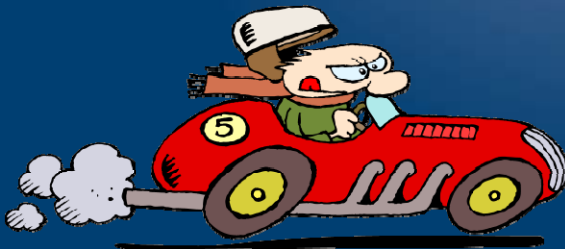


# Traditional versus new: Smartphone versus profiler

by Richard Wix



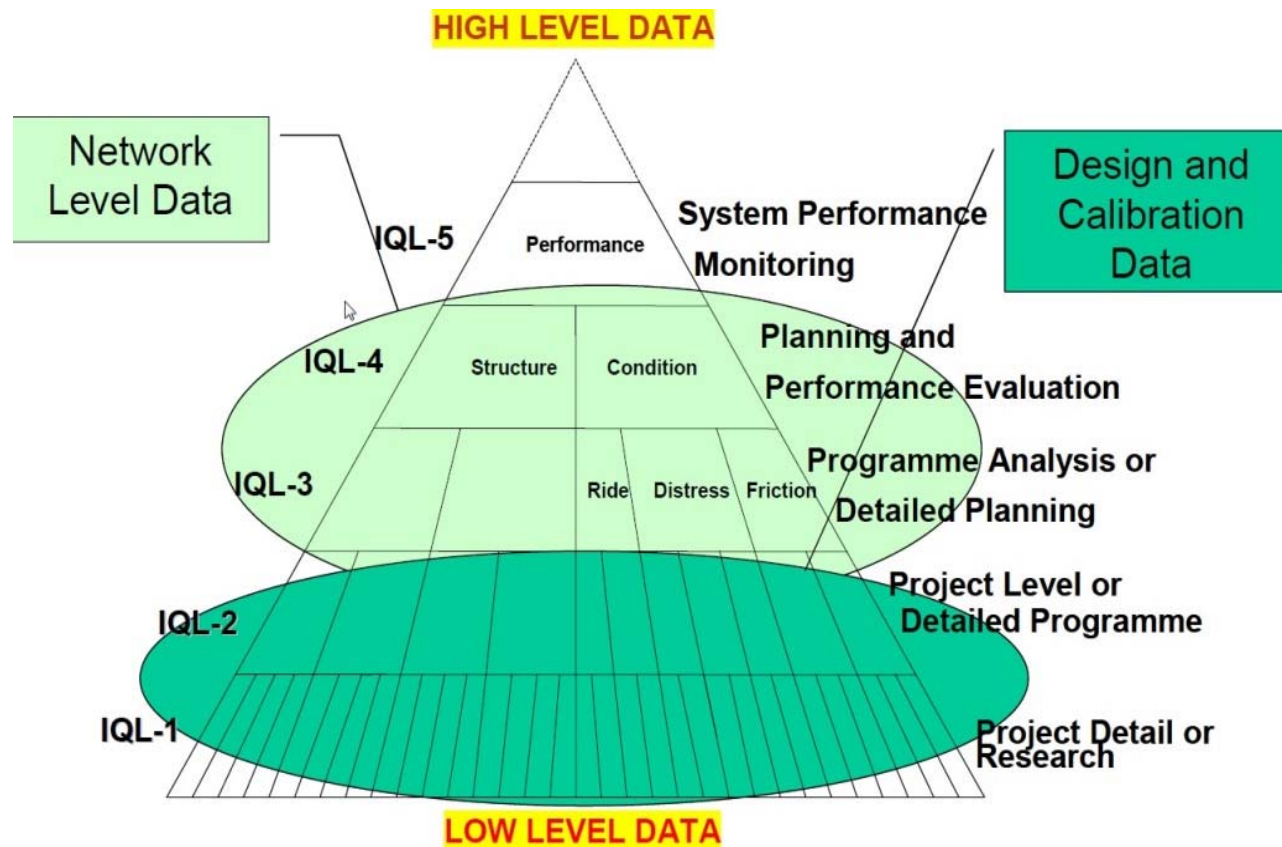
**arob**  
GROUP



RPUG , San Diego  
3 November 2016

Trusted advisor to road agencies

# Information quality levels

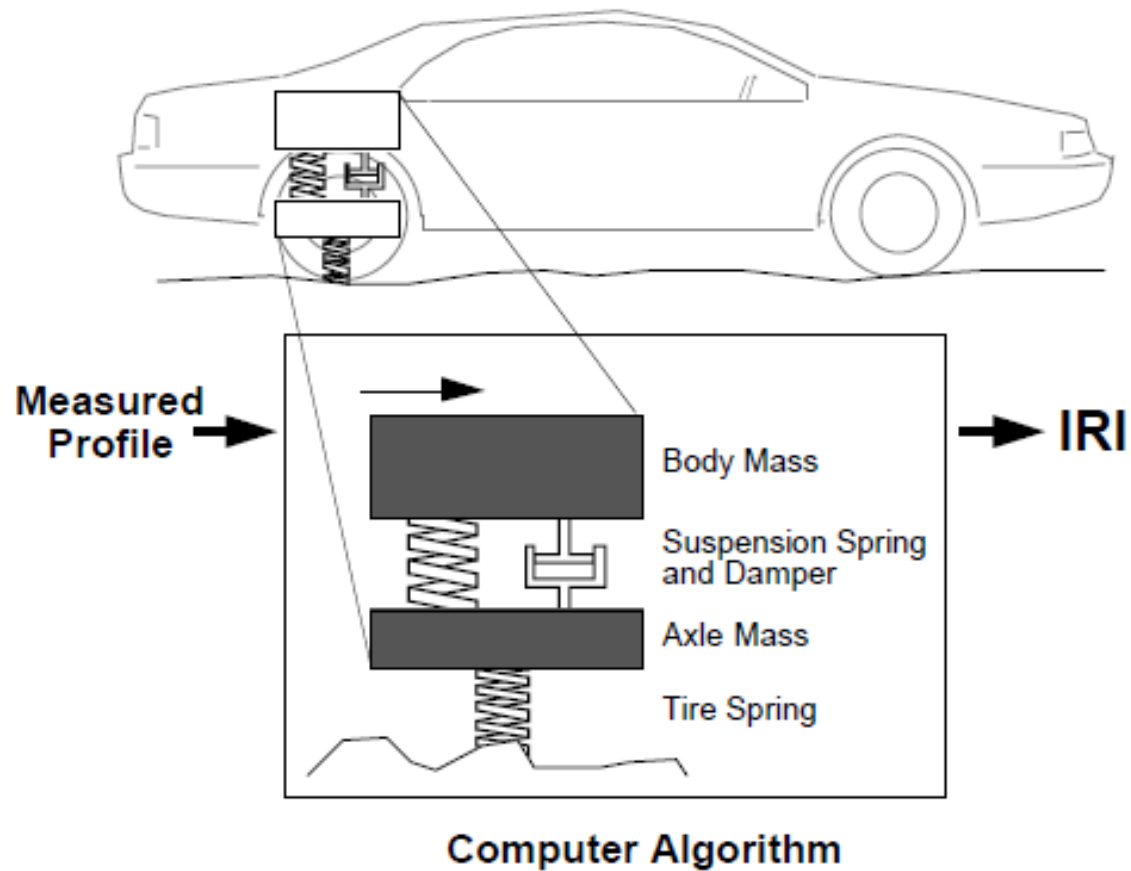


# Roughness (smoothness)

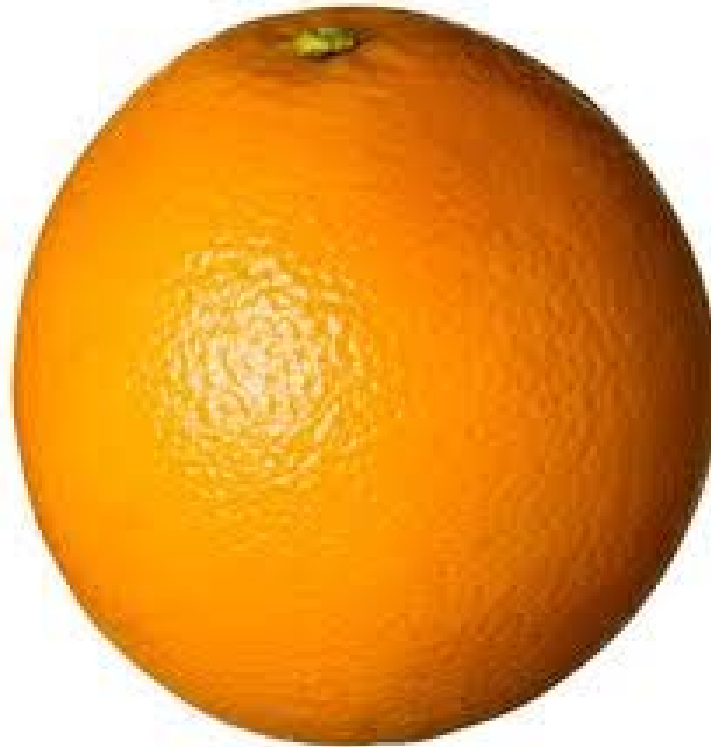
