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NEW METHODS FOR NETWORK LEVEL SURFACE CONDITION ASSESSMENT IN THE UK

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Traffic-speed surveys in UK

- **Traffic-speed condition surveys on Trunk Roads (TRACS)**
  - **TRACS1 2000-2006**
  - **TRACS2 2006-2011**

- **Measure**
  - **Transverse profile**
  - **Longitudinal profile**
  - **Texture profile**
  - **Cracking**
  - **Locationally referenced using GPS**

- **Covers the Highways Agency network:**
  - **Lane 1 and Lane 2 annually**
  - **Slip roads over 2 years**
  - **Over 30,000km each year**

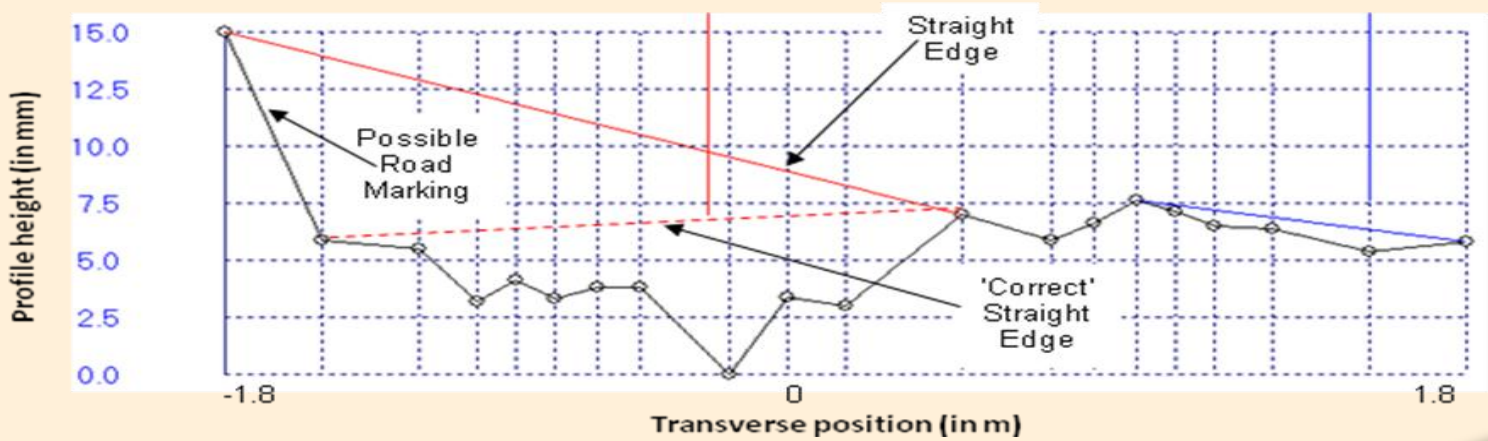
HARRIS1
HA/TRL research vehicle

An opportunity…

- A new 5 year "TRACS3"survey to commence from 2012
  - Assessment carried out of strengths and weaknesses of the current survey
  - Areas for improvement highlighted included:
    - The robustness of rutting measurements on challenging sites
    - The inability to measure raveling / fretting
    - The consistency of automatic cracking measurements
  - Research undertaken to address these
    - This presentation to consider rutting and raveling

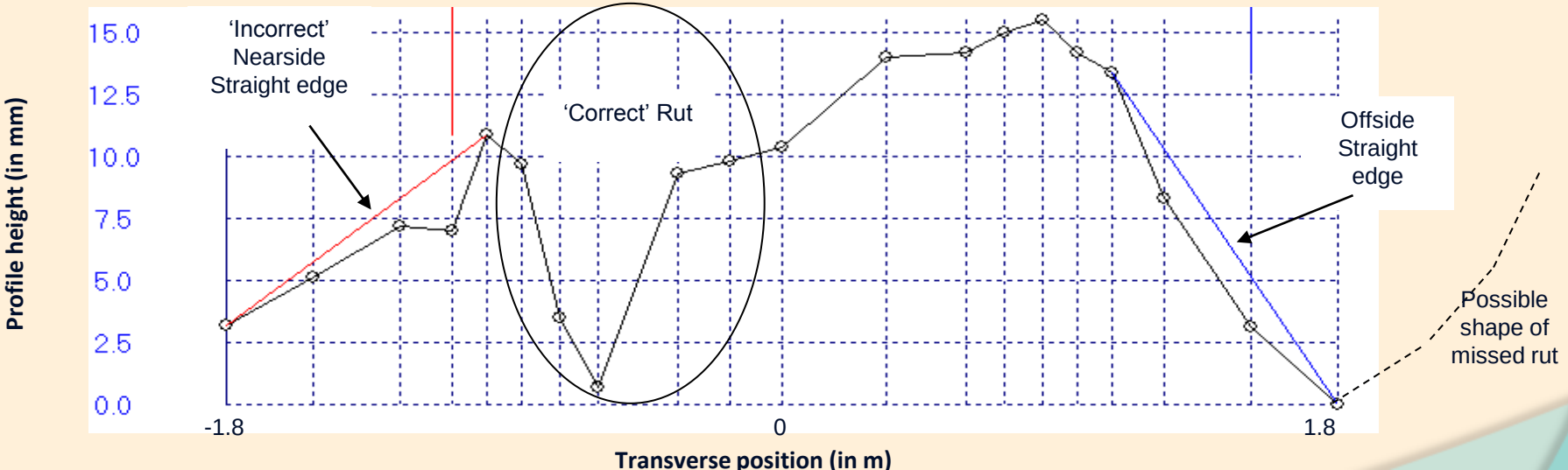
Rutting

- TRACS2 measures multipoint laser transverse profile
  - 3.2m / 20 lasers
- Applies a simulated straight edge to calculate rutting
- Accuracy affected by
  - Road markings (in particular thermoplastic “rumble strip”)
  - Road studs



Rutting

- Accuracy also affected by driving line
- Result
  - Conflict with engineers
  - Conflict with survey contractor
  - Difficult to audit, Difficult to trend
- Can we improve this for TRACS3?



New technologies

- **Provide more information**
  - **Wider, more points, more data**
  - **Should allow us to remove the road markings and accommodate driving line**
  - **But what is the "right amount" of data and how do we process it?**

