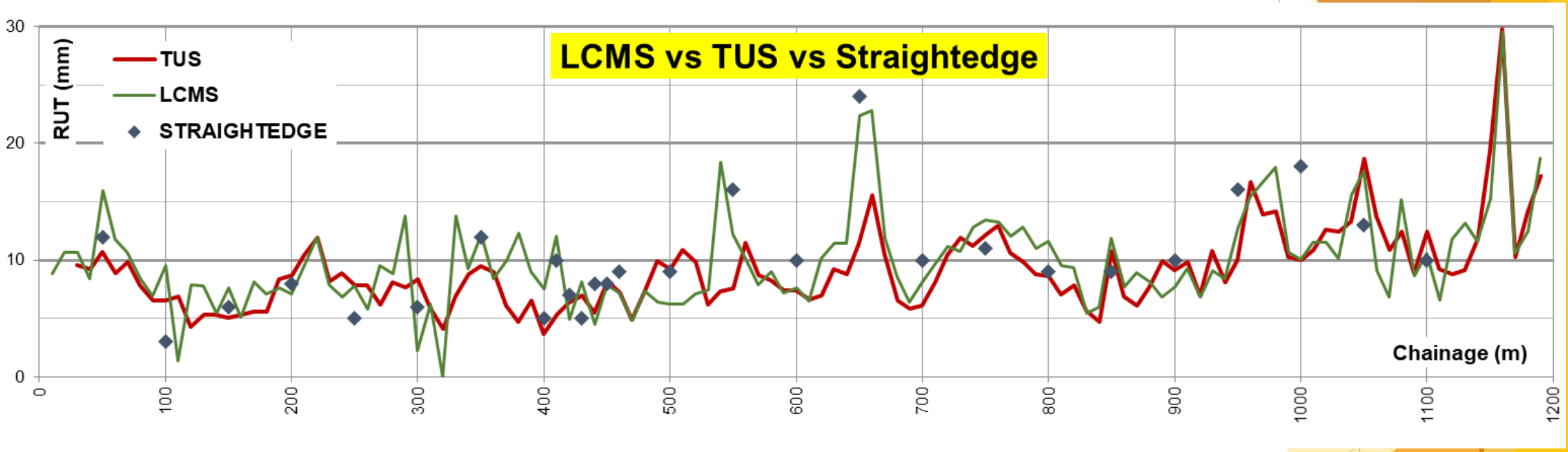






RUTTING

Laser Crack Measurement System v.s. TUS v.s. Straightedge



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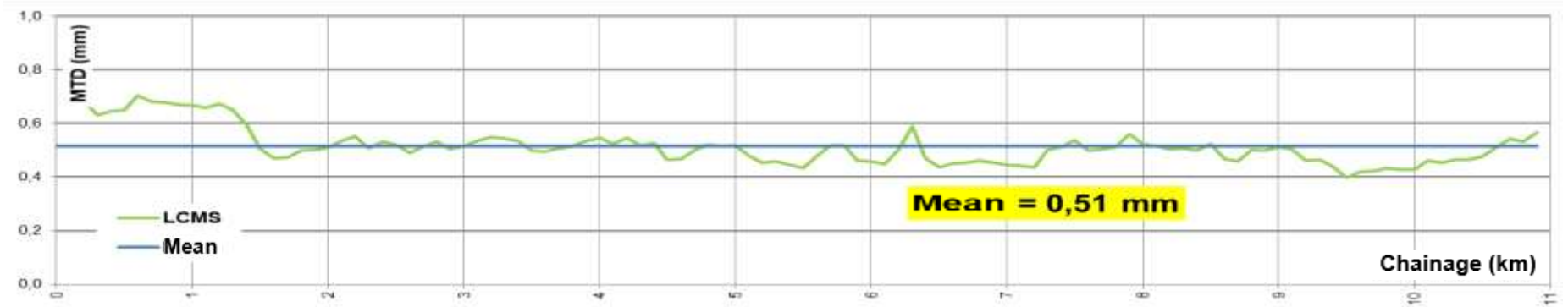
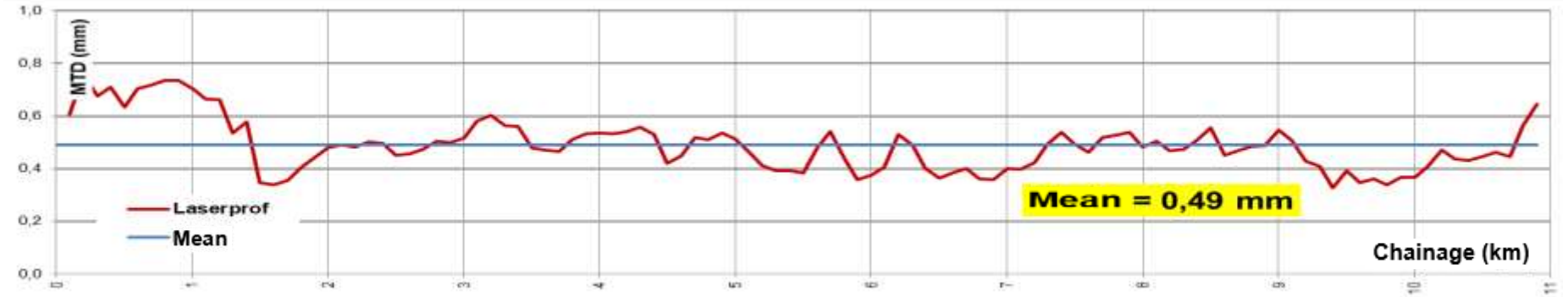
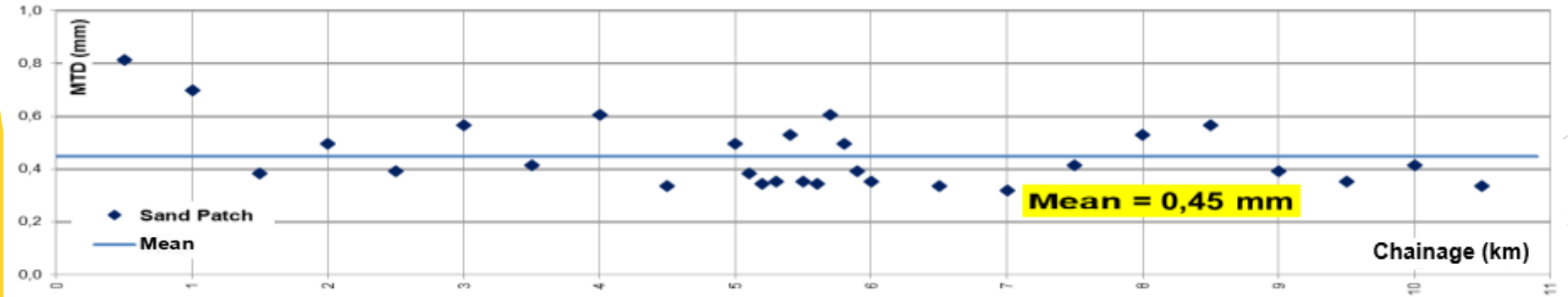
MACROTEXTURE (M.T.D.)

