

Using a 3D system for measuring pavement macro-texture

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Australian Road Research Board



5th International Safer Roads Conference
Auckland, New Zealand
21 -24 May, 2017



Summary

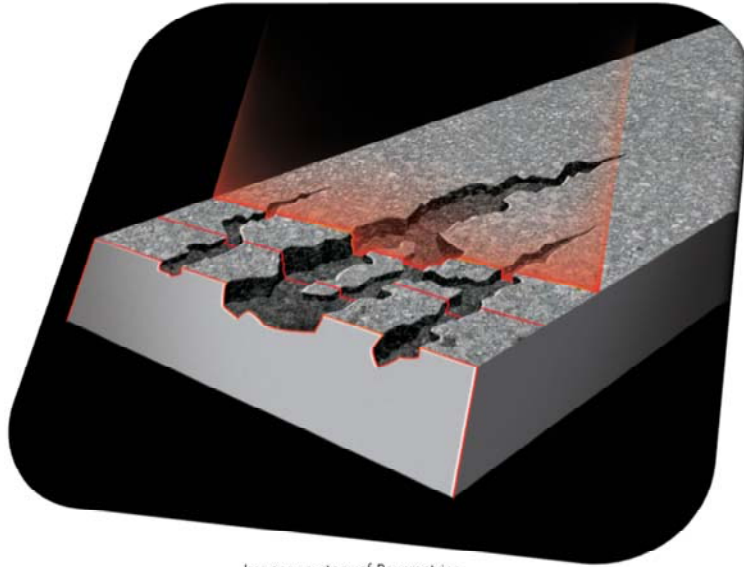
- 3D technology
- Texture measurement
- Validation testing
- Observations
- Conclusions & future work



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LCMS - system configuration

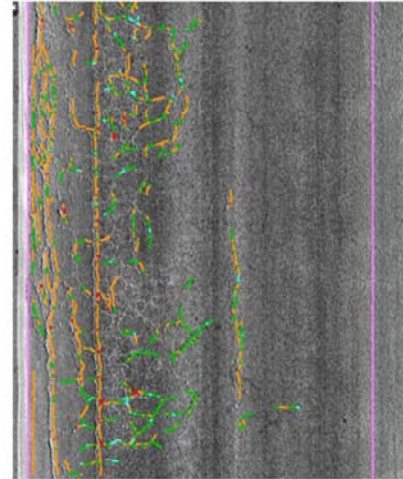
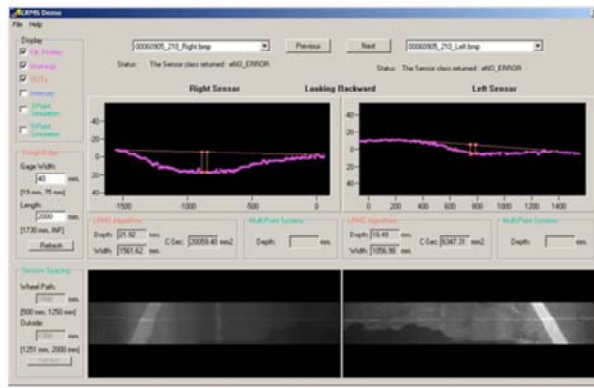


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Images courtesy of Pavemetrics