*the deviations of a surface from a true planar surface with characteristic dimensions that affect vehicle dynamics, ride quality, dynamic loads, and drainage, for example, longitudinal profile, transverse profile, and cross slope (ASTM 2015).*



# International roughness index (IRI)



Need to ensure....



# Inertial profiler



1. I

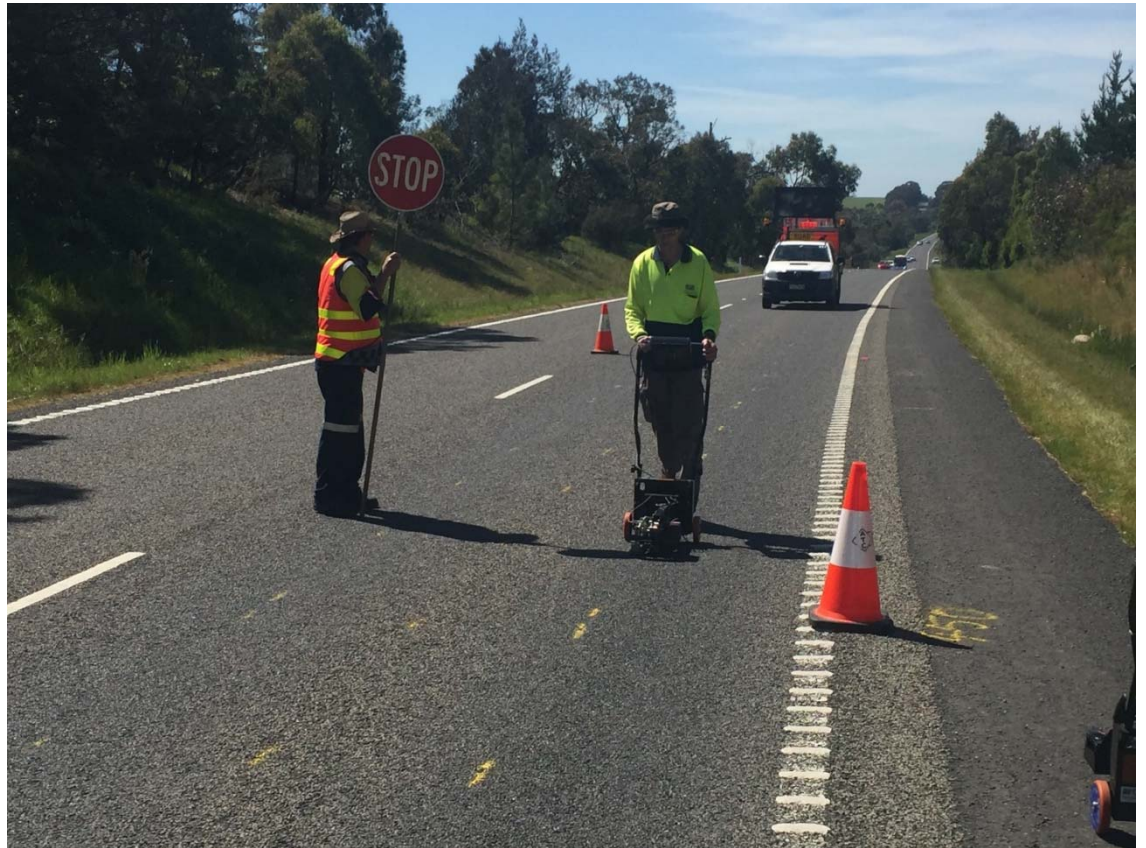
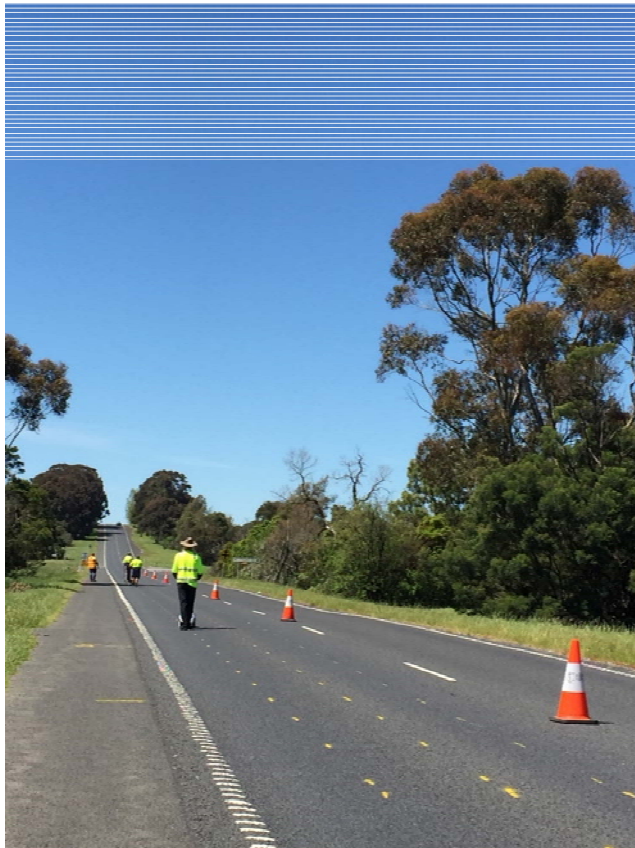
surin