Laser Crack Measurement System v.s. Laserprof v.s. Sand Patch

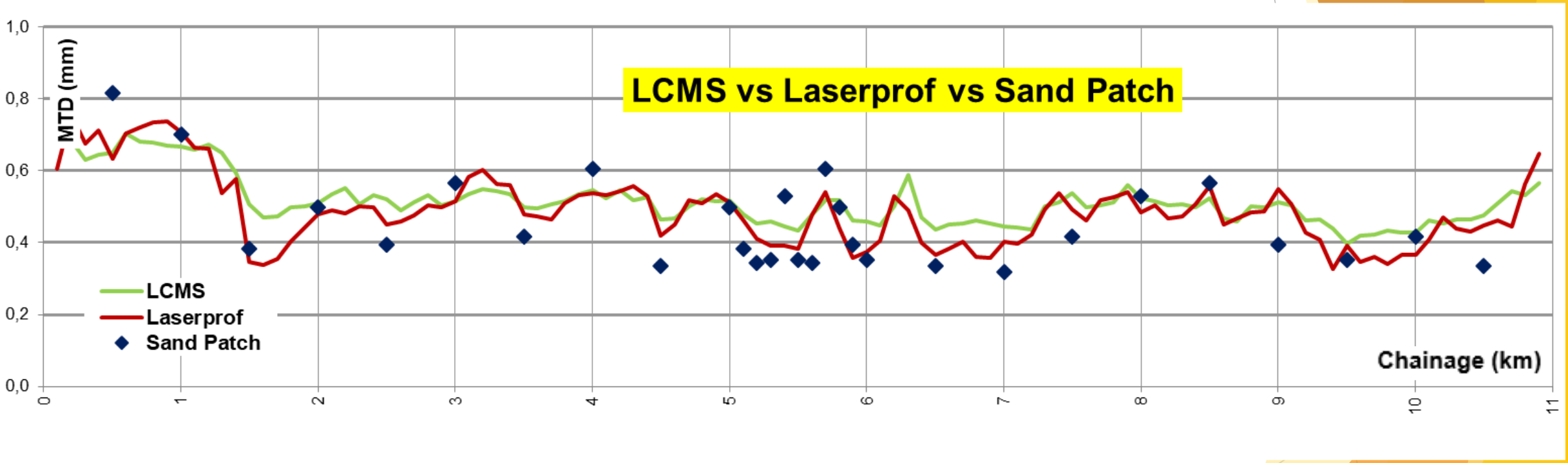






MACROTEXTURE (M.T.D.)

Laser Crack Measurement System vs Laserprof vs Sand Patch



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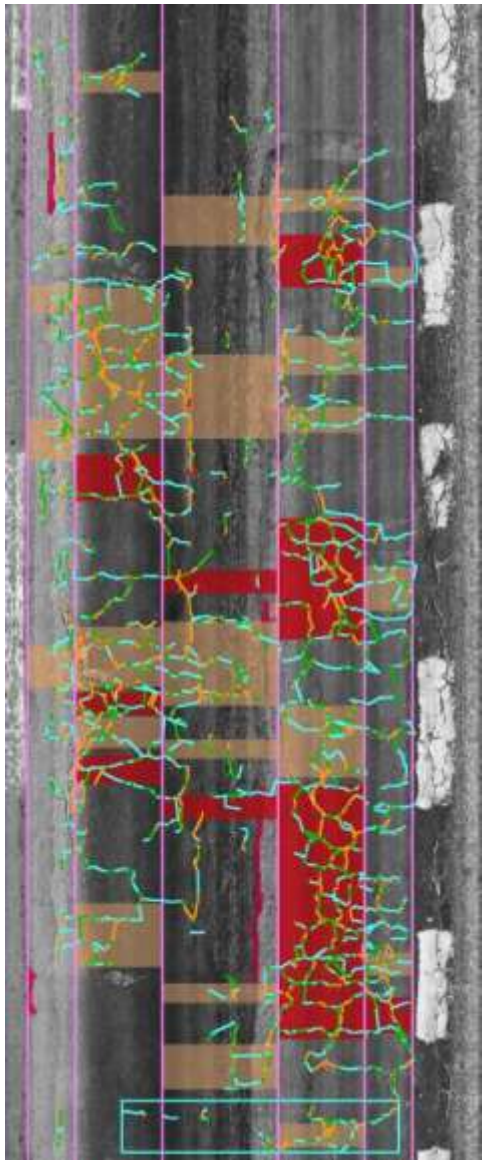
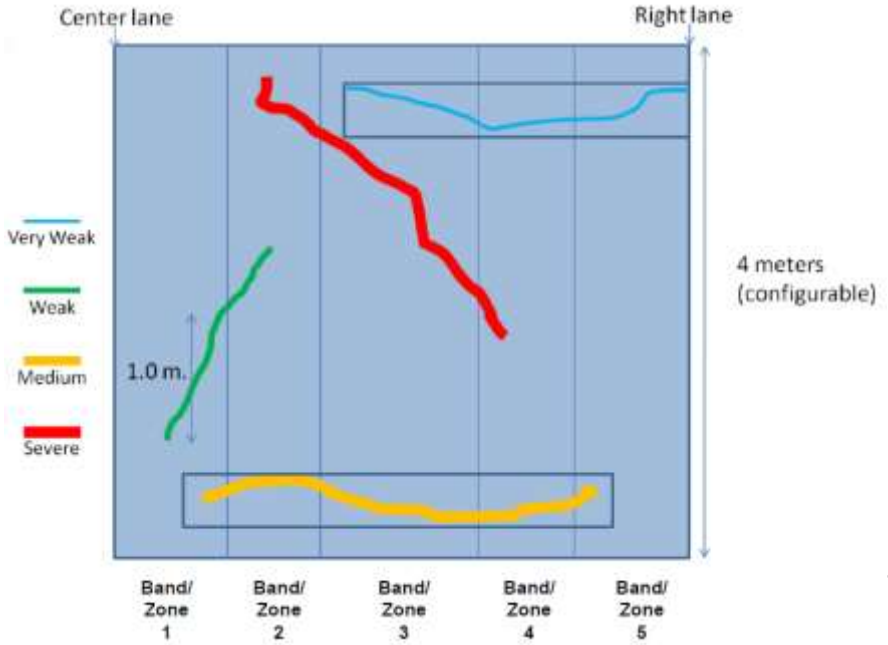
AUTOMATIC DISTRESS DETECTION