Phoenix PPS

1000 points / 4m

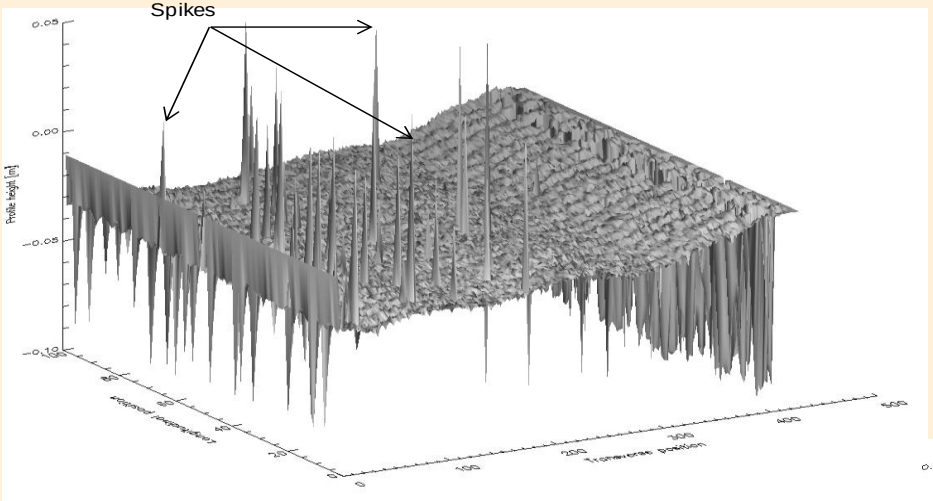
INO LRUT/LCMS

@1200 – 4000 points / 4m

RPS RoadScout

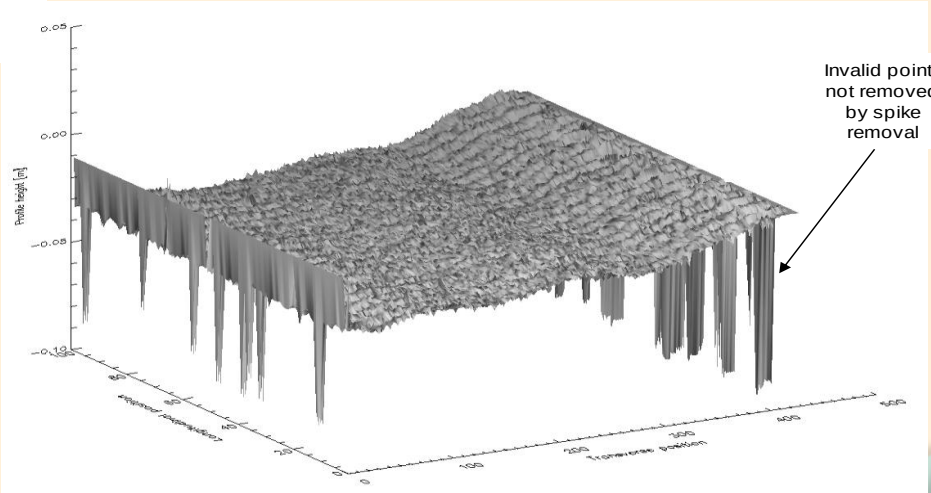
2048 points / 4m

Applying the technology

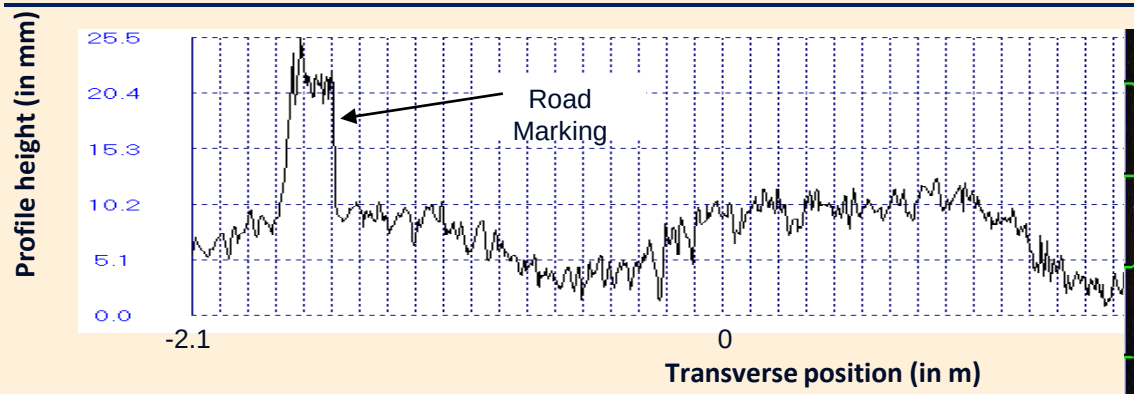


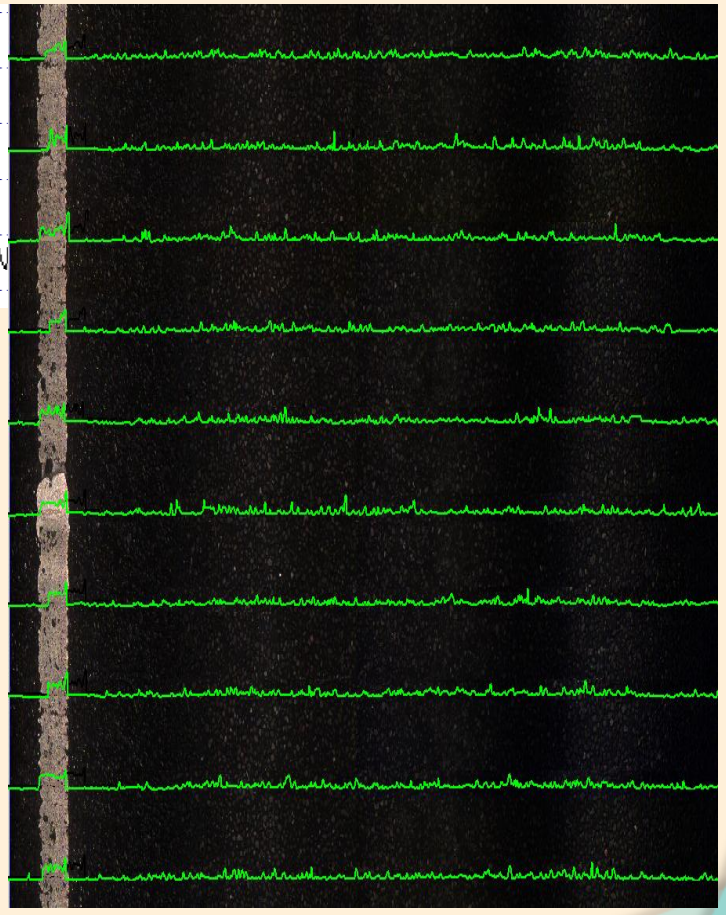
- The Phoenix system
- Provides 1000 point profiles every 25mm along the road

- First we remove the noise
  - Using a simple spike algorithm
  - Leaves some “edge” issues which we truncate



Road markings

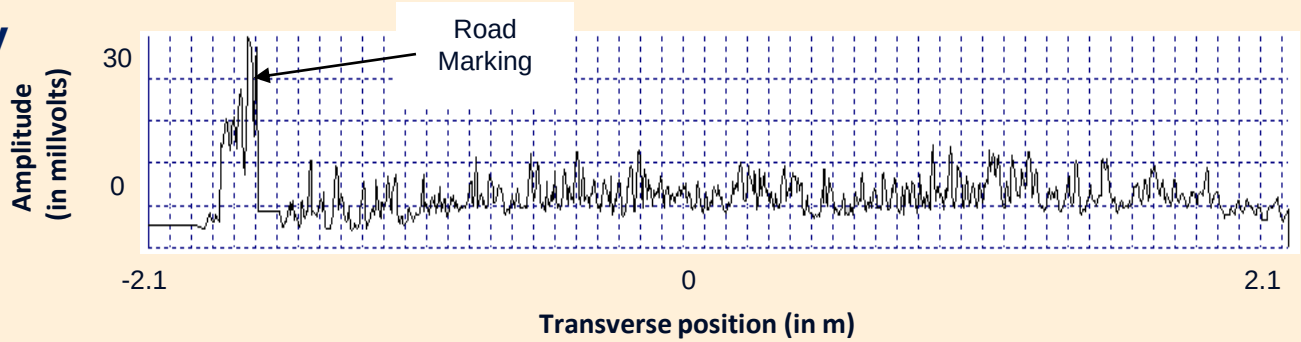


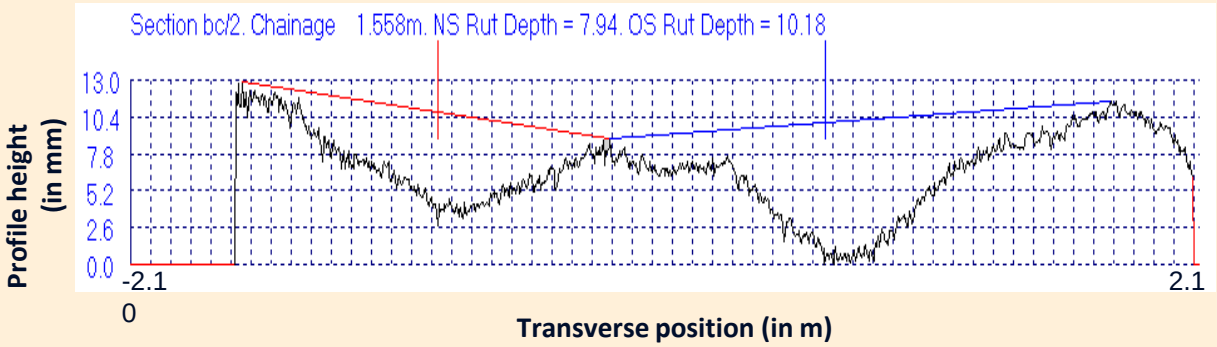


- Many points measured on the line
  - Should simplify identification and removal?
- Not necessarily
  - Brightness and reflectivity affect height measurement (gain control)
    - Have seen in projected line systems as well
  - Additional data would be useful