Typical uses of 3D technology

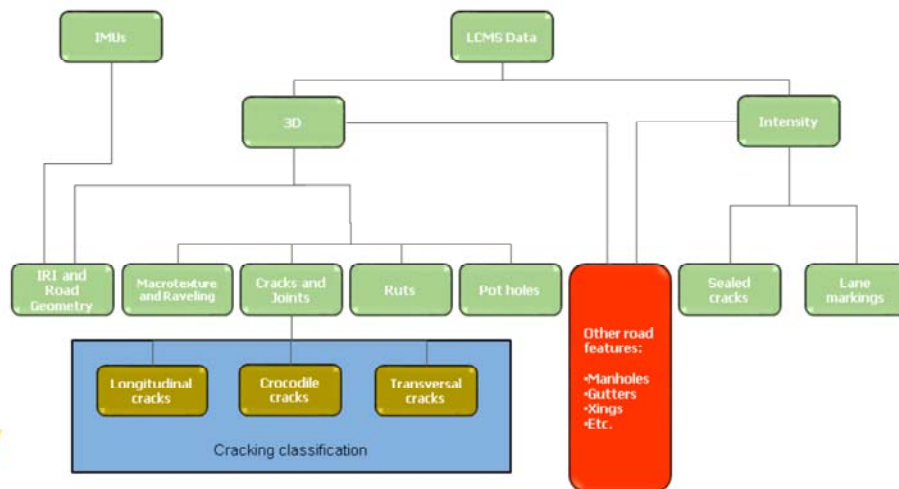


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Cracking and pavement distresses, rutting.

3D technology can do more



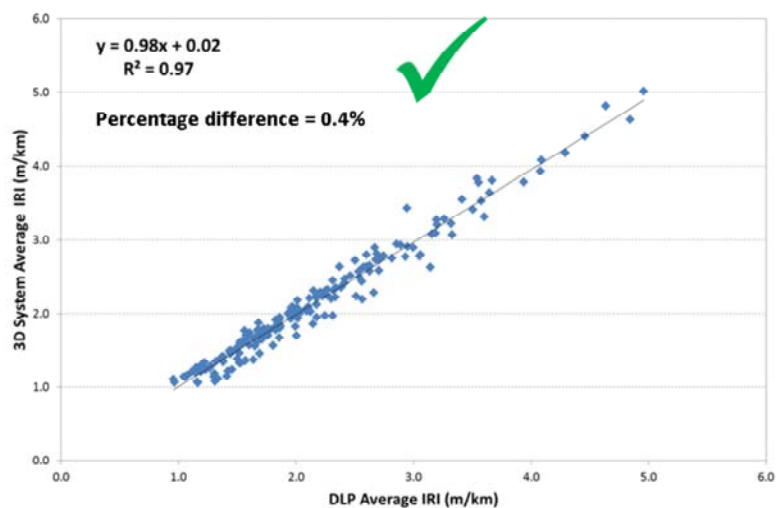
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Flow chart courtesy of Pavemetrics