**AUSTROADS TEST METHOD AG:AM/T002**

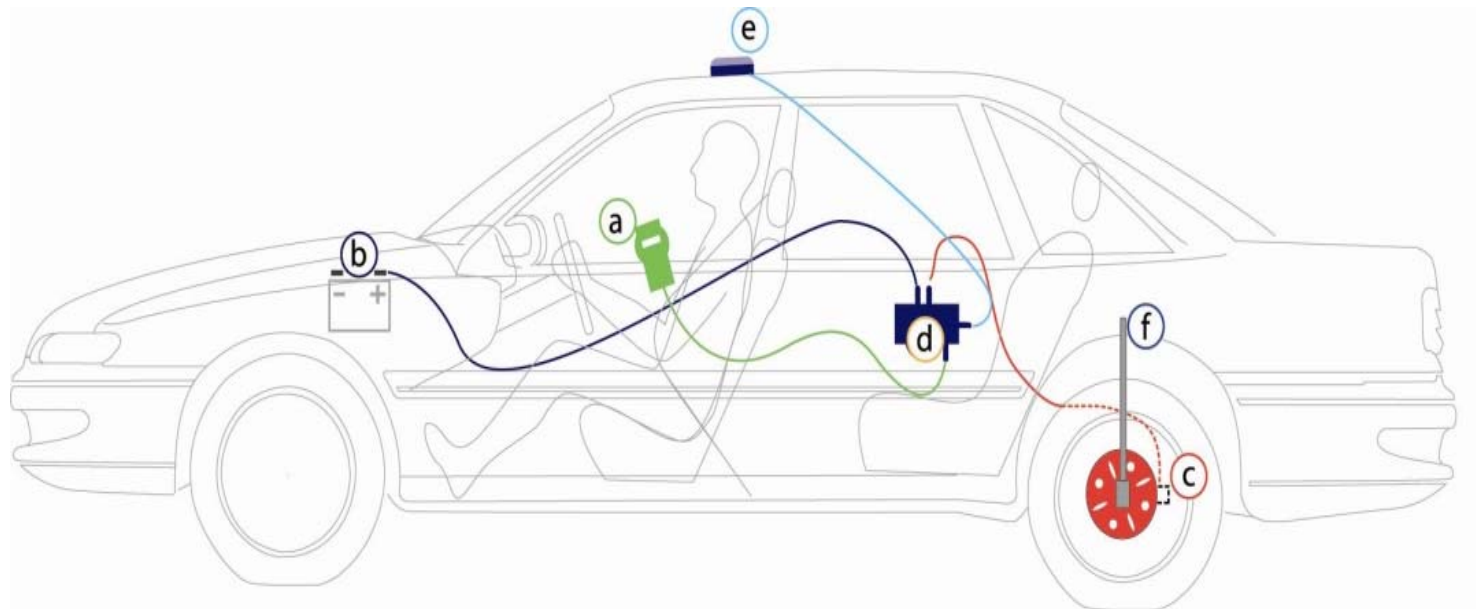


Validation of an Inertial Profilometer for Measuring  
Pavement Roughness (Reference Device Method)

# Ground truth measurements



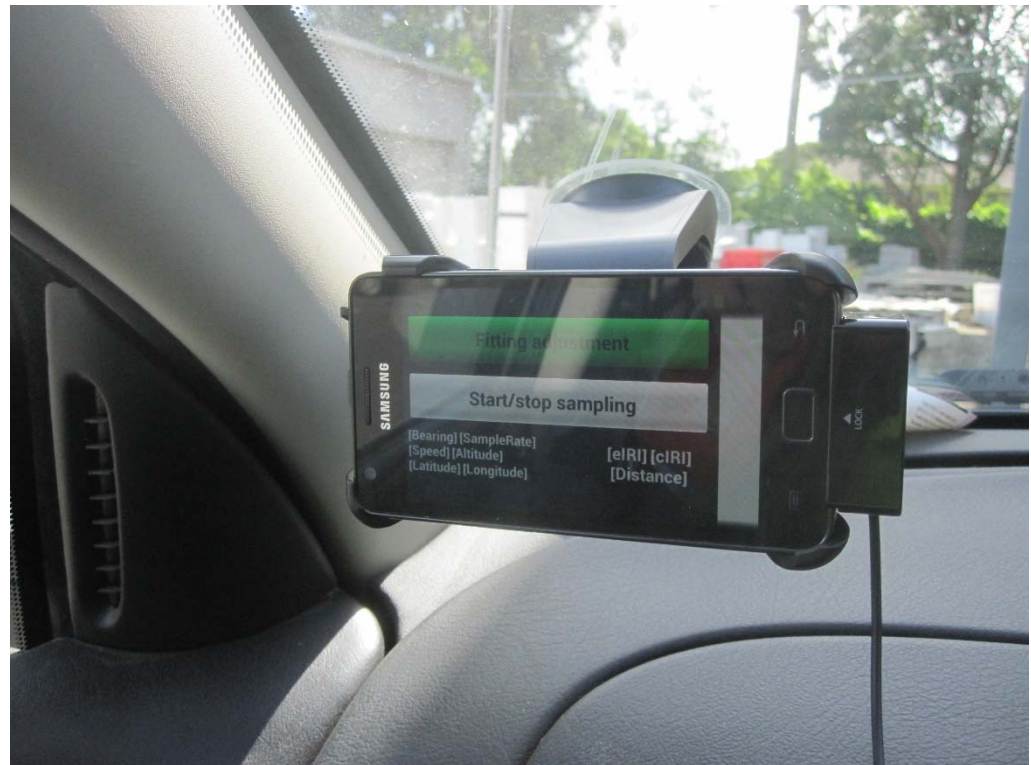
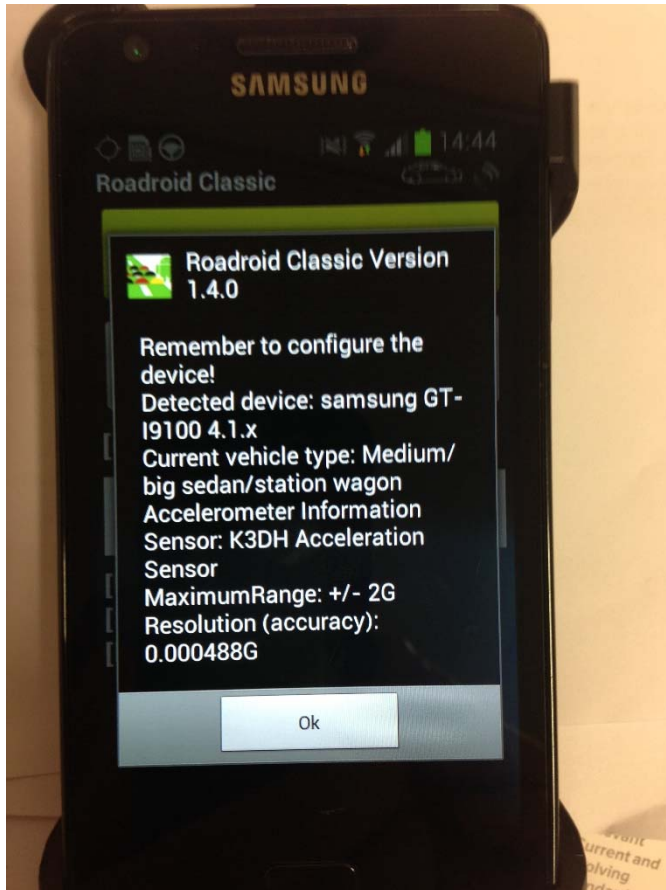
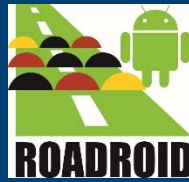
# Roughometer III



- (a) Hand-held controller
- (b) Power supply
- (c) Inertial sensor on axle
- (d) Interface module
- (e) GPS receiver
- (f) DMI



