Road scanning V2.0: Preliminary results from updated TSD and NM-GPR technologies

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Overview

- **TSD**: Traffic Speed Deflectometer
  - ARRB modifications & analysis method
  - Data display
  - Comparison to FWD

- **NM-GPR**: Noise-Modulated Ground Penetrating Radar
  - Overview of upgraded technology
  - Data examples
  - Multi-offset analysis

- **TSD + NM-GPR**
  - Rapid pavement investigations
Overview & analysis method

ARRB-modified TSD:

• Continuous deflection

+ 

• Hawkeye sensors: rutting; roughness; automatic crack detection (ACD); geometry; texture; cameras & DGPS.

TSD analysis method: Muller & Roberts (2013)

• Plot: measured road surface velocities in terms of slope $V$’s wheel offset.

• Assume: zero slope at wheel & far from wheel.

• Curve fit: to determine intermediate values.

• Numerical integration: to determine deflection bowl

\[
\frac{dy}{dx} = \frac{Vu}{V_H} \\
Slope = \frac{V_v}{V_H} \\
y_x = \sum_{\infty}^{x} \frac{Vu}{V_H} dx
\]

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TSD scanning in QLD & NSW

• >13,300km (8,200 miles) collected (April-September 2014)
• Geospatial views of data generated
• Comparisons with FWD in selected locations
TSD data visualisations
Noise-Modulated Ground Penetrating Radar

- **Development:**
  - 1st generation: extensive field use since 2008\(^2-3\).
  - 2nd generation: recently completed.

- **Performance:**
  - Uses coded signals for much cleaner data & better penetration compared to existing GPR equipment.
  - Rugged; highway speed operation (100km/hr).

- **Scalable:** 1 or 2 pods or full trailer for 3D.

- **Compliance:** Expected to meet FCC limits (TBC).

- **Cost:** similar to existing GPR alternatives.

- **Multi-offset operation (full trailer):**
  - Non-destructive calibration of EM wave velocities for accurate layer depths.
  - Avoids key limitations of surface reflection methods.
  - Semi-automated analysis methods being developed\(^4,6\)
  - Quantitative pavement moisture mapping\(^4-6\)
NM-GPR: Data examples (fixed offset)
• Prelim. work in 2010 comparing TSD and NM-GPR:
  – Clear correlation observed between TSD $d_0$ and NM-GPR data.
  – Complementary methods, greater than either method alone.
Comparing TSD and FWD $d_0$ values

- TSD: 2 July 2014
- FWD: 28 May 2014

(40kN scaled to 50kN)
A few differences, but overall very encouraging comparisons.
Deflection bowl shapes also compare well, not just $d_0$ plots!
TSD + NM-GPR: Recent examples

NOTE: TSD and NM-GPR on opposite wheelpaths in this example
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Conclusions

• **ARRB TSD:**
  – Overview of capability & preliminary use.
  – Visualisations of TSD deflection data.
  – TSD v’s FWD: encouraging comparisons so far... more to be done.

• **NM-GPR**
  – Overview of updated traffic speed 3D GPR technology
  – Data examples.

• **GPR + TSD**
  – Complementary methods that enable rapid road investigations.
  – Example comparisons.


Thank you

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