Other stuff that 3D technology can be used for

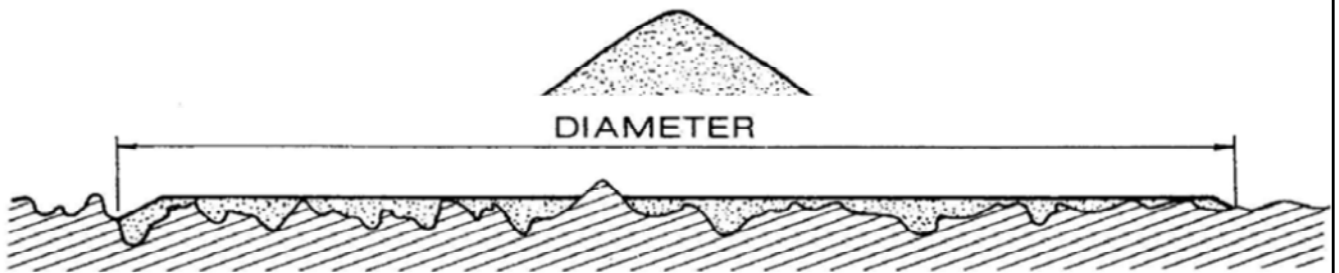
Other uses - IRI



Other uses – pavement macro-texture

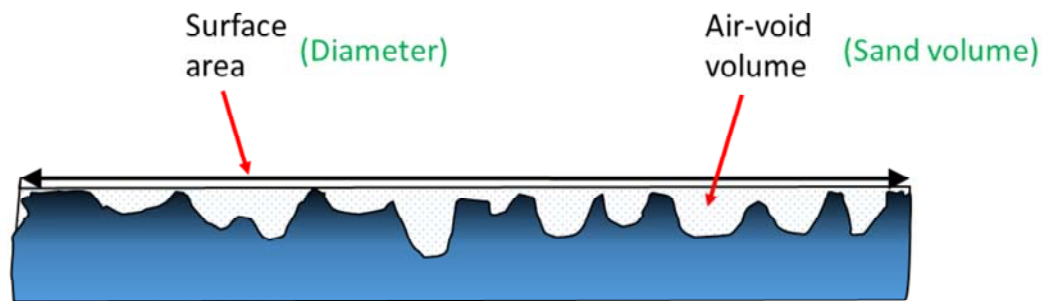


Manual sand patch test method



$$MTD = \frac{4V}{\pi D^2} \times 10^3$$

LCMS sand patch method



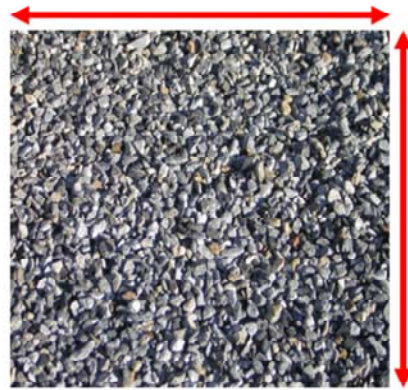
$$MTD = \frac{Volume_{air\ void}}{Surface\ Area}$$

Automatic method MTD = air void volume measured divided by a fixed surface area (approximately 25x25 cm) (rather than round)

Comparison



Known volume



Known area (250mm x 250mm)

Known volume, versus know surface area.

3D texture versus ground truth

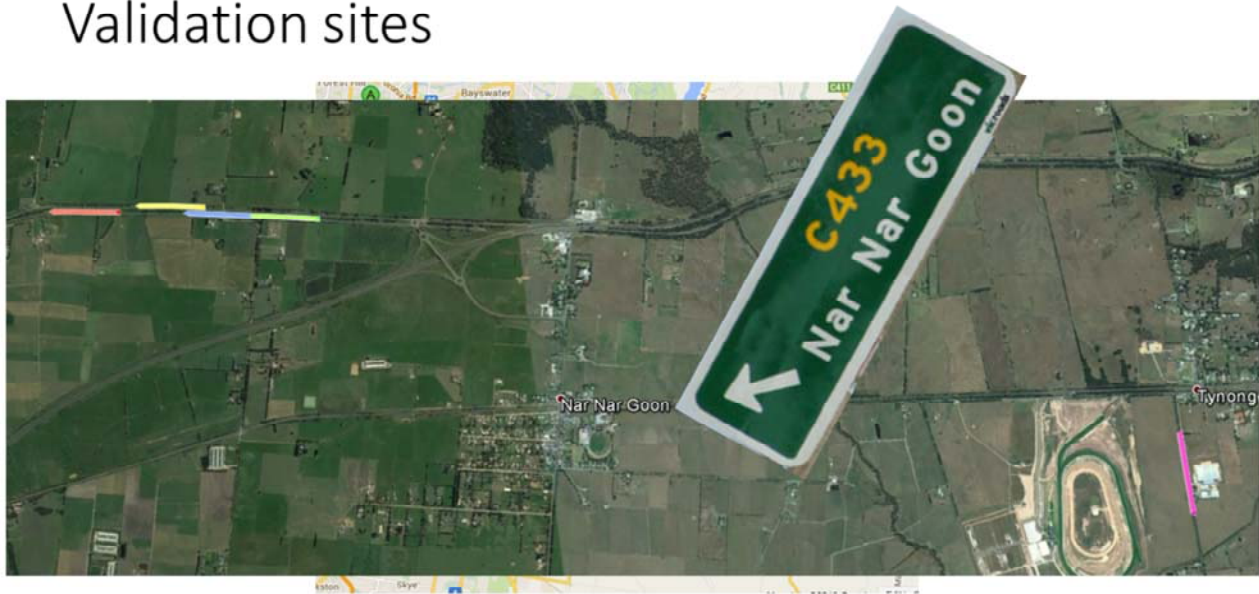


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ARRB has been using 3D systems since 2012. Used a single vehicle, with a profiler on the front and the 3D system on the rear. Removes tracking issues.