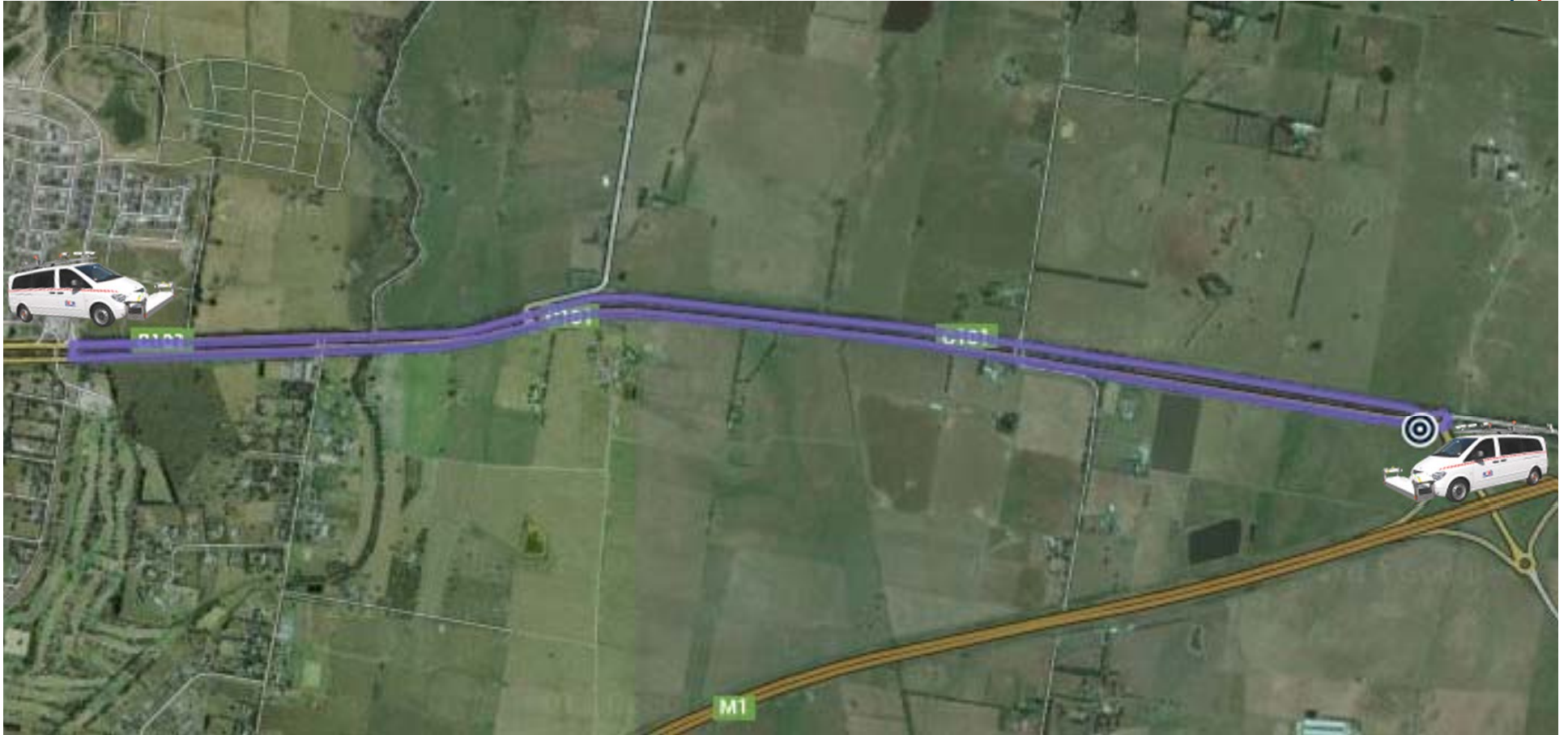
# Smartphone App



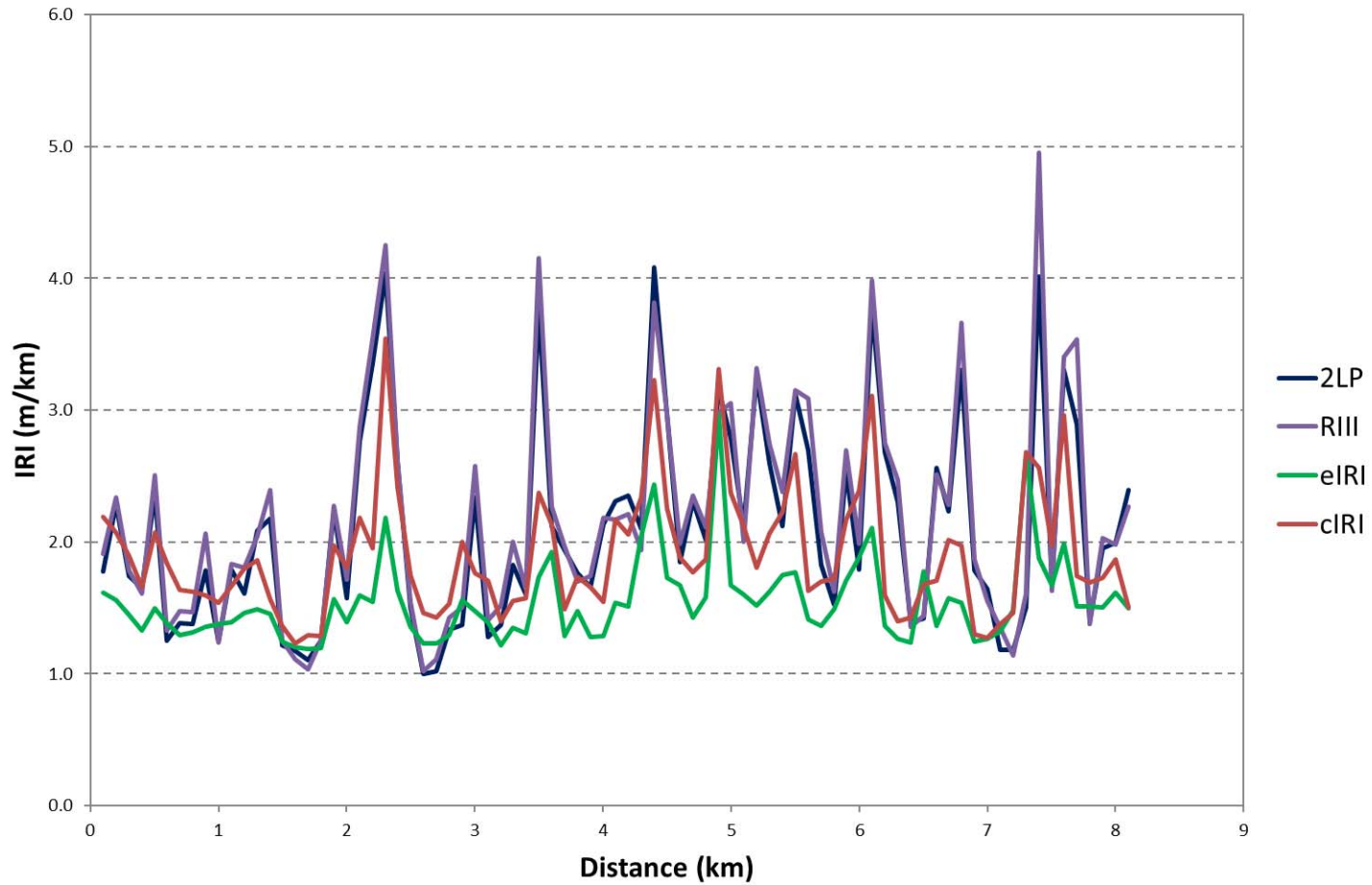
# Test sites

Site Number	Location	Test speeds (km/h)	Sealed/Unsealed	Length (km)
1	Nar Nar Goon repeatability loop	60, 80, 100	Sealed	8.8
2	Nine Mile Road	40, 60, 80	Sealed	1.5
3	Convent Road	40, 60	Unsealed	3.9
4	Daly Road	40	Unsealed	2.8