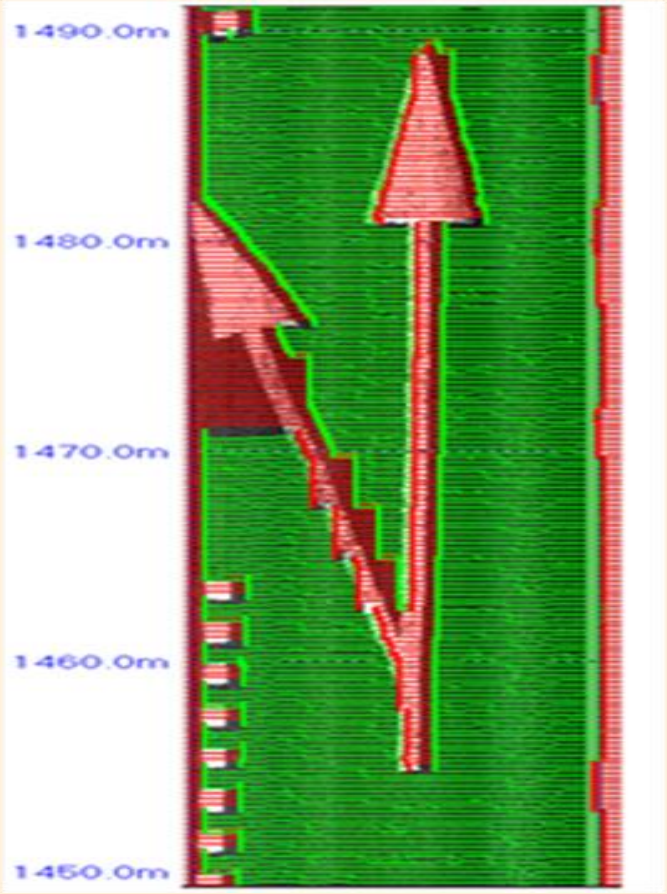
Amplitude response

- Amplitude reported by the laser will indicate marking
- Algorithm developed based on
  - Thresholding
  - Cleaning of spurious values
  - Longitudinal joining of continuous features
  - Removal of regions to the left and right of markings



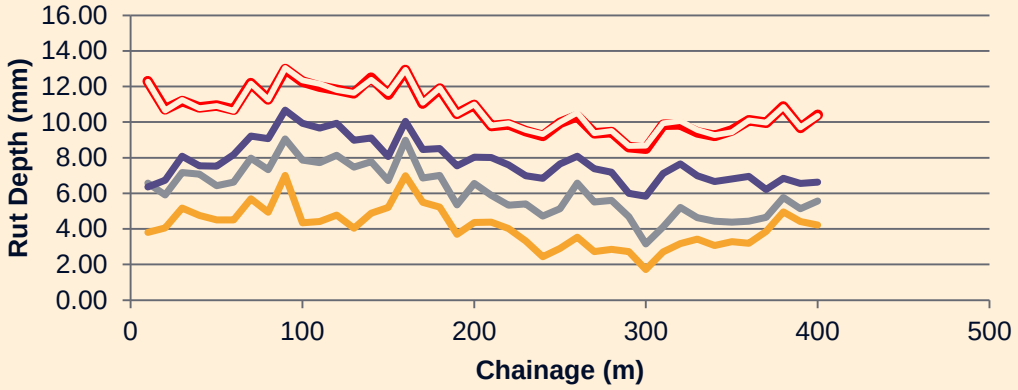


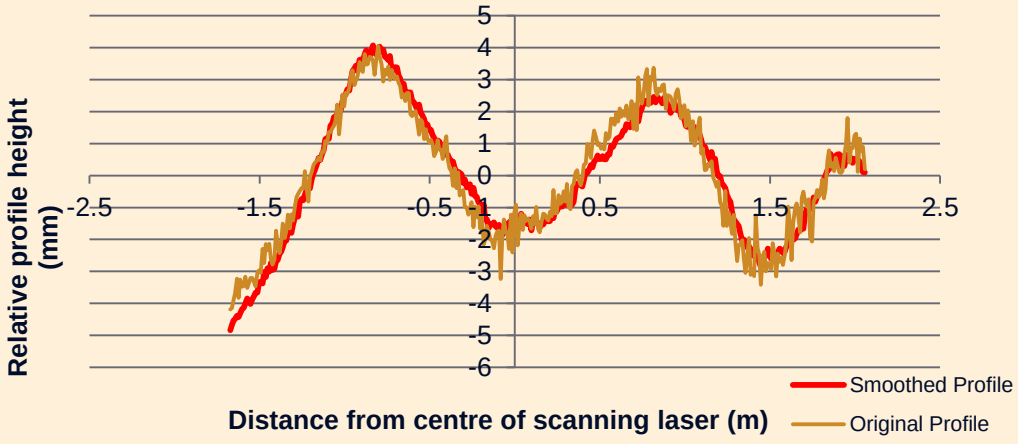
Masking



- The resulting road marking mask leaves only valid transverse profile data to measure rutting
- However, still not quite right

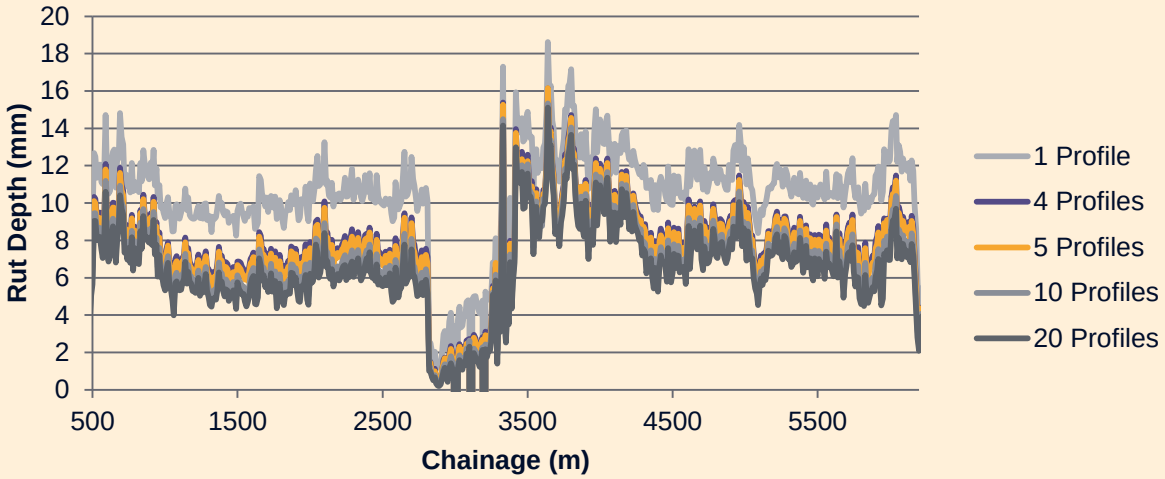
Smoothing

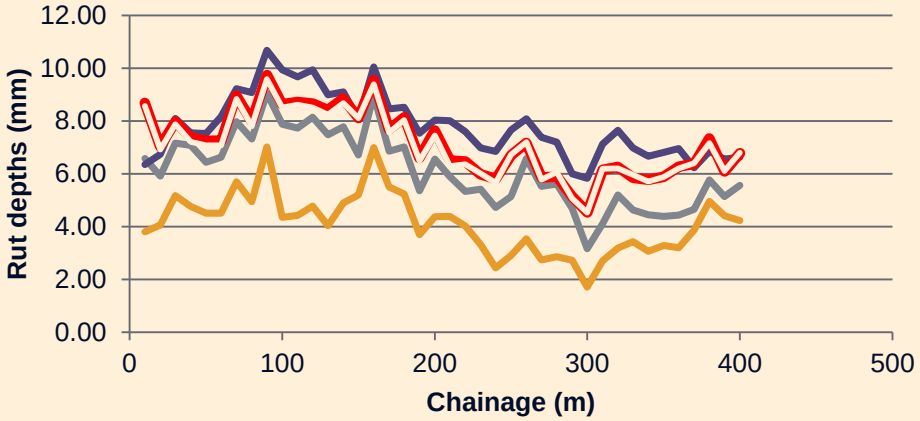




- We have seen bias in rutting from high-resolution profilers
  - Red lines (high res). Yellow/grey/purple (traditional laser system)
  - Due to the texture
- Have to smooth
  - We apply this *longitudinally*