Validation sites



12

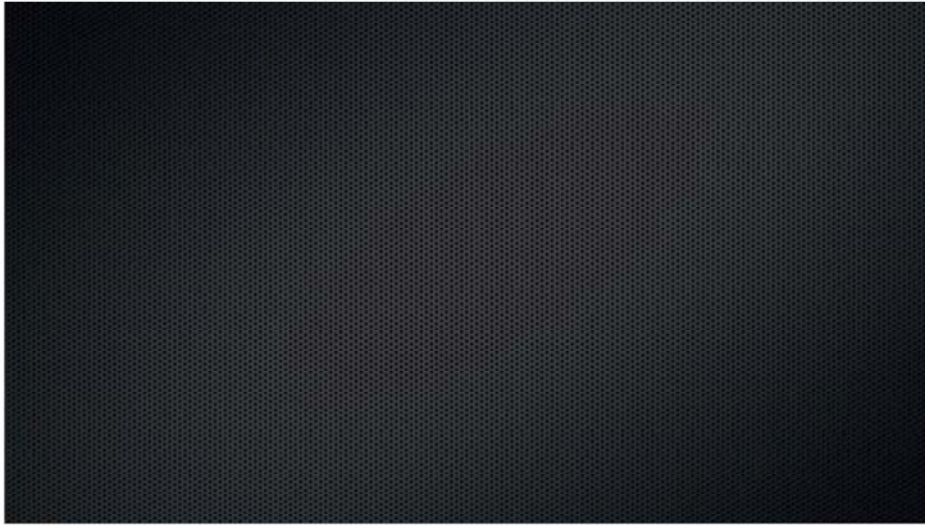
Provide a brief description of validation sites, used for roughness, rutting and texture validation, 500m long, range of texture 1 to 3mm. Tested at 3 speeds – 40, 60 & 80 km/h

Historically.....