# The trial



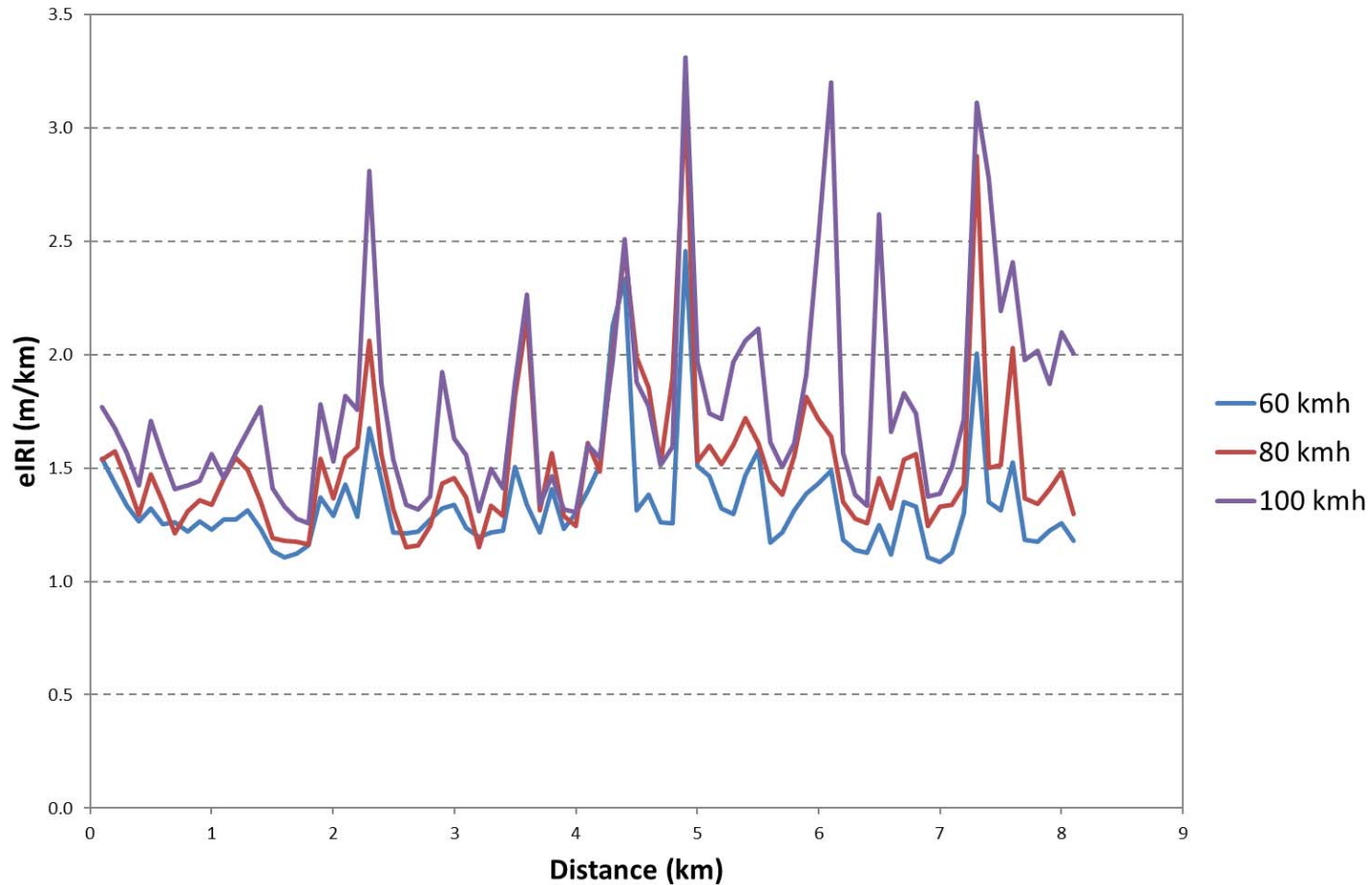
# Reproducibility



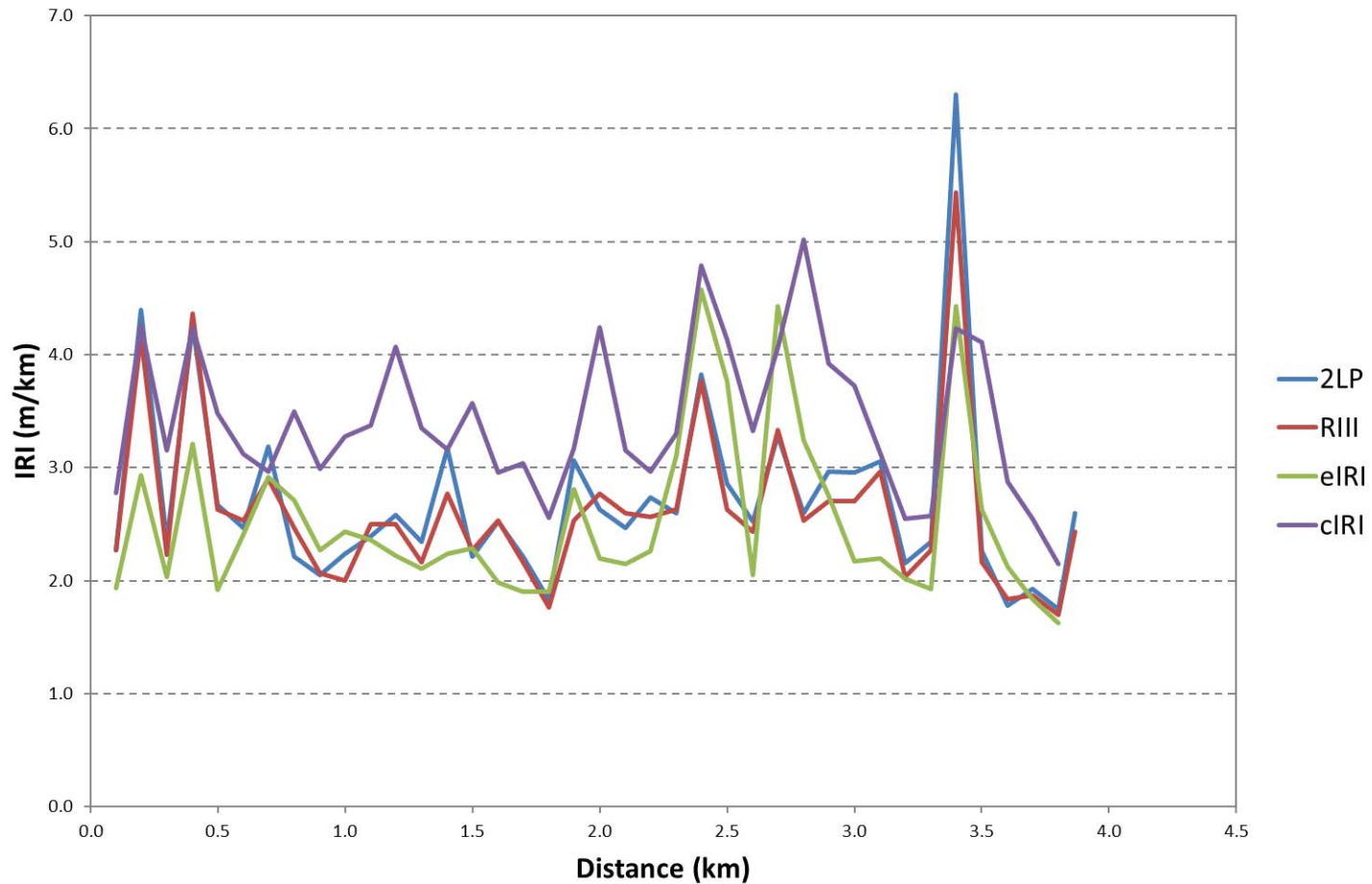
# Reproducibility (accuracy) statistics

Site	Speed (km/h)	Statistics	Roughometer III	Smartphone	
				eIRI	cIRI
Nar Nar Goon	60	$r^2$	0.98	0.19	0.40
		Slope & intercept	0.98, 0.03	0.14, 1.05	0.33, 0.90
	80	$r^2$	0.96	0.22	0.38
		Slope & intercept	1.05, -0.03	0.21, 1.08	0.42, 1.03
	100	$r^2$	0.93	0.31	0.55
		Slope & intercept	1.18, -0.17	0.33, 1.08	0.60, 0.95

# IRI variation with speed for Smartphone



# Reproducibility (accuracy)



# Reproducibility (accuracy) statistics

Site & direction	Speed (km/h)	Statistics	Rougho III	Smartphone	
				eIRI	cIRI
Convent Road (EB)	40	r <sup>2</sup>	0.89	0.12	0.06
		Slope & intercept	0.98, 0.08	1.17, 1.94	0.36, 2.91
	60	r <sup>2</sup>	0.96	0.53	0.39
		Slope & intercept	0.99, -0.03	0.77, 0.51	0.57, 1.78
Convent Road (WB)	40	r <sup>2</sup>	0.89	0.14	0.10
		Slope & intercept	0.86, 0.39	1.10, 3.14	0.43, 3.15
	60	r <sup>2</sup>	0.95	0.50	0.32
		Slope & intercept	0.86, 0.29	0.62, 0.85	0.44, 2.22



# Repeatability

Site	Speed (km/h)	Statistic	2LP	Rougho III	Smartphone	
					eIRI	cIRI
Nar Nar Goon loop	60	r <sup>2</sup>	0.98	0.98	0.86	0.86
		COV (%)	4	4	5	9
	80	r <sup>2</sup>	0.98	0.98	0.88	0.87
		COV (%)	4	5	7	10
	100	r <sup>2</sup>	0.98	0.97	0.88	0.89
		COV (%)	5	5	7	9