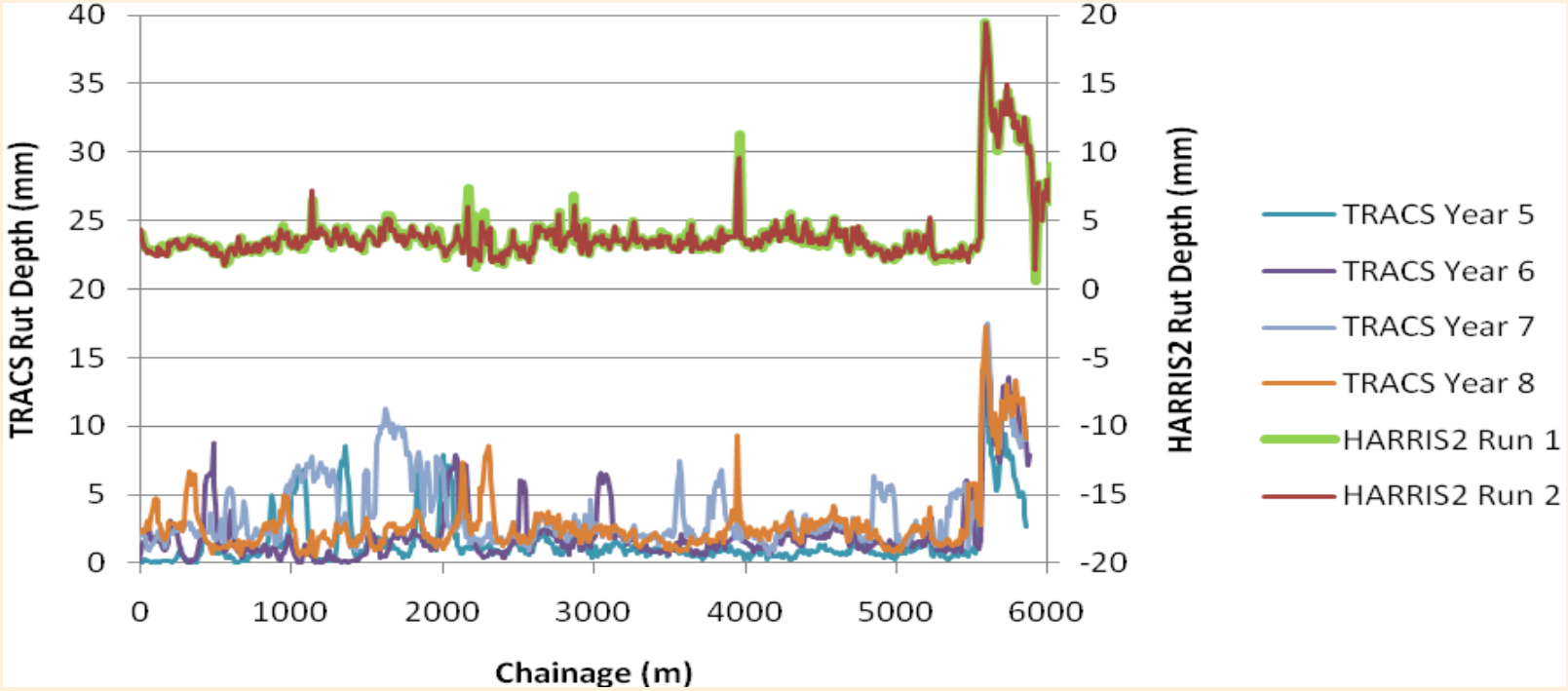
Smoothing



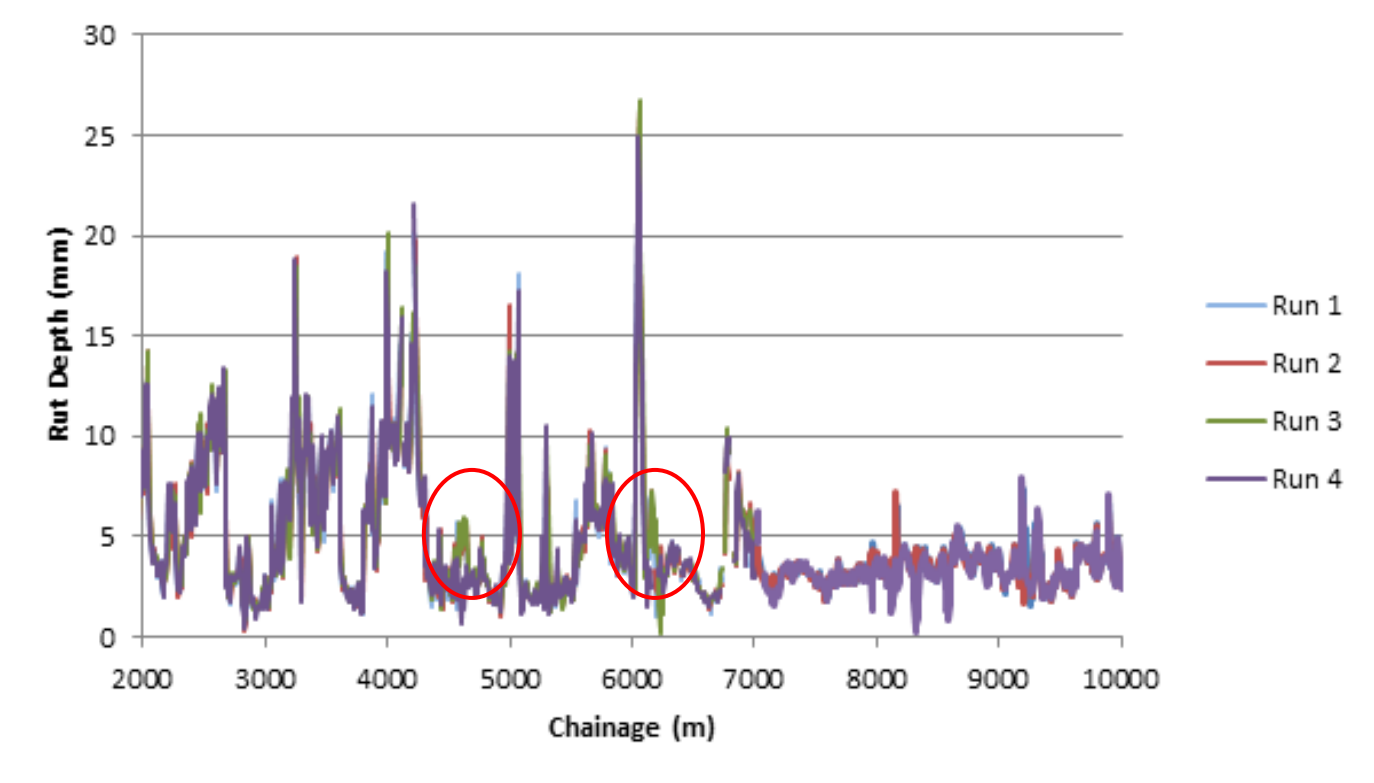


- **We average longitudinally over 10 profiles, after removing outliers**
- **Reduces bias to a negligible level**