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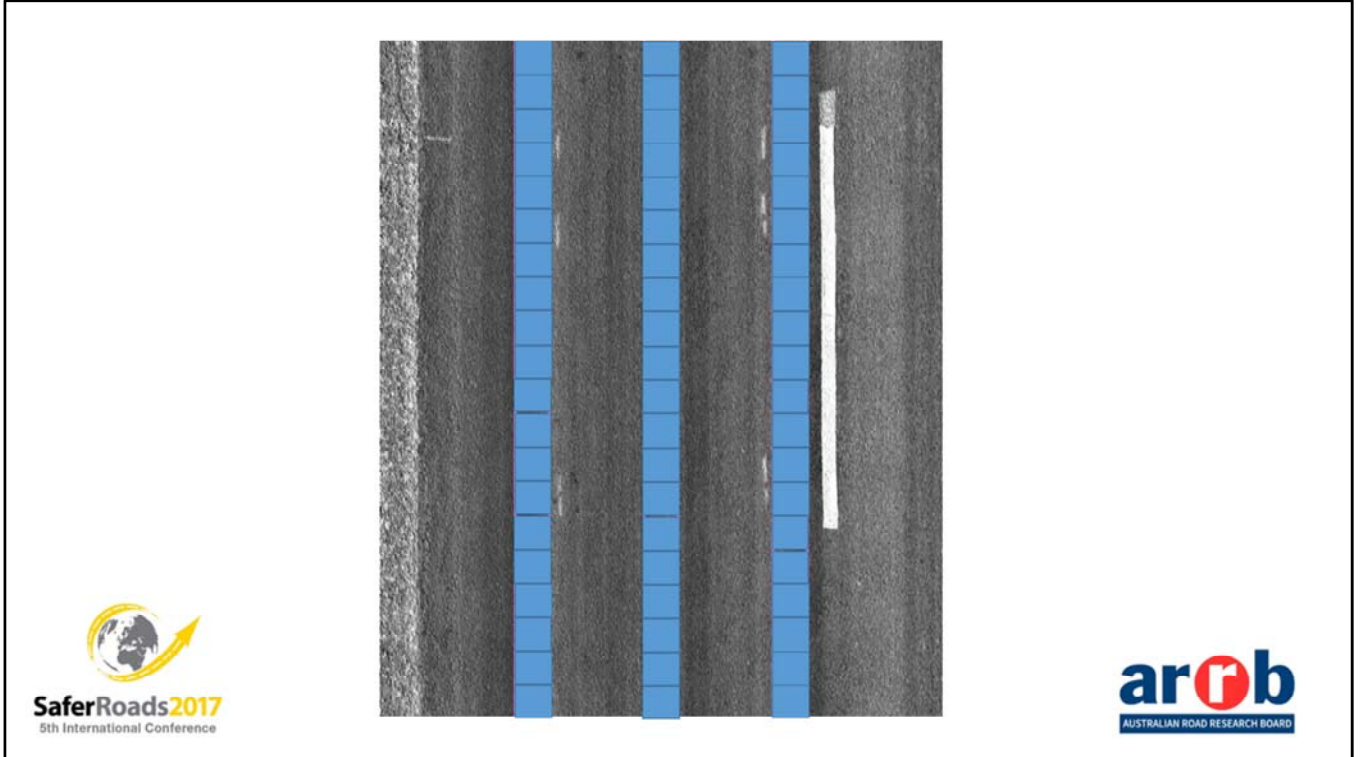
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Validation trial