CRACKING



Quantified Cracking Protocol: MTQ

- Five configurable road zones / bands
- Four severities (width detection): Very Weak, Weak, Medium, Severe (setup)



Very Weak (0-3 mm), Weak (3-6 mm), Medium (6-20), Severe (>20) (setup)

AUTOMATIC DISTRESS DETECTION

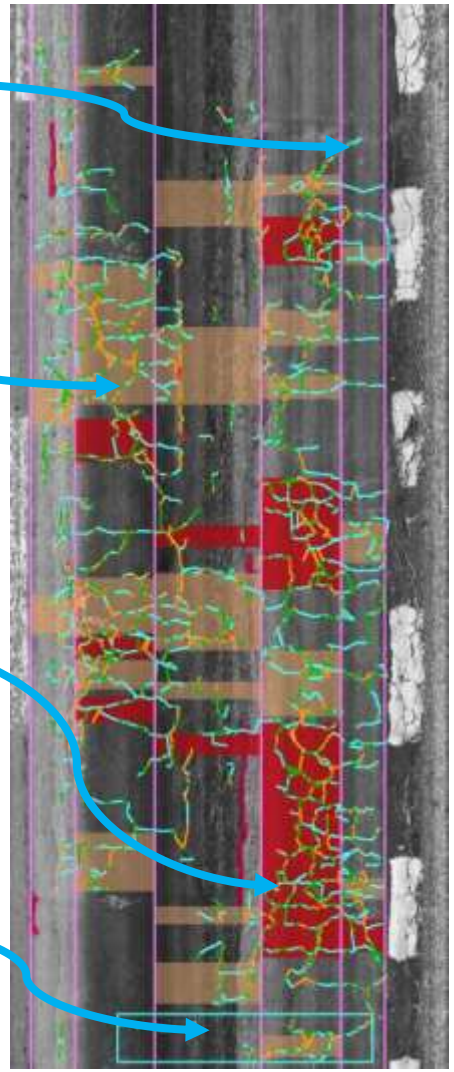
MTQ Cracking Protocol-types of cracks

Longitudinal Cracking
(not high-lighted)
Severity determined by maximum width (4 severities colours)

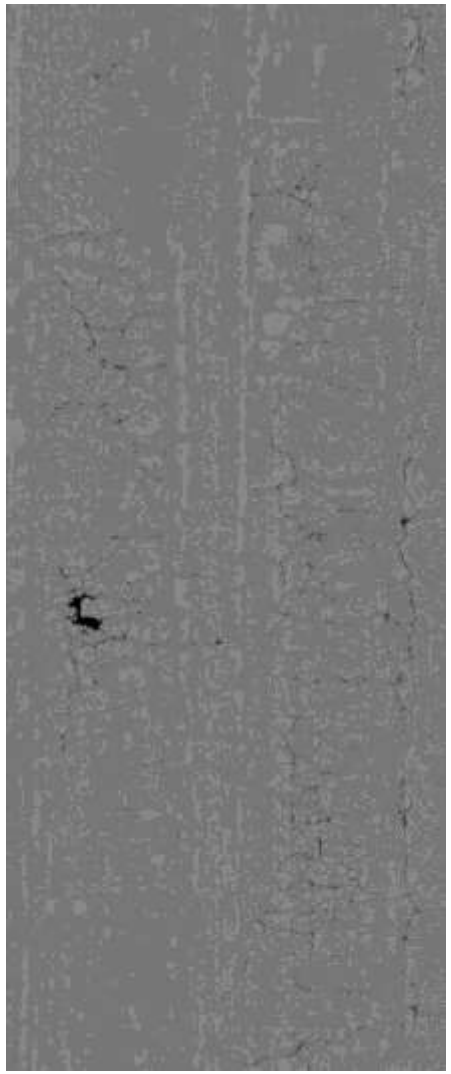
Multiple Cracking
(orange shaded areas)
Determined by finding 2 adjacents cracks within a roadzone or band.

Alligator Cracking
(red shaded areas)
Determined by finding 3 or more adjacents cracks within a roadzone or band.

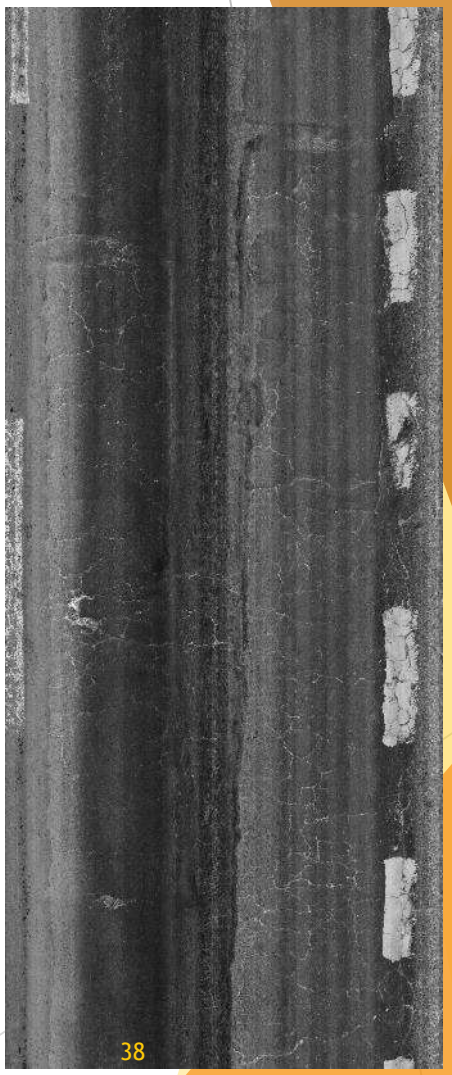
Transverse Cracking
(rectangles)