**AUSTROADS TEST METHOD AG:AM/T004**

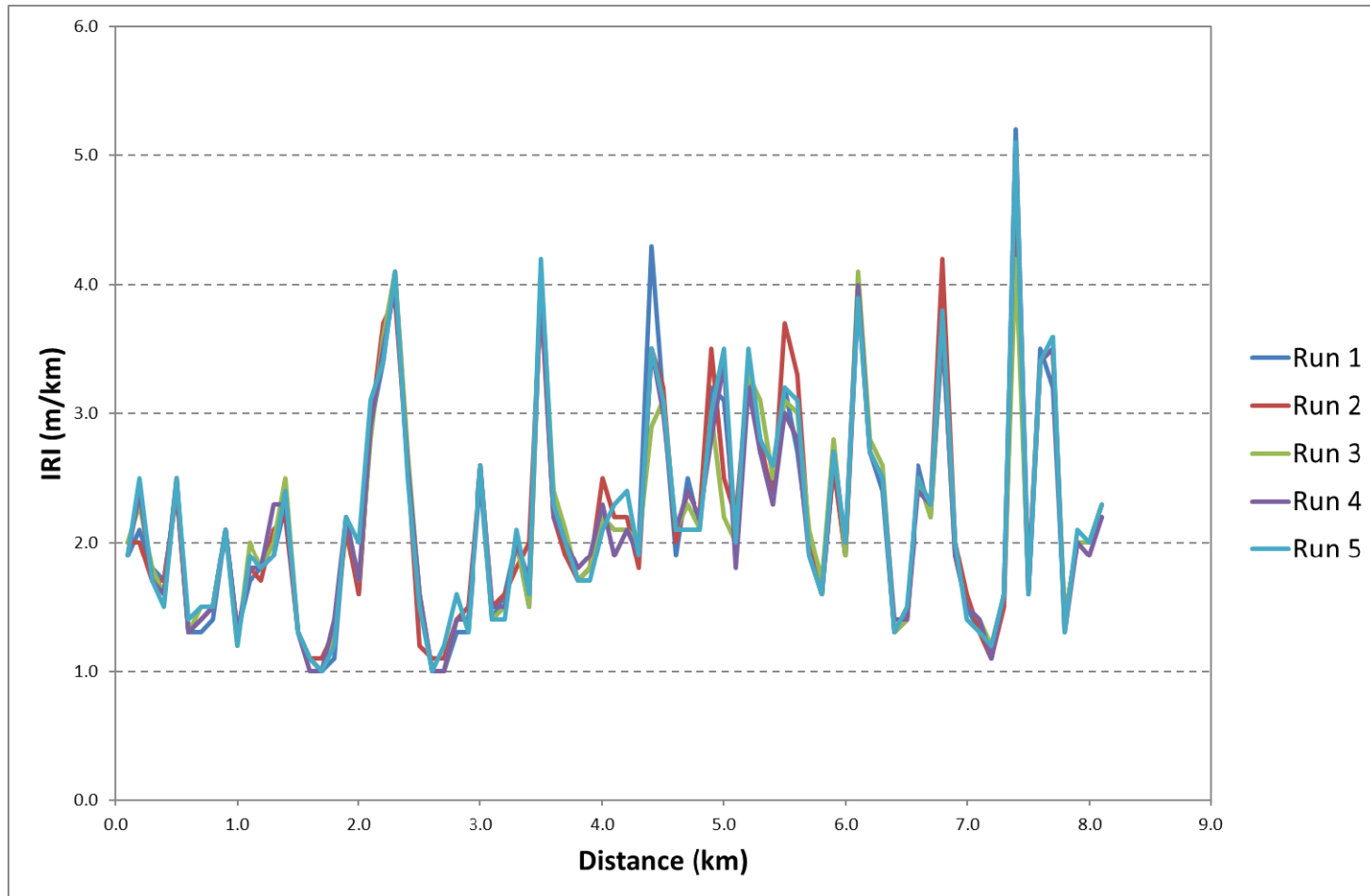


Pavement Roughness Repeatability and Bias Checks for an Inertial Profilometer

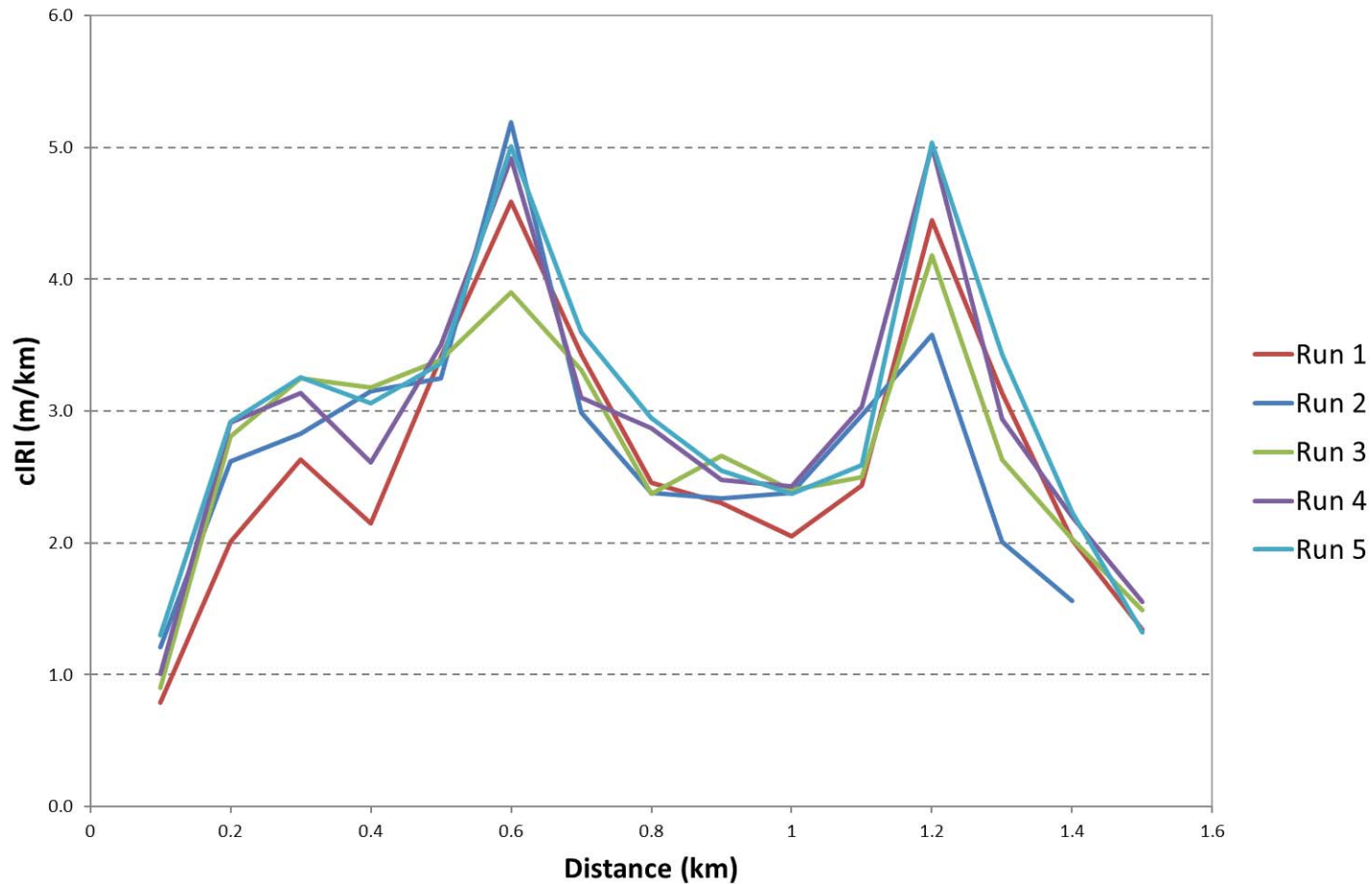


[arrb.com.au](http://arrb.com.au)