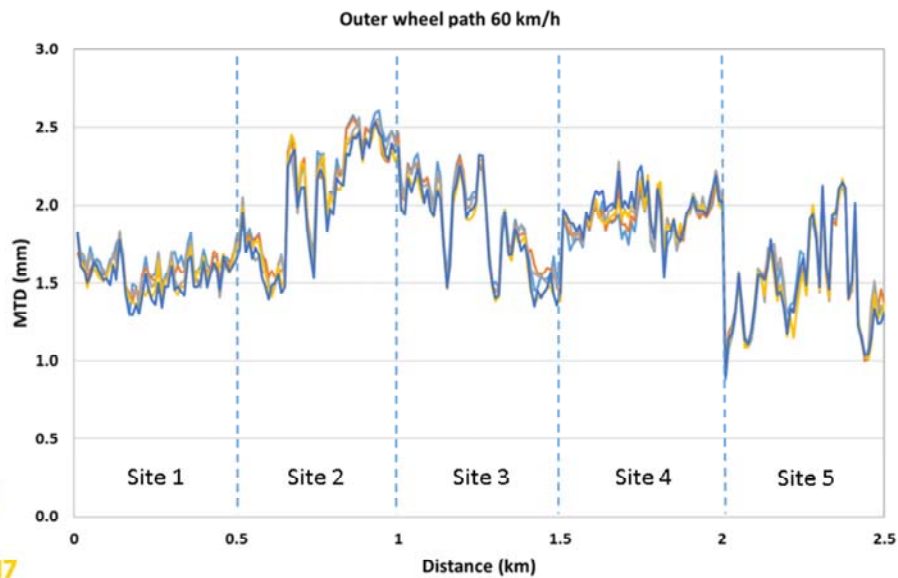


Important to mark out sites correctly



LCMS measurement method

Internal repeatability



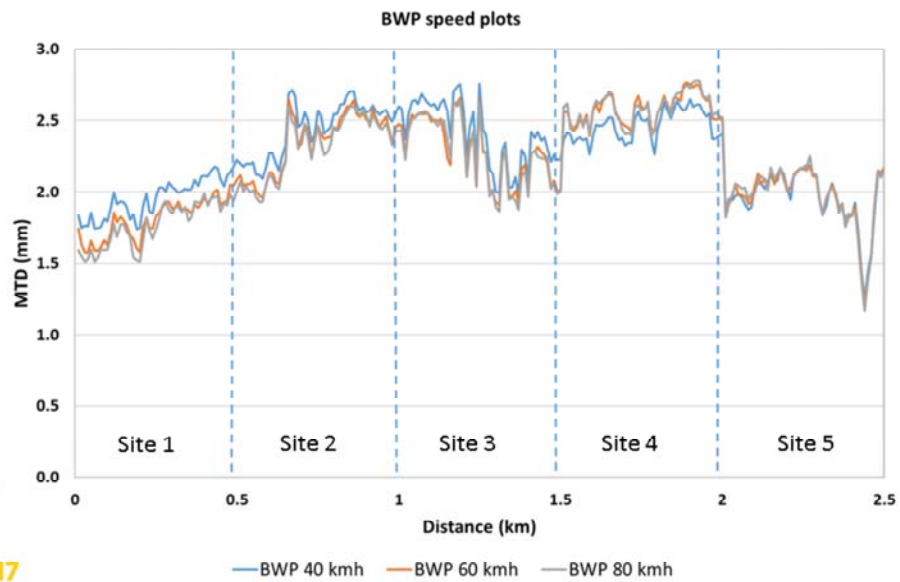
Internal repeatability – typically good, with r -squared > 0.95 , gradients close to 1 and small intercepts

Internal repeatability



Internal repeatability lowest

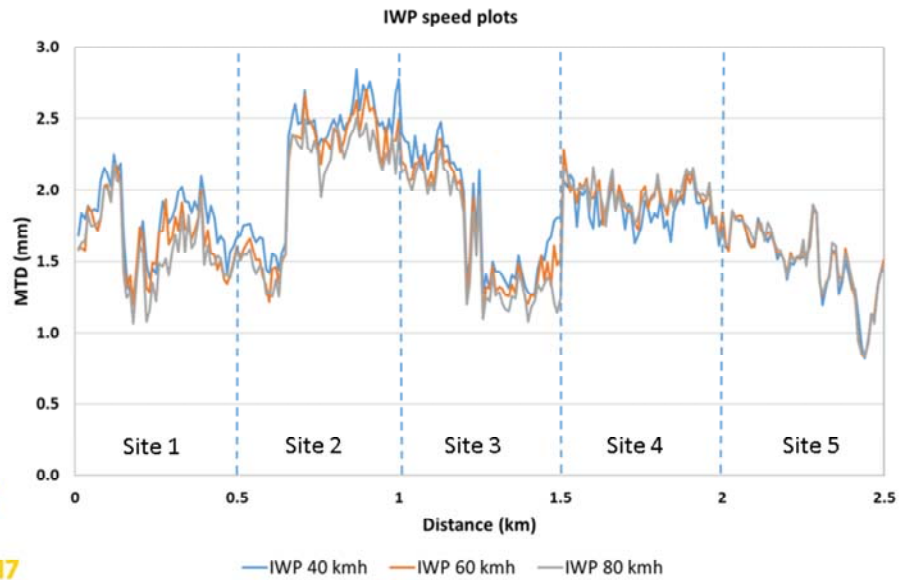
Is there a speed dependency?



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Is there a speed dependency?



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Is there a speed dependency?