Performance

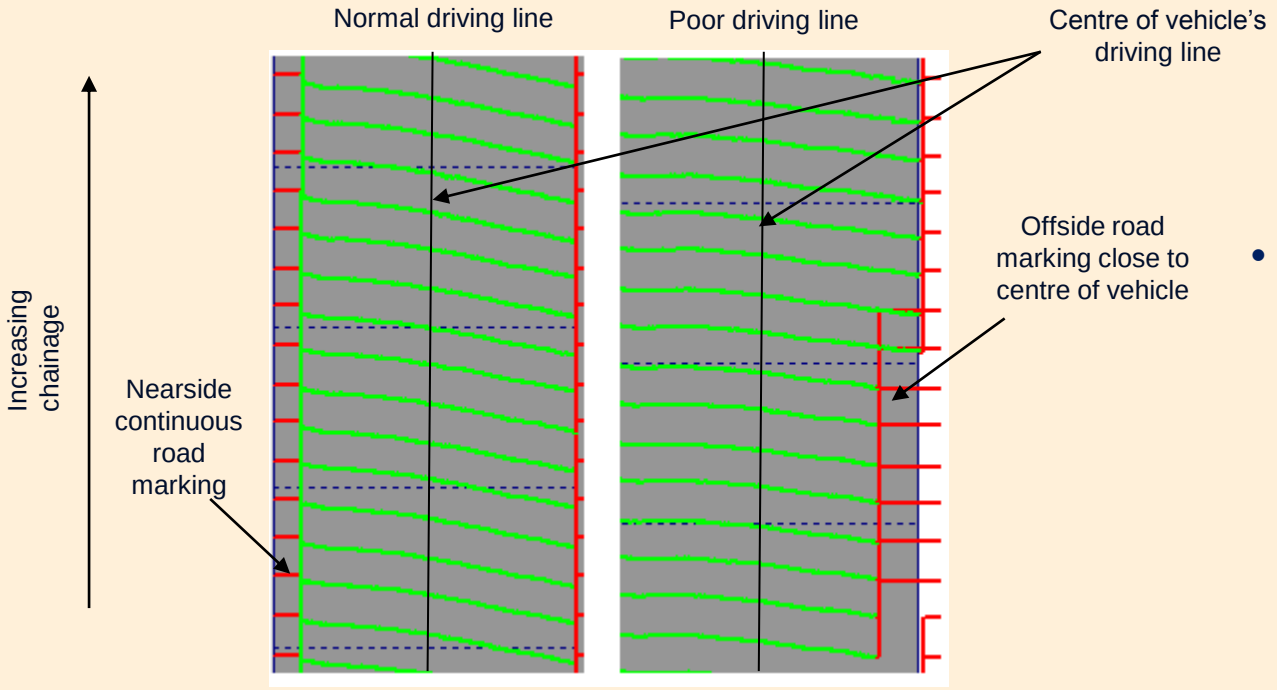


Performance



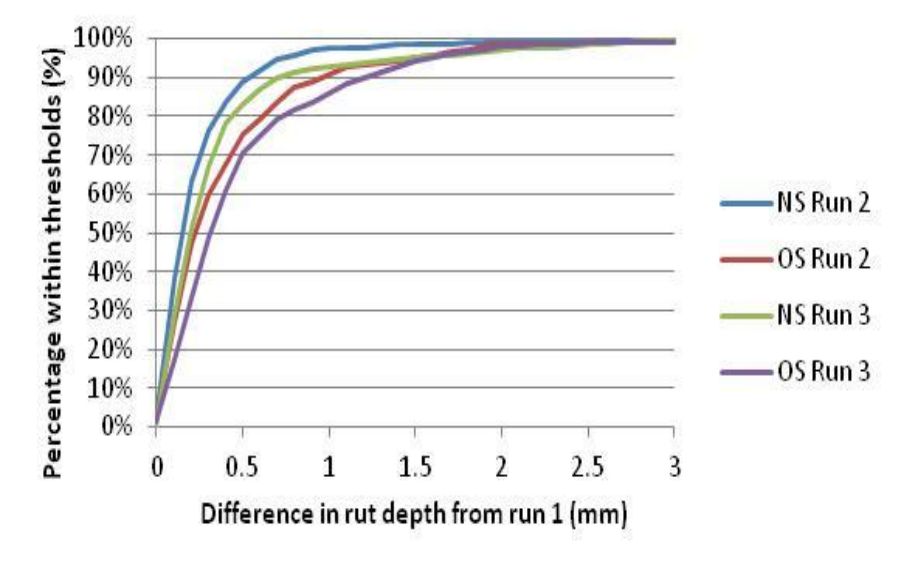
- Four runs
- The driver was asked to deliberately drive poorly in run 4!

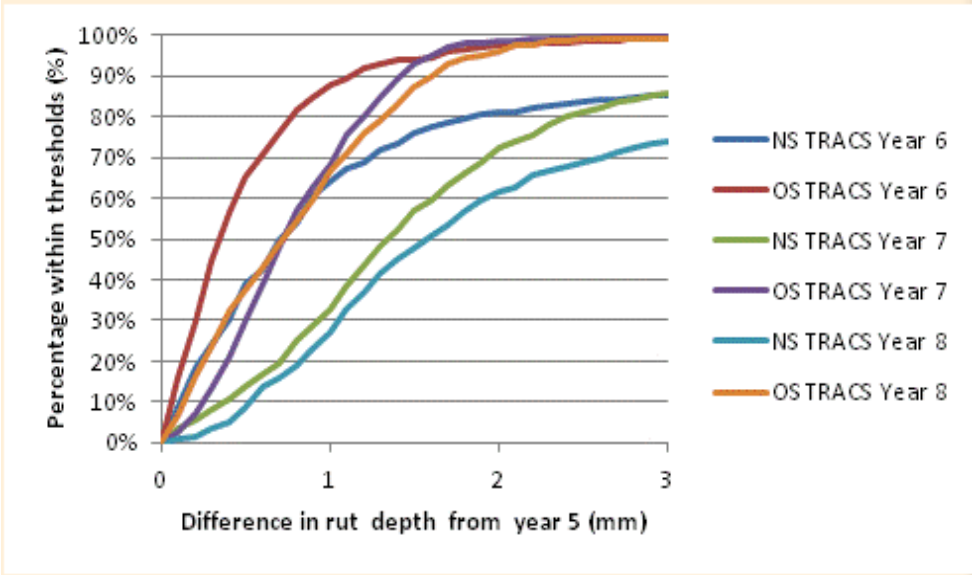
Performance



- **You cannot report it if you didn't measure it**

Performance





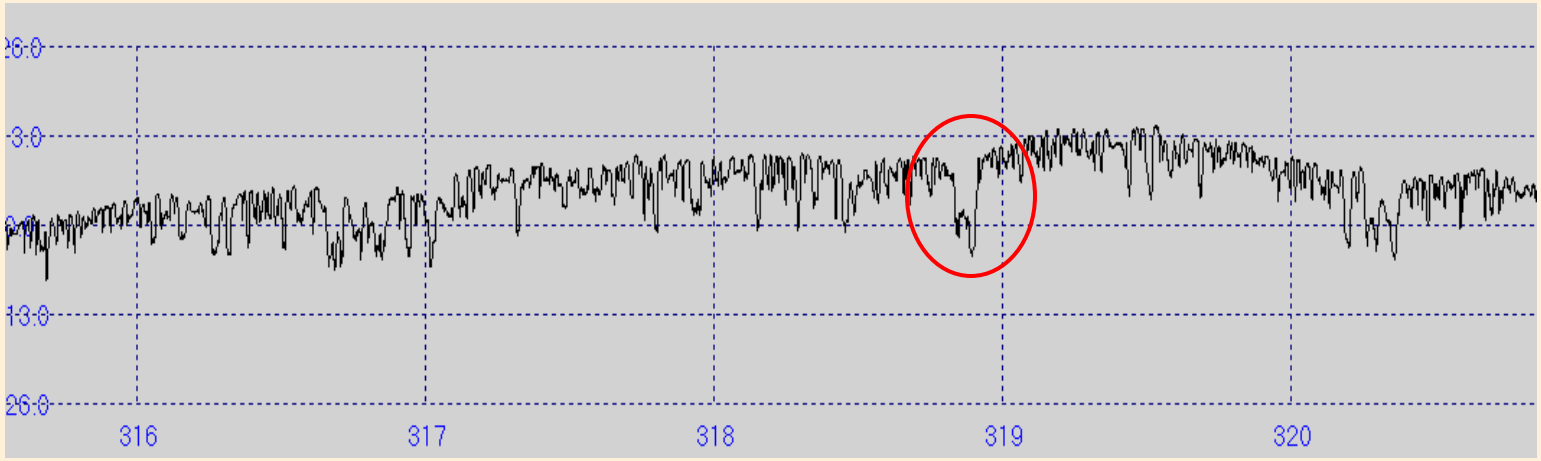
- Histogram of differences
  - Road marking removed
  - Smoothed
  - High resolution laser
  - 4m survey width