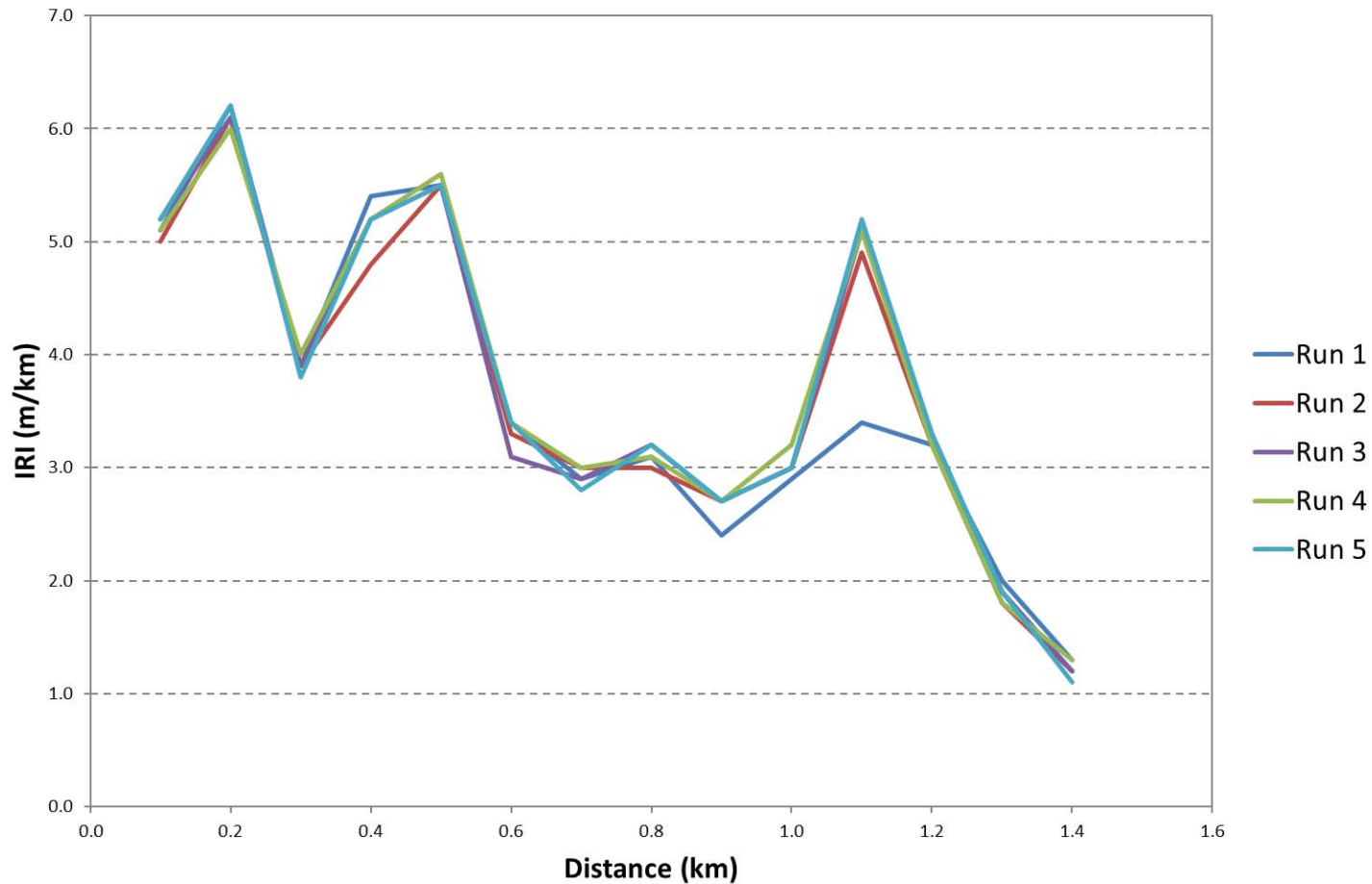
# Repeatability - RIII



# Repeatability - RoadRoid



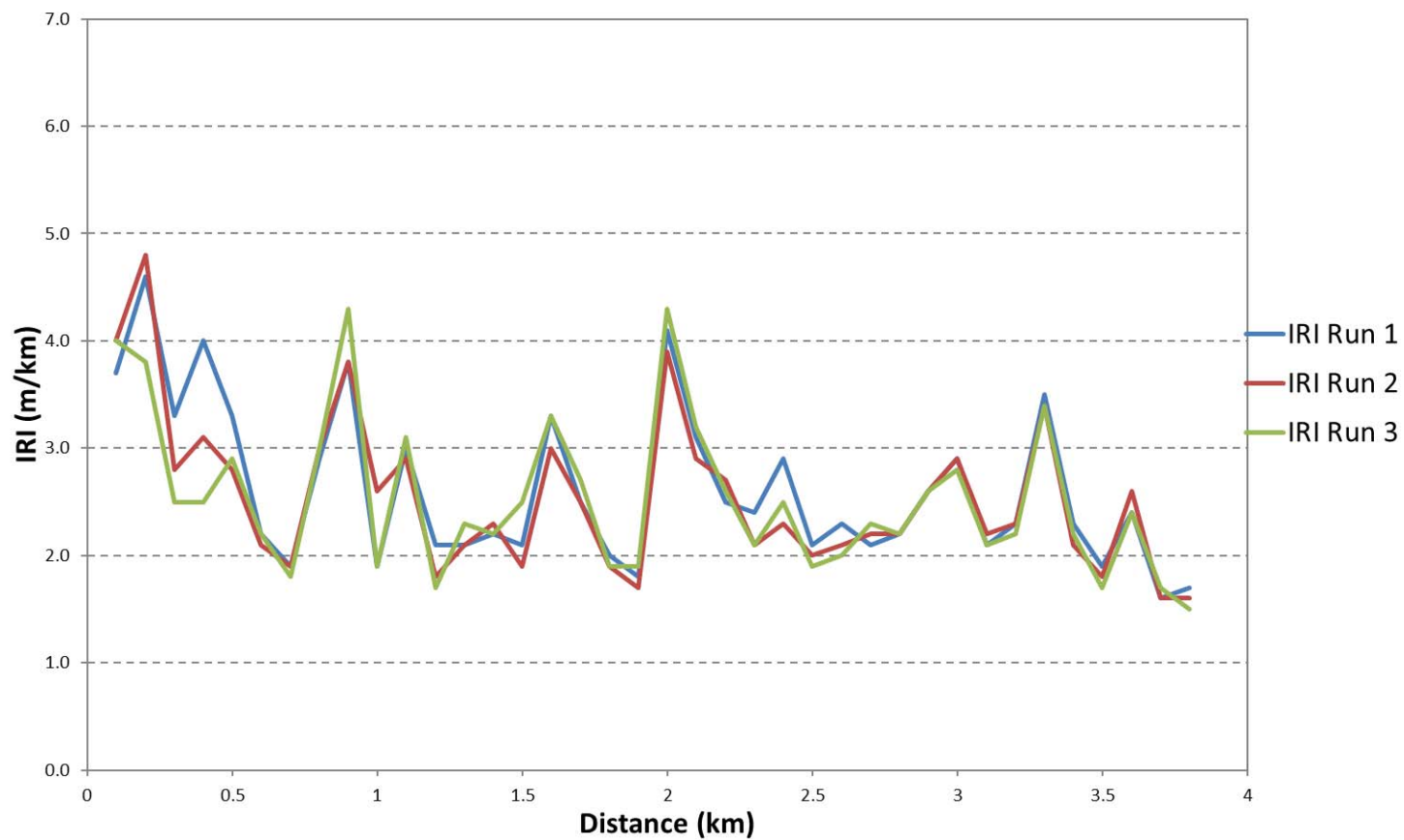
# Repeatability - RIII



# Repeatability

Site	Speed (km/h)	Statistic	2LP	Roughometer III	Smartphone	
					eIRI	cIRI
Nine Mile Road (SB)	40	r <sup>2</sup>	0.99	0.99	0.86	0.88
		COV (%)	3	4	4	8
	60	r <sup>2</sup>	1.00	1.00	0.94	0.88
		COV (%)	2	2	4	8
Nine Mile Road (NB)	60	r <sup>2</sup>	1.00	1.00	0.93	0.92
		COV (%)	3	2	5	9
	80	r <sup>2</sup>	0.99	0.98	0.94	0.91
		COV (%)	4	4	9	11