Small offset, most evident in outer wheel path over first 4 sites, different surface type

Some statistics – speed comparison

MTD	60 v 40 kmh			60 v 80 kmh		
	IWP	BWP	OWP	IWP	BWP	OWP
r-squared	0.91	0.90	0.81	0.95	0.99	0.98
slope	1.00	0.85	0.99	0.96	1.03	1.00
intercept	0.04	0.39	0.13	0.02	-0.08	-0.01

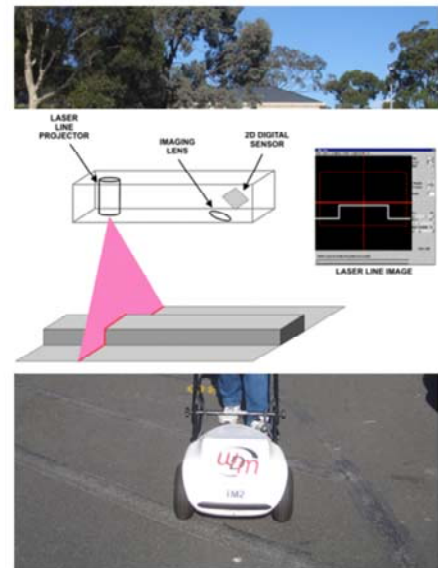
Not too shabby, 60 v 80 kmh the best

Ground-truth comparison

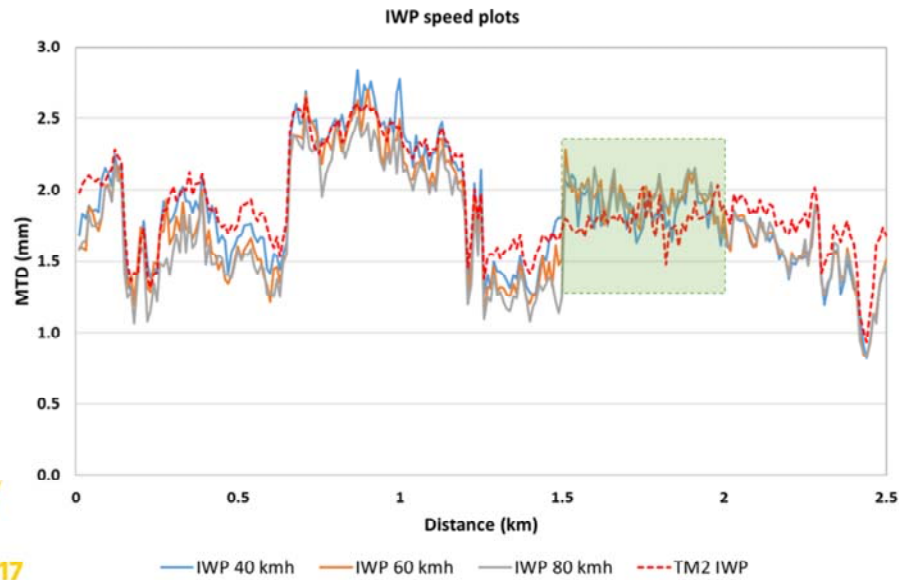
- Reference device: TM2
- Uses a 100mm wide line laser
- Reports MPD every 10m



$$MTD = 0.8 \times MPD + 0.2$$



3D versus ground truth



Follows same trends, highest correlation at 40 km/h

Some more statistics – 3D versus ground-truth

MTD	40 kmh			60 kmh			80 kmh		
	IWP	BWP	OWP	IWP	BWP	OWP	IWP	BWP	OWP
r-squared	0.85	0.94	0.93	0.72	0.85	0.77	0.72	0.85	0.71
slope	1.11	1.02	1.09	1.01	1.09	0.90	0.97	1.13	0.88
intercept	-0.27	-0.09	-0.13	-0.13	-0.30	0.09	-0.10	-0.40	0.12

