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
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?

![Graph showing profile height vs. transverse position with markers for 'Incorrect' nearside straight edge and 'Correct' rut, and possible shape of missed rut offside straight edge.](image)
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 and 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
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?
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