3D Image



Range Image



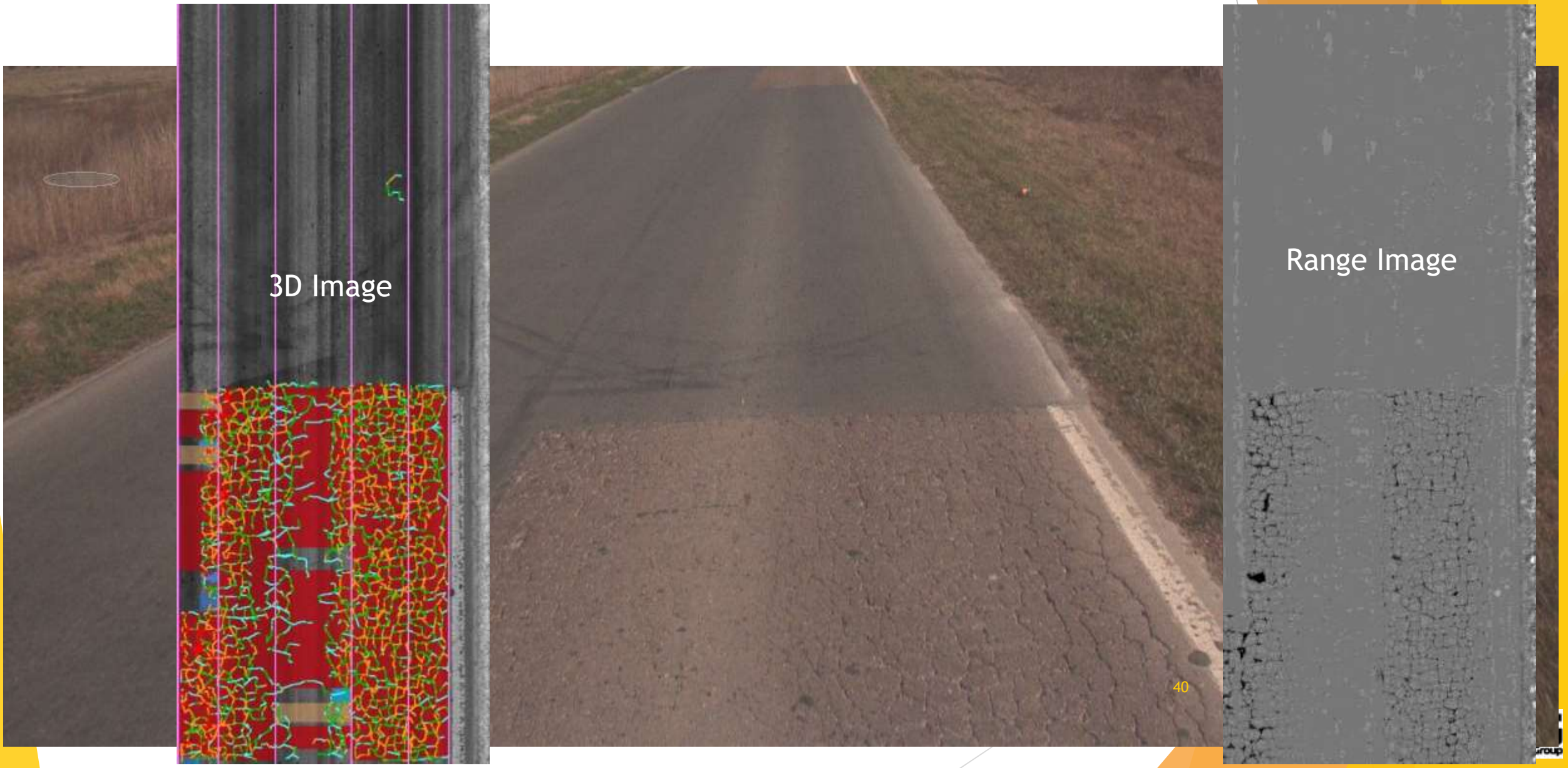
Intensity Image

AUTOMATIC DISTRESS DETECTION

NETWORK "E" – National Road N° 33

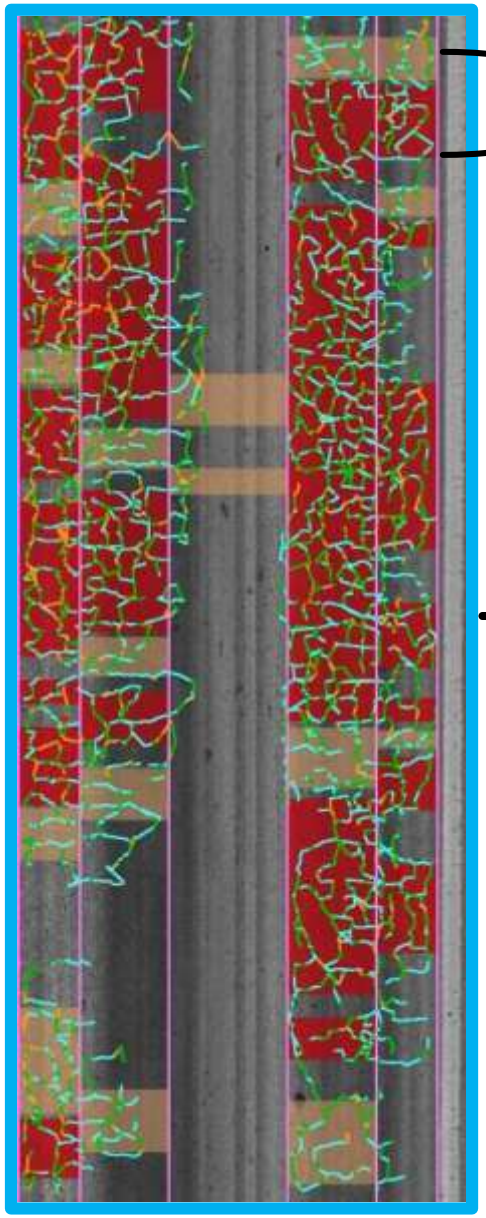
AUTOMATIC DISTRESS DETECTION

NETWORK "E" – National Road N° 33



AUTOMATIC DISTRESS DETECTION