# Repeatability - Roughometer III



# Corrugations

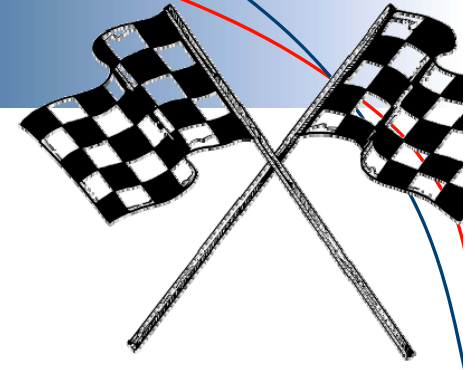


# Comparing factors

Device	Reproducibility	Repeatability	Portability	Functionality	Distance
Smartphone	3	3	1	2	3
Roughometer	2	2	2	3	1
Inertial profiler	1	1	3	1	1



And the winner is.....



# But.....



Or.....



Or maybe.....

**RACV** *we're there for you*



*your no1 motoring friend*



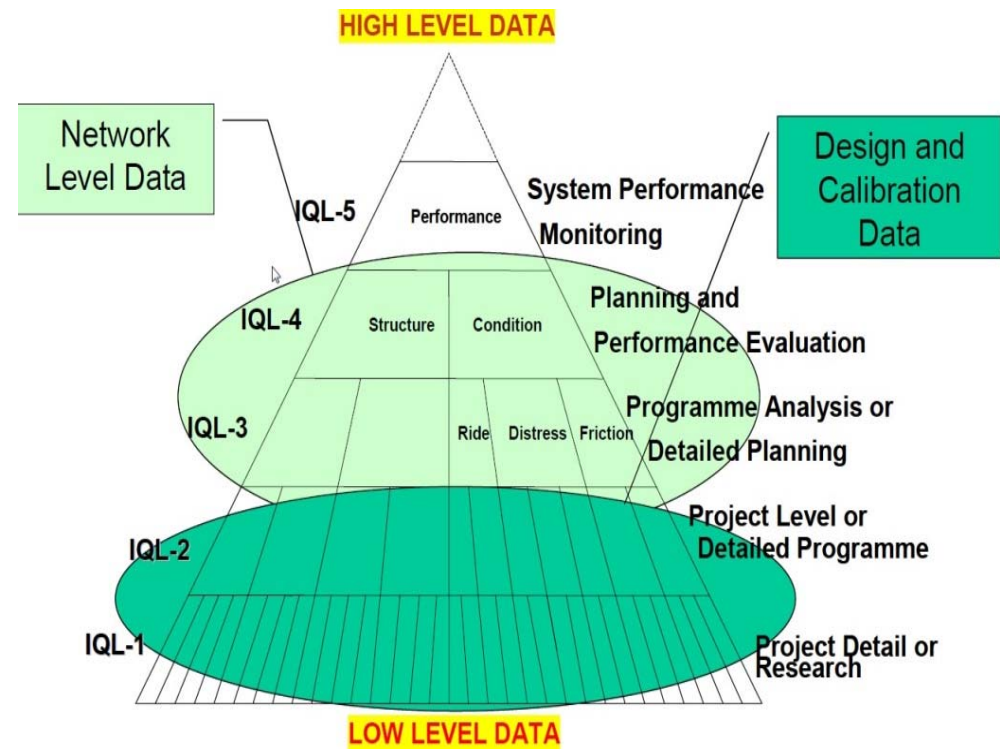
# However, if I'm interested in.....

- Measuring IRI
- Accuracy
- Repeatability
- Deterioration modelling
- Distribution of funding
- Monitoring trends
- Quality control

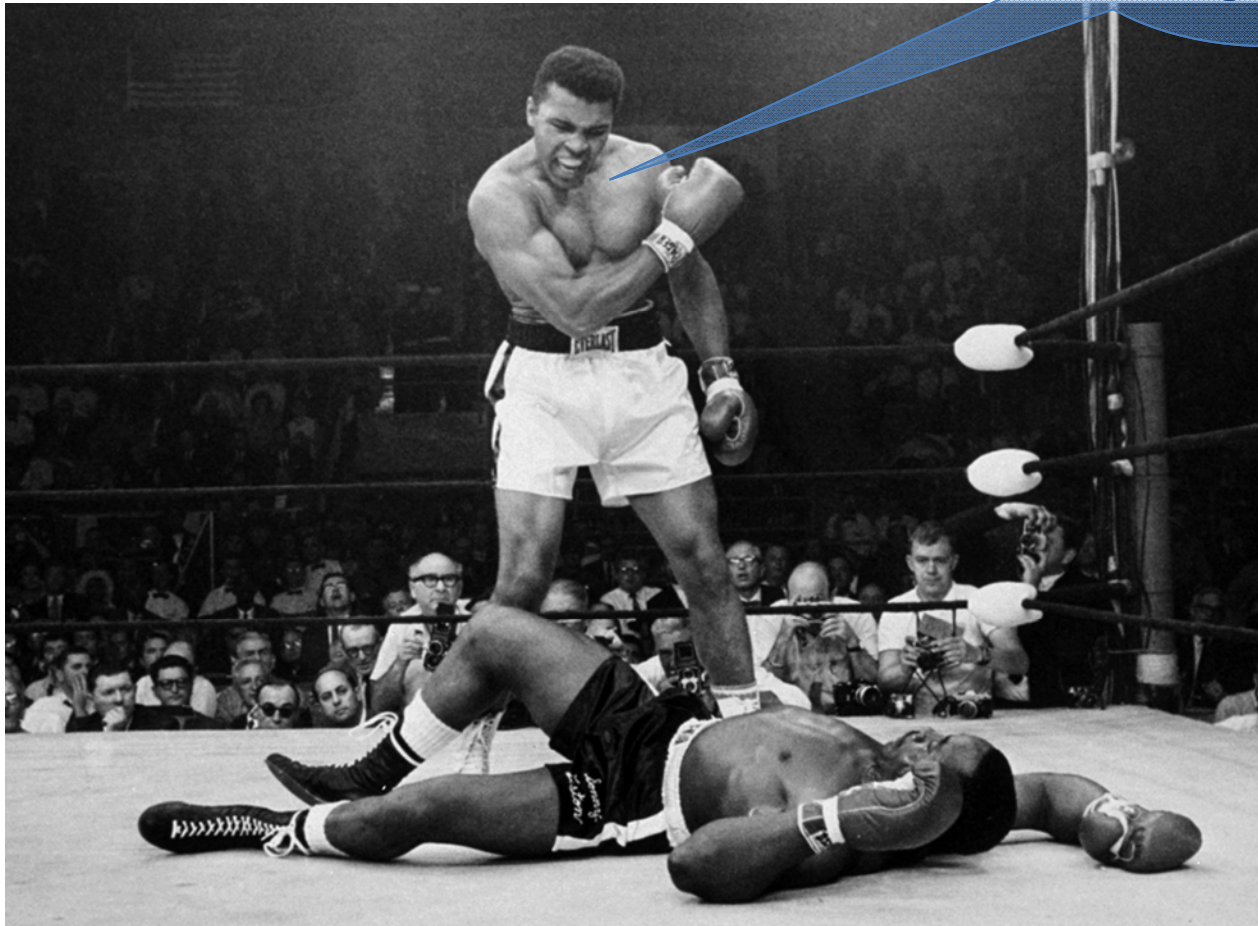


# Conclusions

- Laser profiler: IQL1/2
- Roughometer: <IQL3
- RoadRoid: IQL4/5



Inertial  
profilers are  
the greatest!



# Thank you



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