- Histogram of differences
  - TRACS2
  - 20 points
  - 3.2m survey width

Raveling (Fretting)

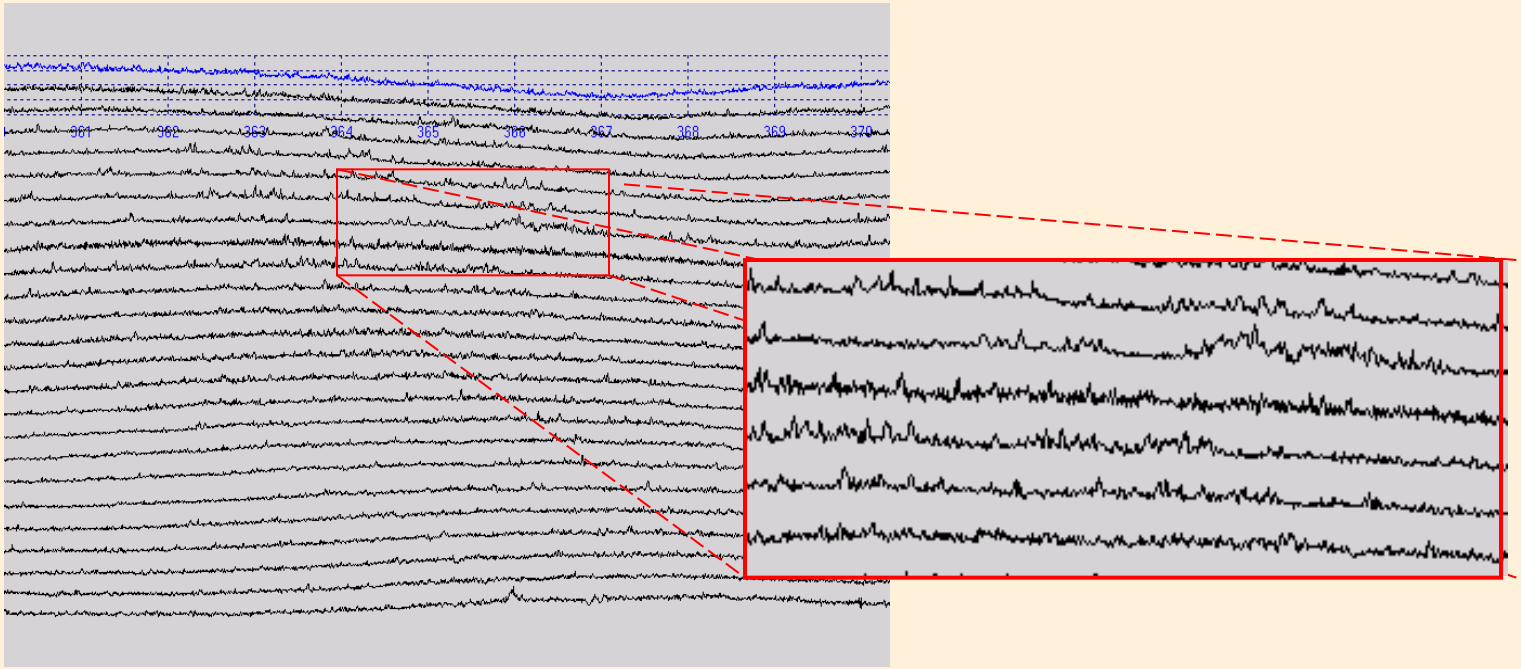
- An important an increasing defect on UK roads
- Surveys carried out manually using CVI
  - Difficult to identify raveling
  - Difficult to quantify
  - Difficult to trend
  - Quality and repeatability issues
- TRACS2 surveys attempted to measure this using single line texture profile
  - Unreliably
- Can we improve this for TRACS3?

Raveling in a single line



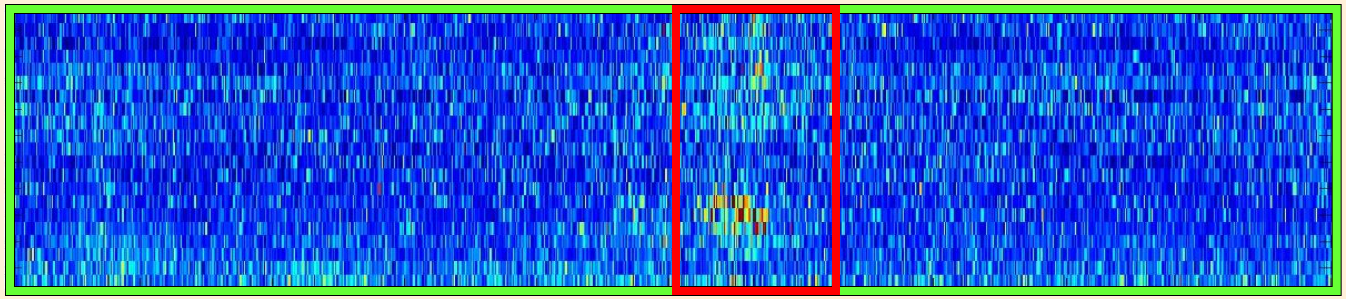
- 1mm spacing texture profile
- TRACS2 employed the Stoneway algorithm
- Looks for missing stones that appear as “holes”
- Reports as total length affected
- Detailed investigation showed it works
  - When the raveling is in exactly that line….