NETWORK "E" – National Road N° 33



Orange and Red shaded areas informed by the automatic crack detection

Total area: 25 m2

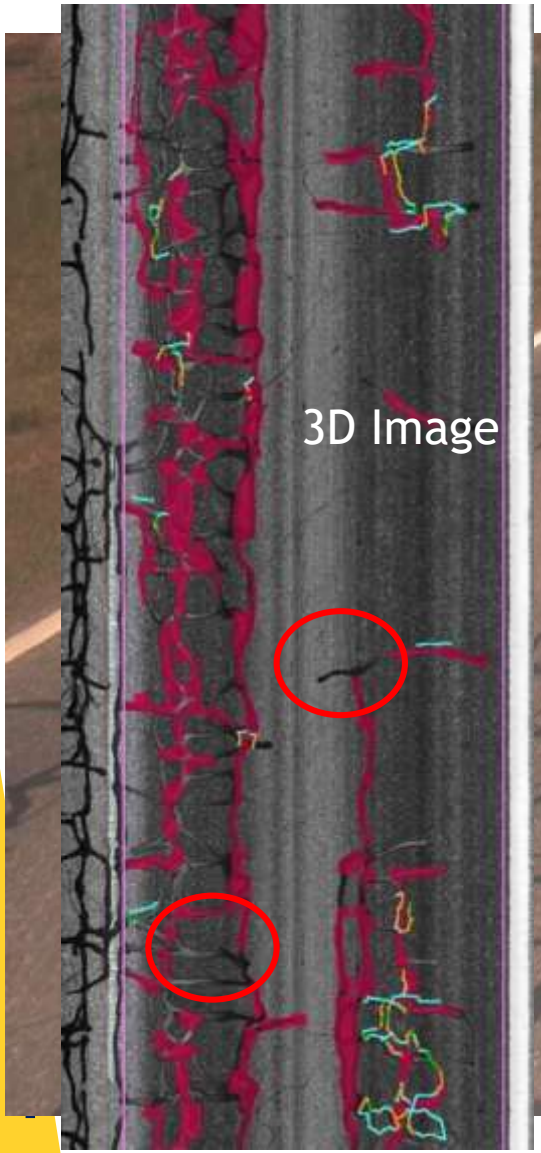
Real intervention zone: 36 m2

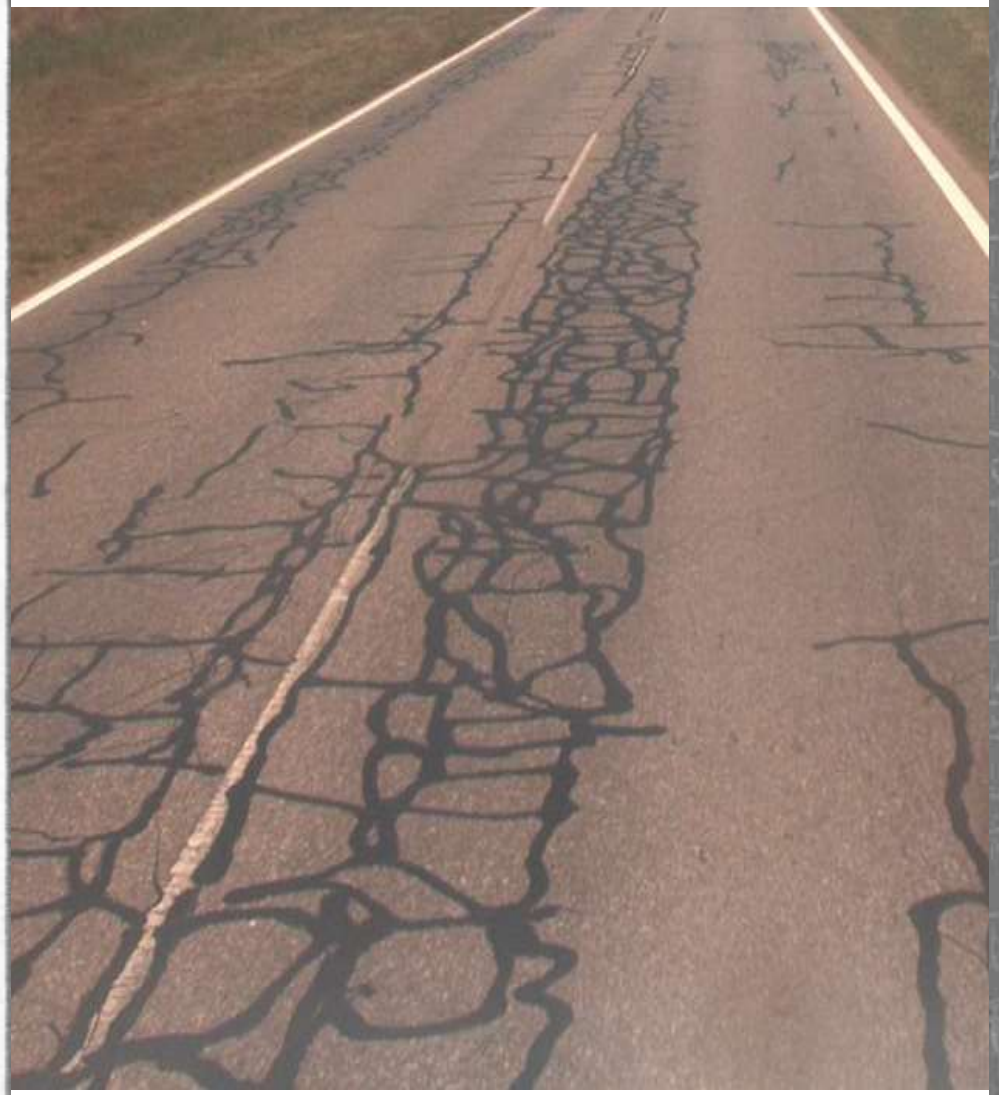
..TO BE CONSIDERED!