Observations-1

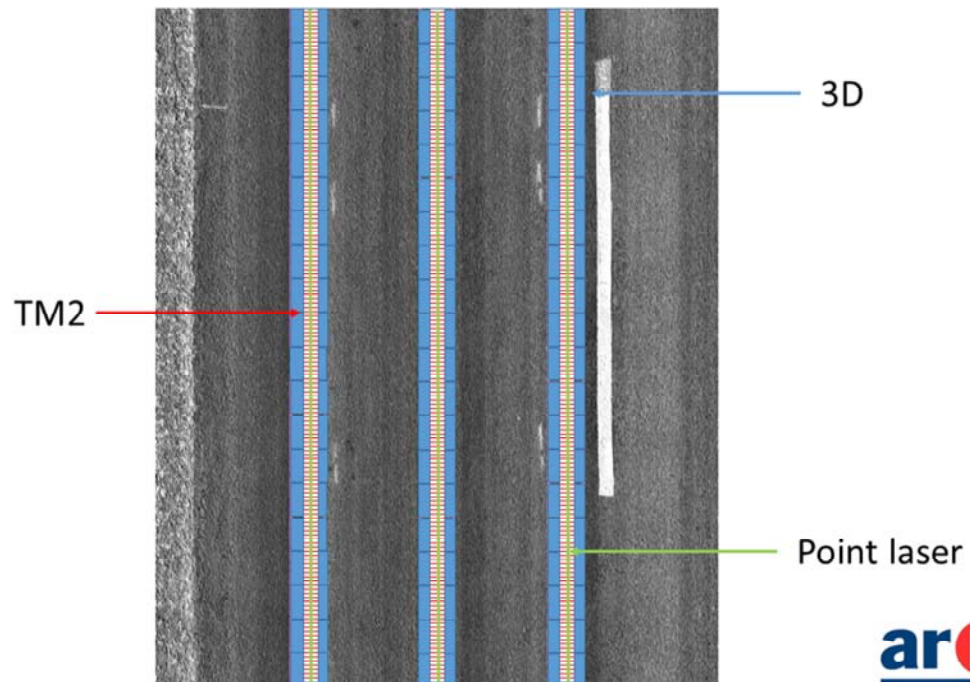
- Good internal repeatability
- Measurements appear to be speed dependant
- Ground truth relationship dependant on accuracy of conversion equation

$$MTD = 0.8 \times MPD + 0.2$$

- Also difference in measurement methods

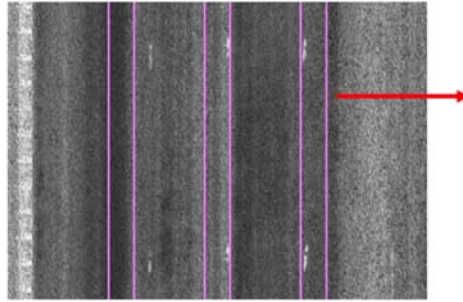


Variation in speed (possibly surface dependent)



Observations-2

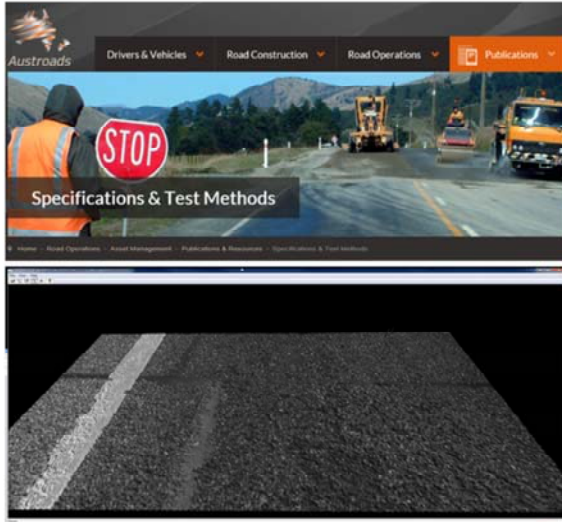
- Driver tracking
(increased lateral
wander at low speeds)
- Compounded by
variations in surface
texture across lane



Insert picture of road surface

Conclusions & future work

- Looks promising
- Compare outputs against point laser systems
- Assess performance in accord with Austroads test methods
- Investigate other outputs
 - ravelling



Above image courtesy of Pavemetrics

Thank you for listening

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