Multiple line texture

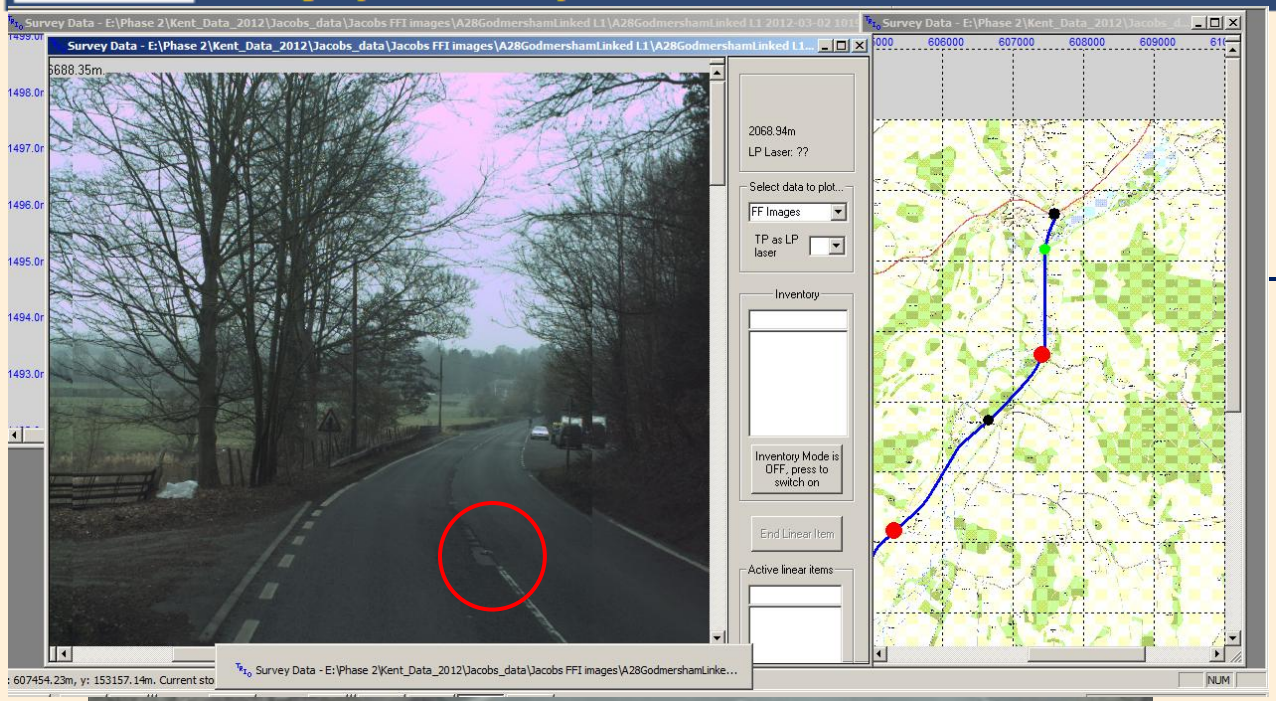


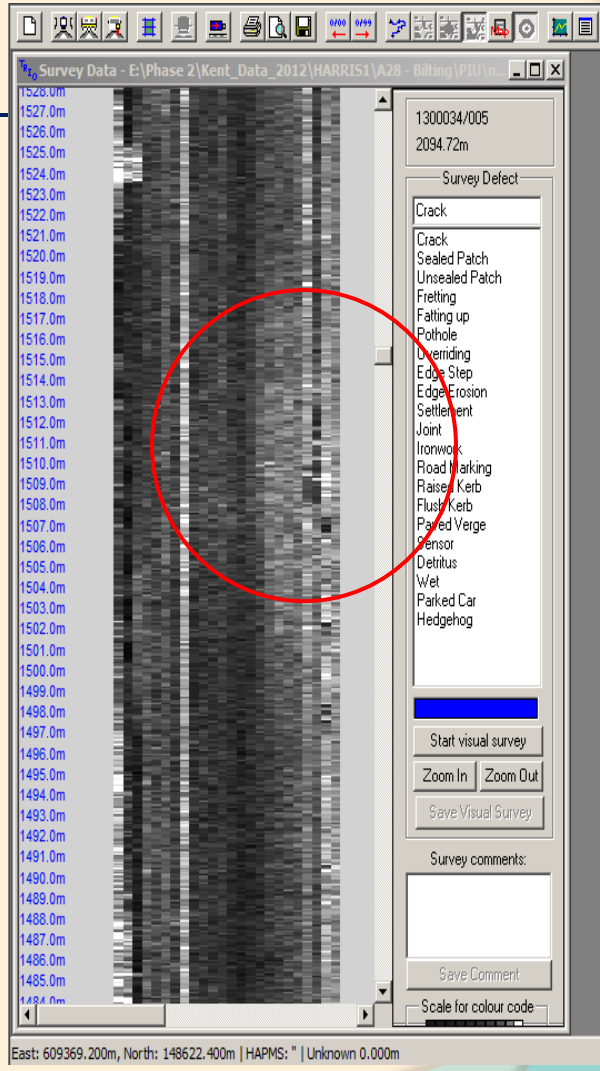
- The raw data from traditional 16kHz point lasers – 4mm spacing at 50 mph
- Can we use these to detect fretting?

Multiple line texture



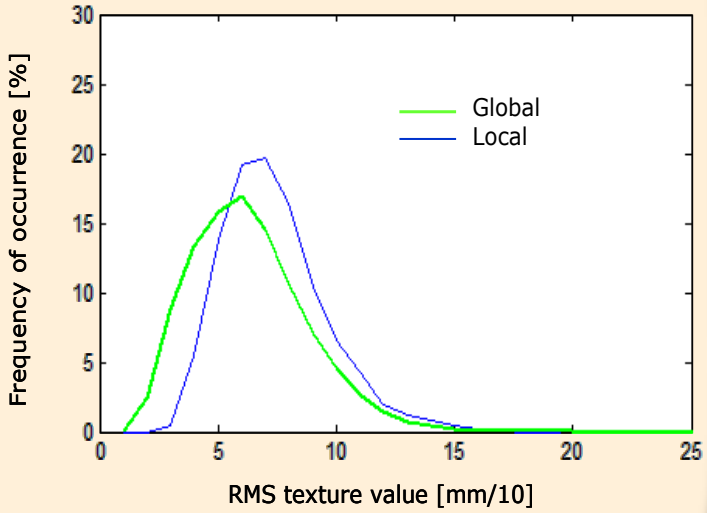
- Resolution is insufficient to use Stoneway on thin surfacing systems
  - 10mm stones, 4mm data points
- But, we can obtain a “mat” or “grid” of the texture and assess in general:
  - Calculate the RMS texture depth in each line every 100mm
  - Localised high texture then highlights the presence of fretting
- But how to quantify?


Survey Data - E:\Phase 2\Kent_Data_2012\Jacobs_data\Jacobs FFI images\A28GodmershamLinked L1\A28GodmershamLinked L1...
2068.94m
LP Laser: ??
Select data to plot...
FF Images
TP as LP laser
Inventory
Inventory Mode is OFF, press to switch on
End Linear Item
Active linear items

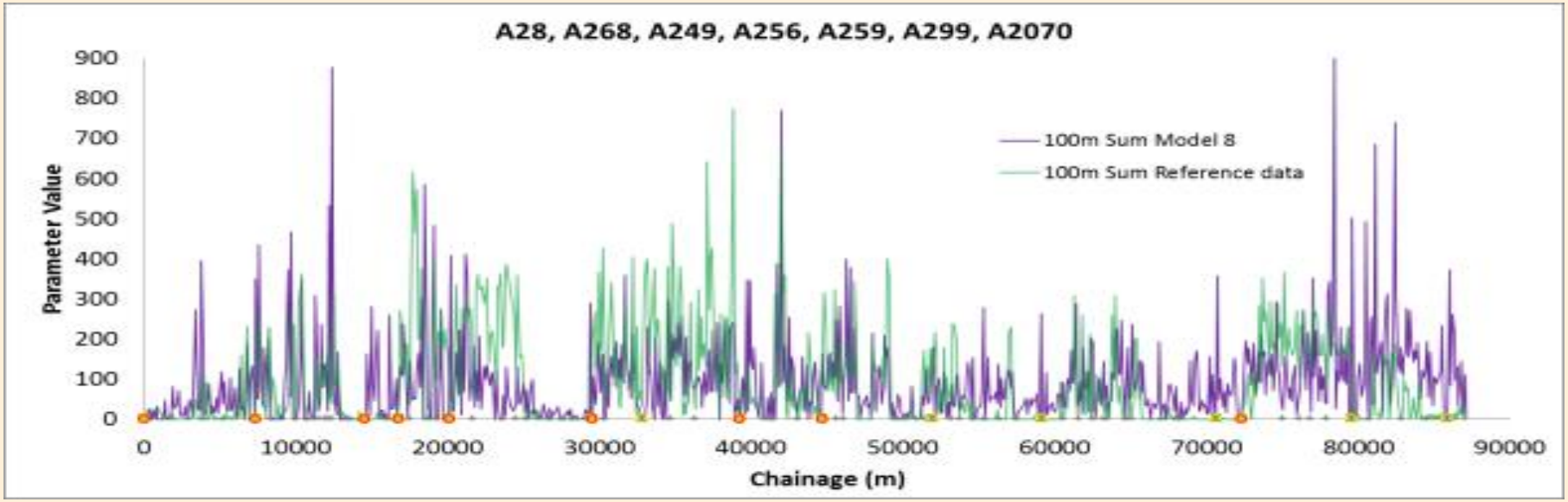

Survey Data - E:\Phase 2\Kent_Data_2012\HARRIS1\A28 - Bilting\PIU\n...
1300034/005
2094.72m
Survey Defect
Crack
Sealed Patch
Unsealed Patch
Fretting
Fatting up
Pothole
Overriding
Edge Step
Edge Erosion
Settlement
Joint
Ironwork
Road Marking
Raised Kerb
Flush Kerb
Paved Verge
Sensor
Detritus
Wet
Parked Car
Hedgehog
Start visual survey
Zoom In
Zoom Out
Save Visual Survey
Survey comments:
Save Comment
Scale for colour code
East: 609369.200m, North: 148622.400m | HAPMS: " | Unknown 0.000m