AUTOMATIC DISTRESS DETECTION

SEALED CRACKS

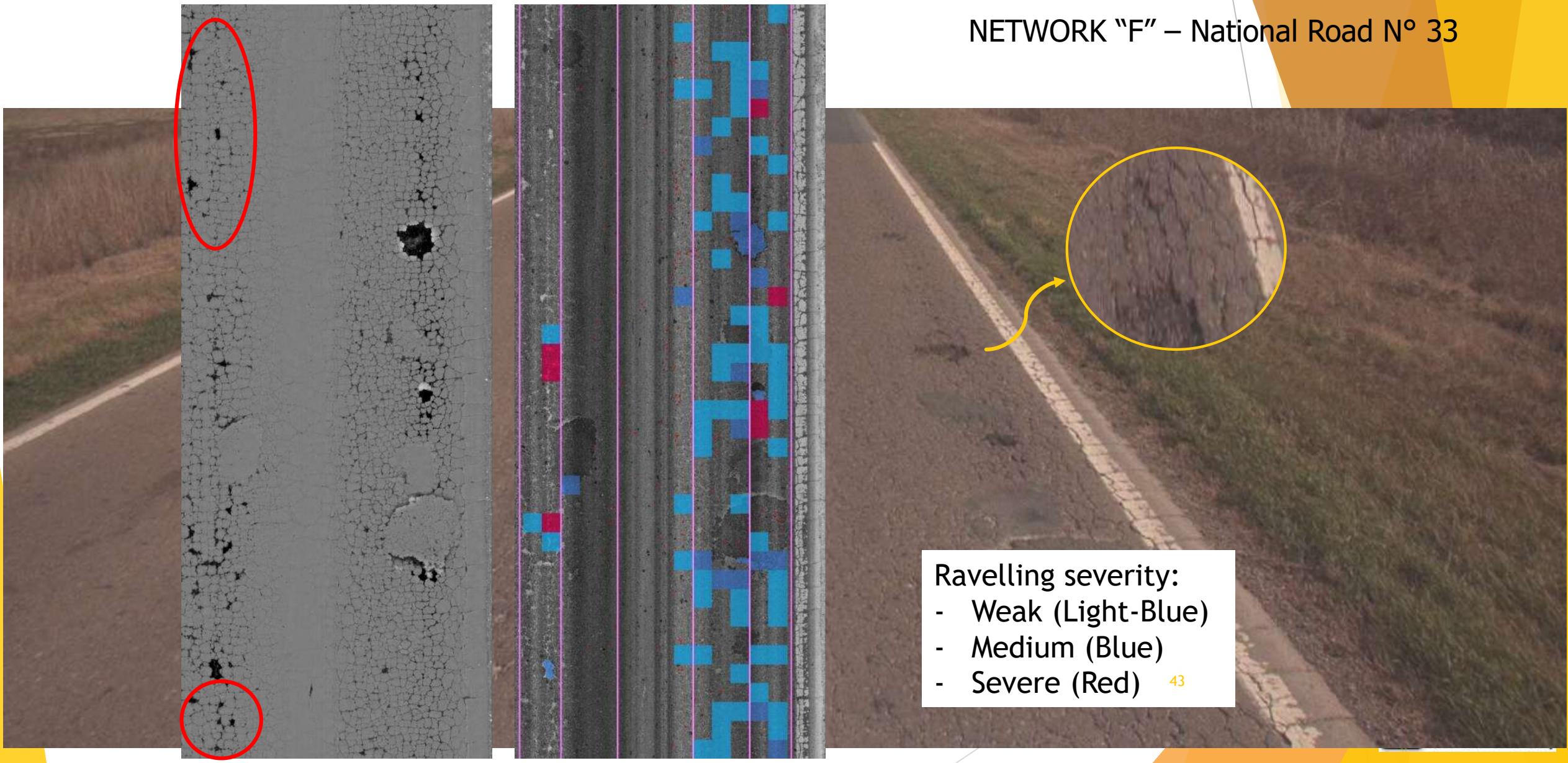
NETWORK "B" – National Road N° 05





AUTOMATIC DISTRESS DETECTION
POTHOLES AND RAVELLING

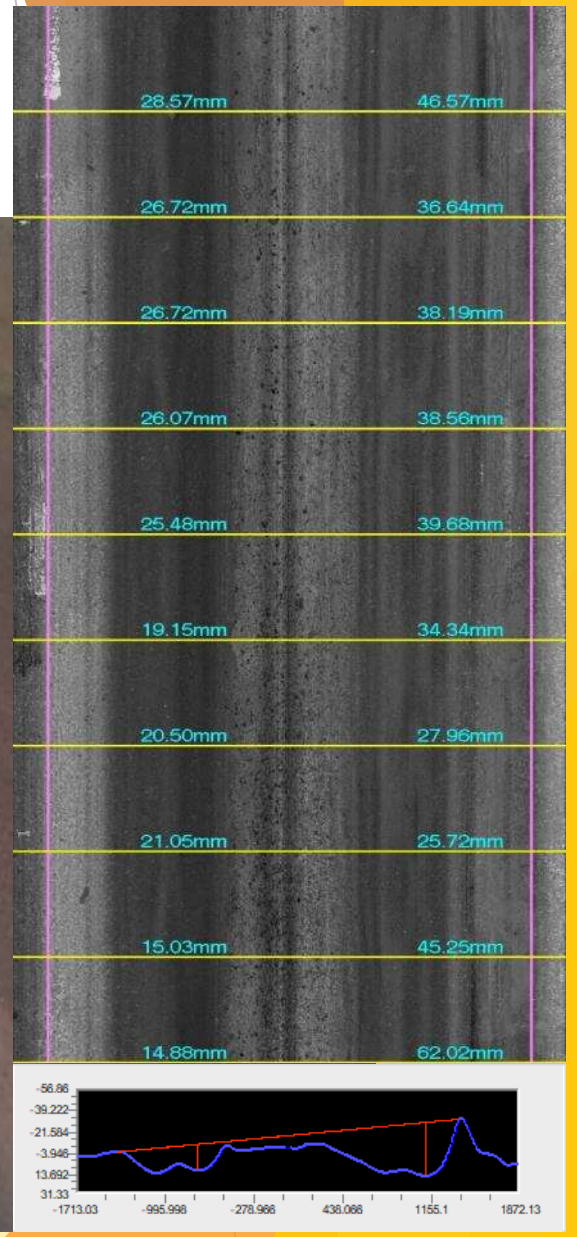
NETWORK "F" – National Road N° 33



Ravelling severity:
- Weak (Light-Blue)
- Medium (Blue)
- Severe (Red)

TO BE CONSIDERED… RUTTING

NETWORK "E" – National Road N° A-012



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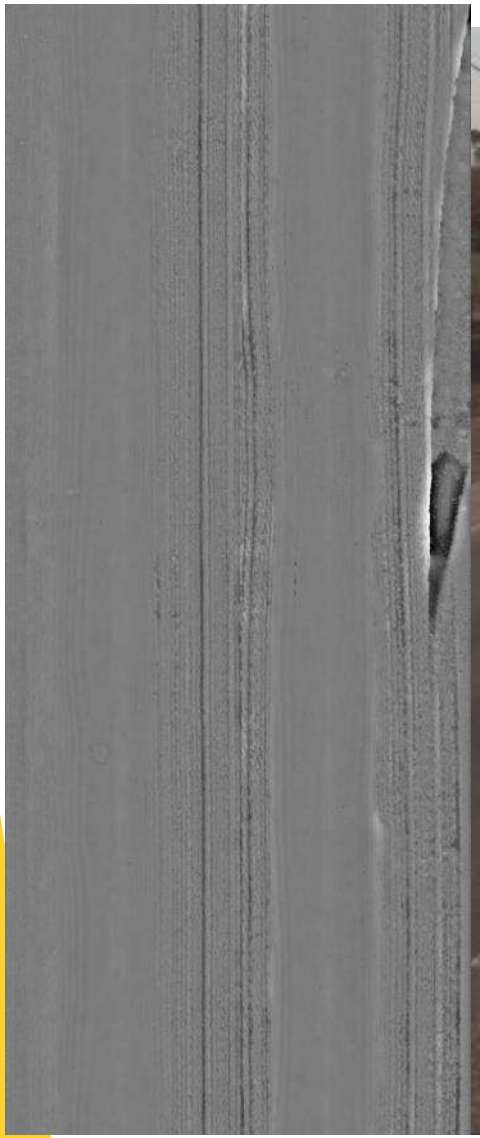
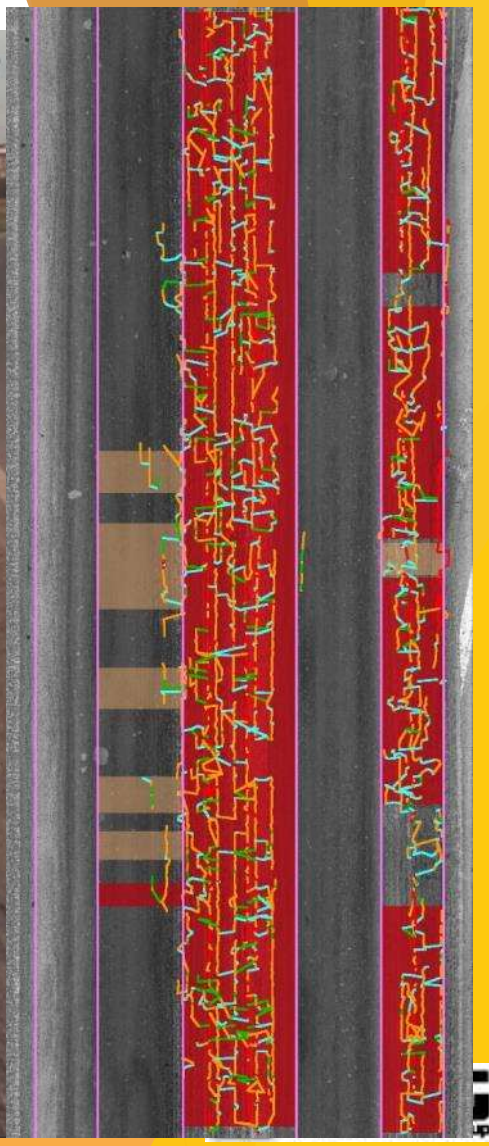
TO BE CONSIDERED…