Raveling using Multiple line texture

- Comparing the distribution of RMS values over the local 10m length with the surrounding 100m length
- Statistical parameters can describe the differences
  - Correlation coefficient
  - Correlation between Nearside/Middle/Offside regions
  - Comparison of percentiles
  - The proportion of values that are locally high compared with the global region
- Then we further analyse
  - By applying thresholds to each and reporting a scaled value

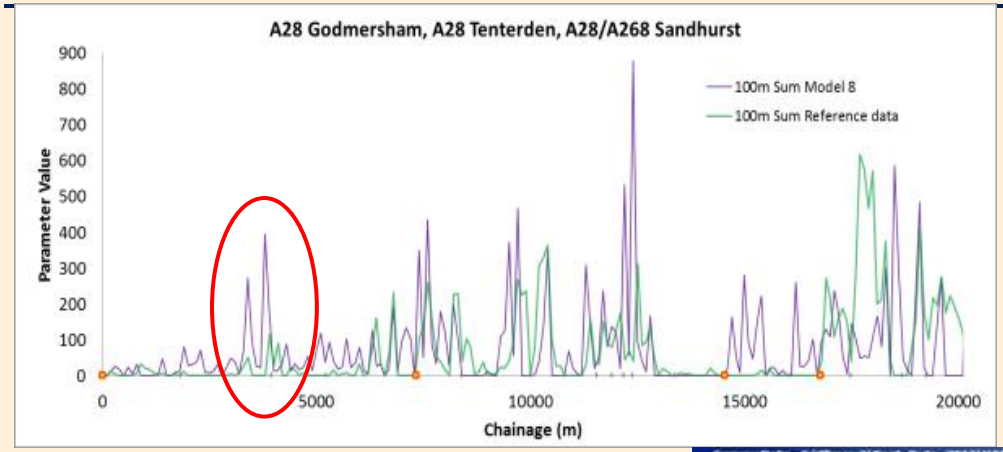


Performance

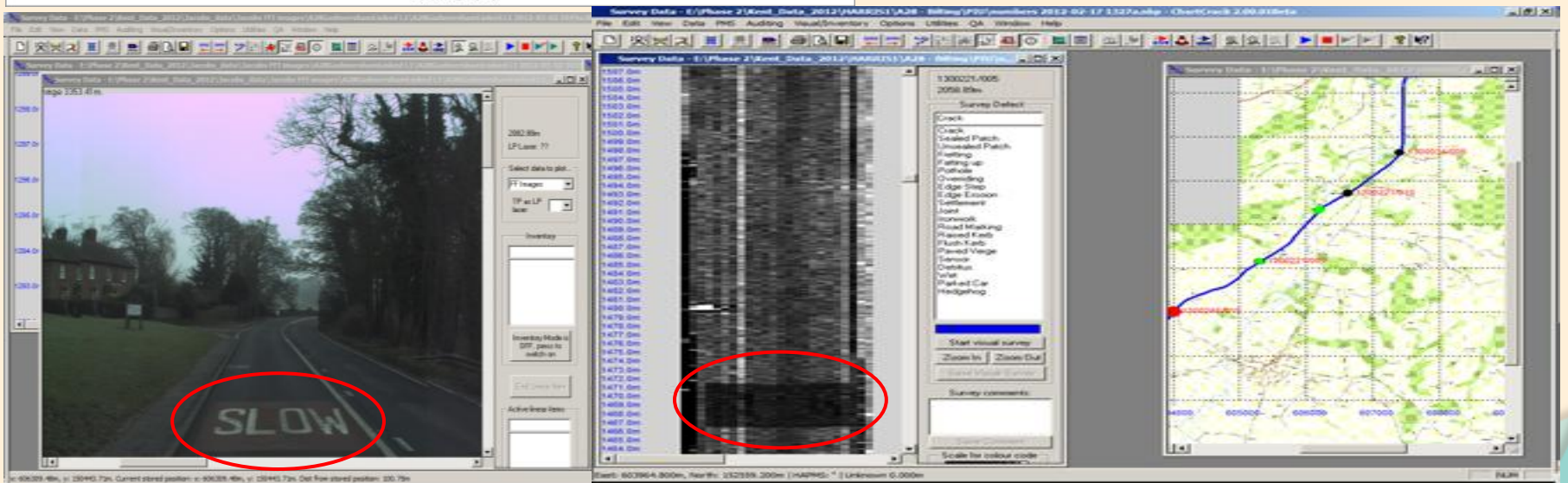


- Obtaining consistent reference data is very difficult
- The above reference obtained via manual surveys from a slow moving vehicle
- Good overall agreement
  - Localised differences

Performance

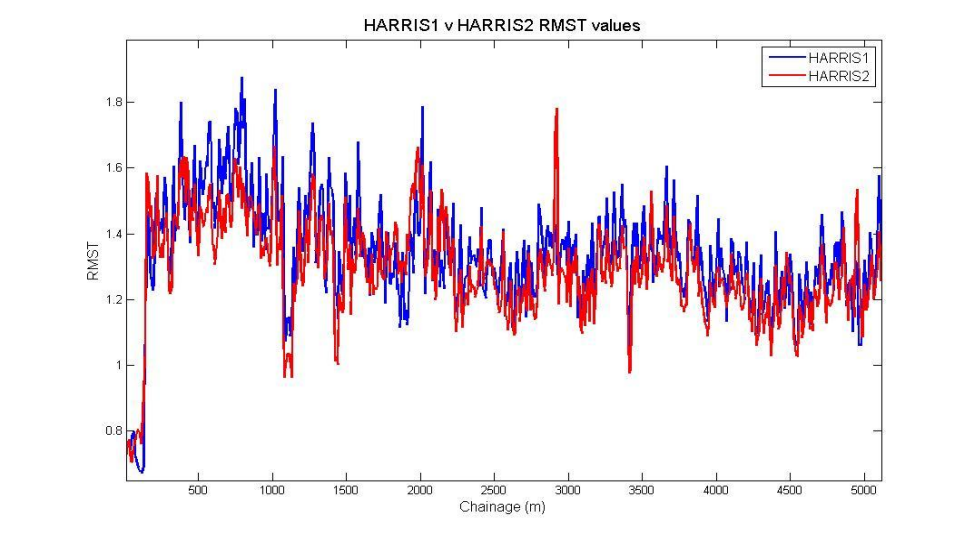


- Differences due to local false positives
- Checks are included but not always robust
- However, more of a problem on minor roads



Specifying a requirement

- Both the rutting and raveling research has identified the strength of higher resolution data
  - Rutting requires high resolution transversely
  - Raveling used high resolution data longitudinally
- However
  - The RMS data can be provided by the Phoenix laser,
  - By calculating the RMS data across the transverse profile
- One system could provide all of requirements



Summary

- With the introduction of TRACS3 in the UK, automated surveys of the surface condition of trunk roads are being updated
- We have developed improvements to rutting
  - TRACS3 will require transverse profiles with >100 points over a 4m width
  - The location of road markings is also required at the same resolution
  - The combined data will be used to calculate rutting.
  - The accuracy requirement will increase from 3mm (95%) to 2mm (95%).
- We have developed a method to identify raveling using multiple line surface texture measurements
  - With good general agreement with manual surveys
  - To calculate raveling TRACS3 will have to deliver texture in at least 7 lines
  - However, it will also be possible to use high resolution transverse profile to measure this defect
  - Research continues, to fine tune the algorithm