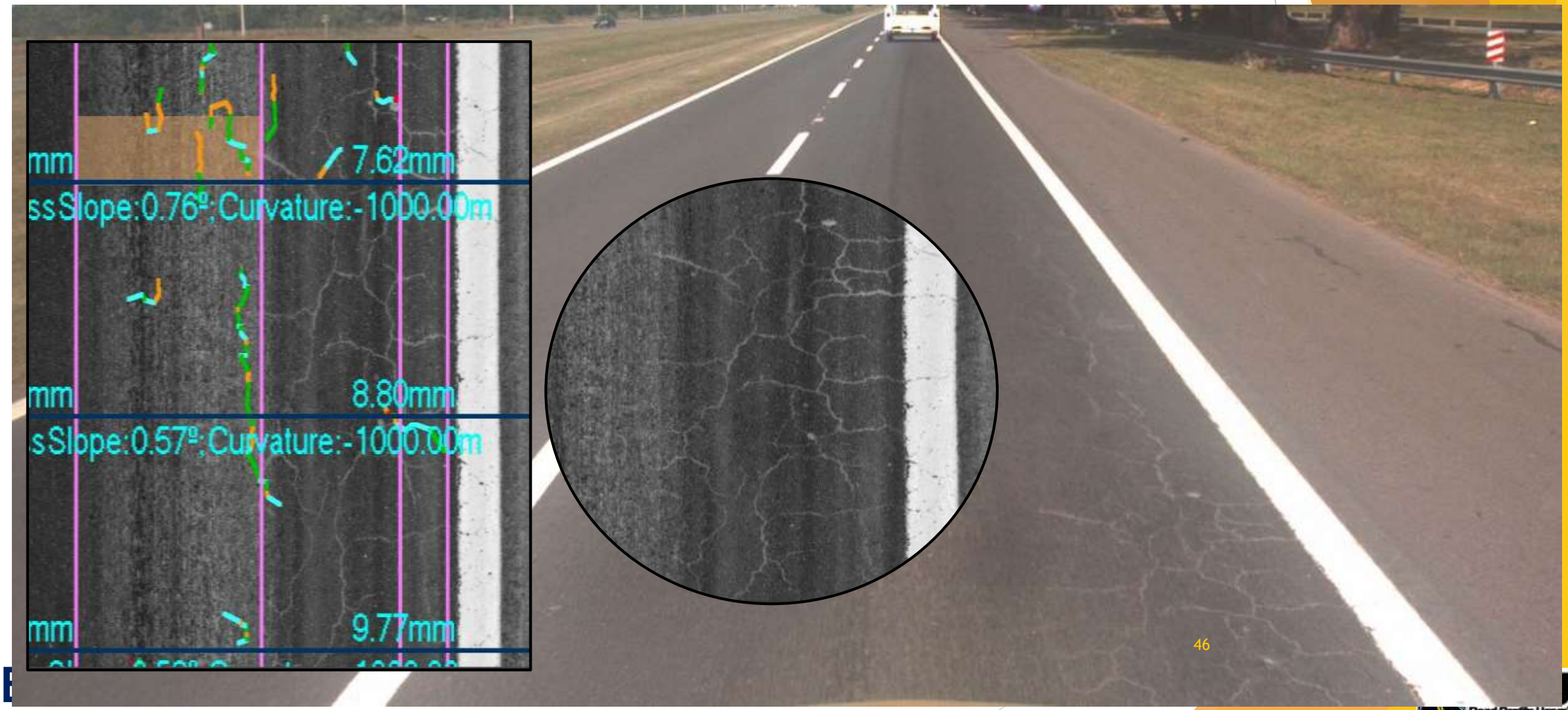
PRESENCE OF MILLING





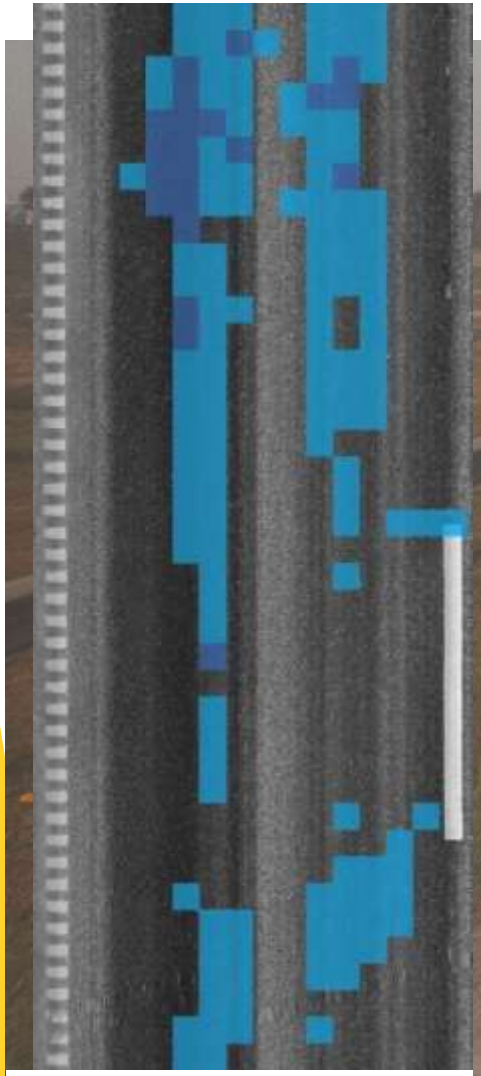
TO BE CONSIDERED …

PRESENCE OF FINE AGGREGATE



TO BE CONSIDERED …

RAVELLING IN STONE MASTIC ASPHALT

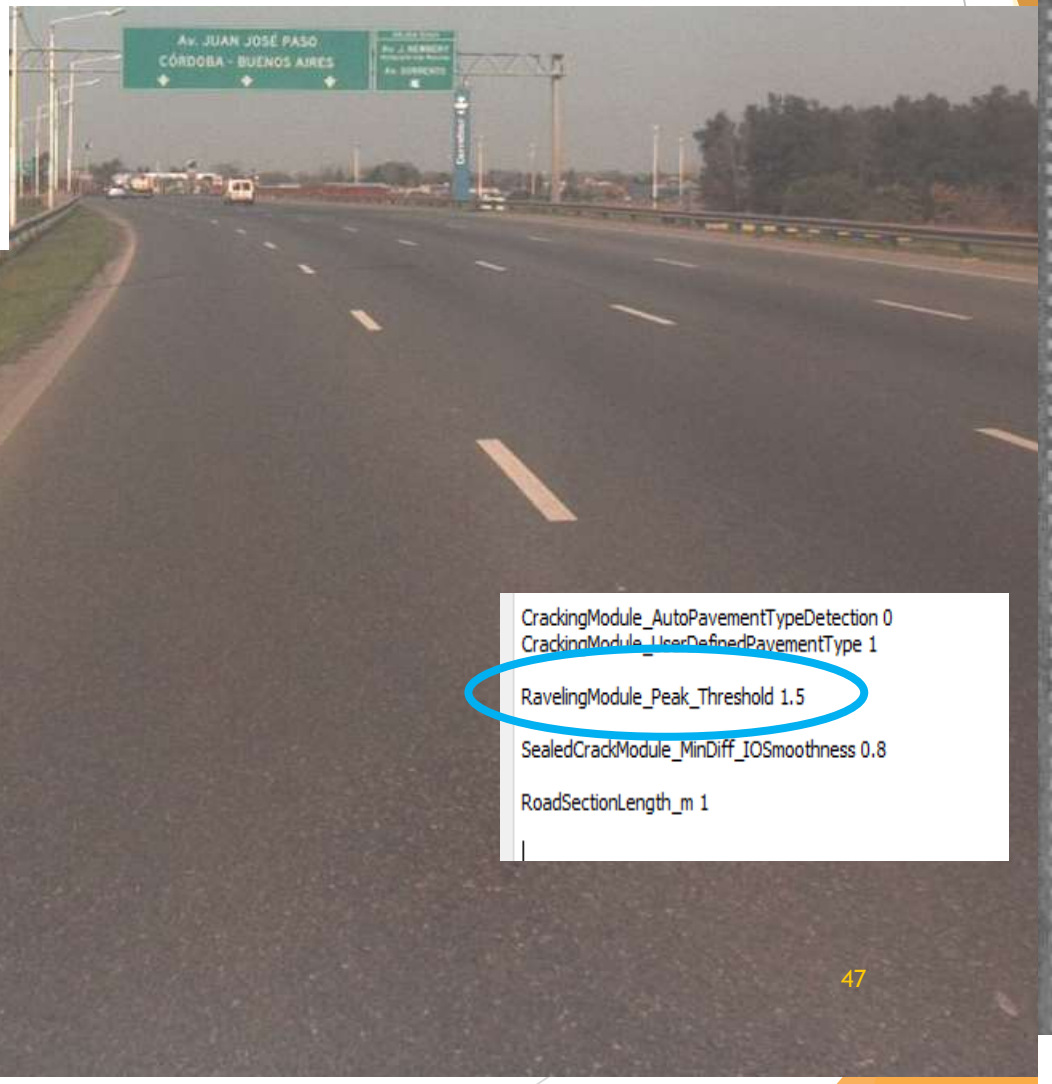


CrackingModule_AutoPavementTypeDetection 0
CrackingModule_UserDefinedPavementType 1

RavelingModule_Peak_Threshold 2.5

SealedCrackModule_MinDiff_IOSmoothness 0.8

RoadSectionLength_m 1

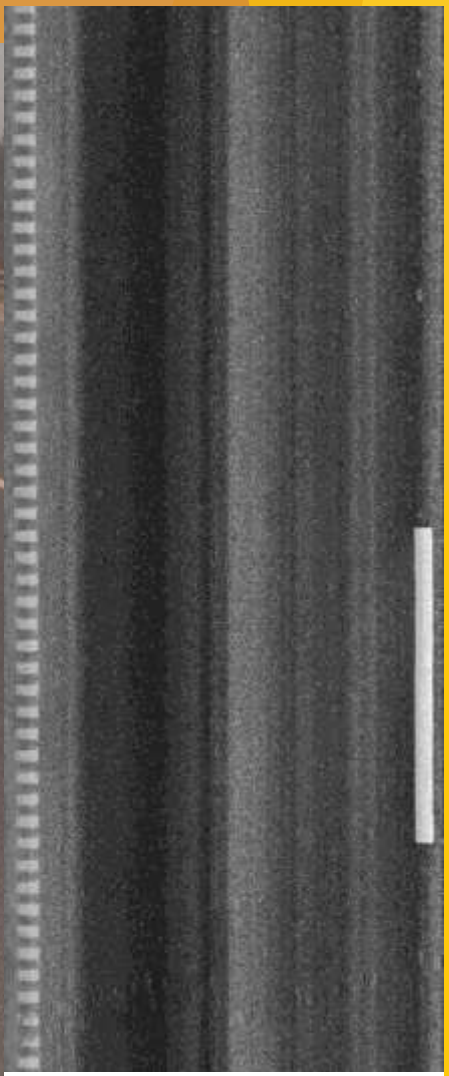


CrackingModule_AutoPavementTypeDetection 0
CrackingModule_UserDefinedPavementType 1

RavelingModule_Peak_Threshold 1.5

SealedCrackModule_MinDiff_IOSmoothness 0.8

RoadSectionLength_m 1



Without Modifying Limits

After Modifying Limits

Nowadays situation

PAVEMENT CONDITION PRINCIPAL INDICATORS

Longitdinal profile - Roughness	Rutting	Cracking	Ravelling and Potholes	Macrotexture	Friction	Deflections
						
100 %	100 %	1-2 %	1-2 %	100 %	100 %	Semi continuous
						
100 %	100 %	100 %	100 %	100 %	100 %	Semi continuous

PE 2019 IE 2% → IE 100%

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FINAL CONSIDERATIONS

- We have assembled and turned up a High Performance multifunction device for Automated Pavement Evaluation and Road Inventory in Argentina.
- Our aim was to produce a substantial improvement in terms of objectivity, accuracy, performance and safety for pavement management in order to conform to the new requirements established in maintenance contracts.
- Considering these needs, first experiencies with SPIDER LCMS in Argentina has been really satisfactory.
- Some special considerations or cares should be taken in terms of the use of an automatic treatment sofware
- IE (Status Index) can be now fully determined in the 100 % of the pavement surface


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POR EL BUEN CAMINO
SPIDER
MUCHAS GRACIAS !!!