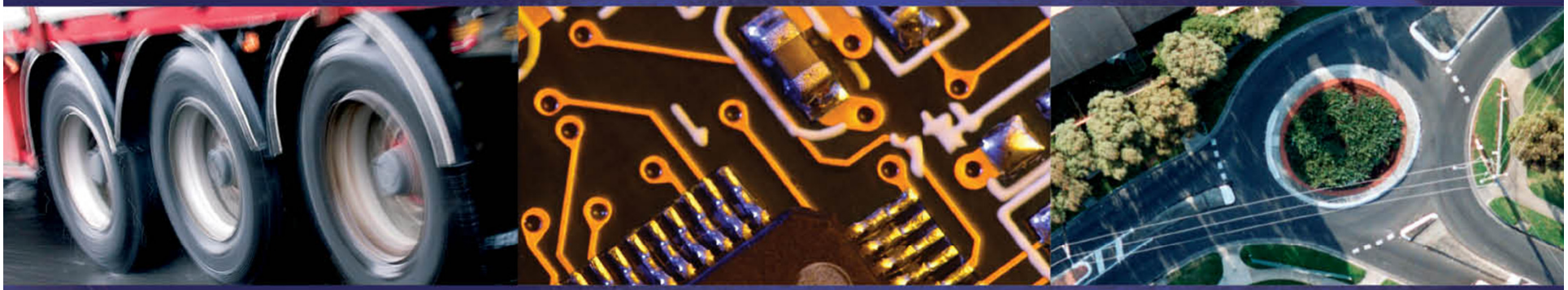


Pavement Evaluation 2010

October 25-27, 2010 ▼ Roanoke, Virginia

How coarse was my texture?

Richard Wix & Roland Leschinski, ARRB Group

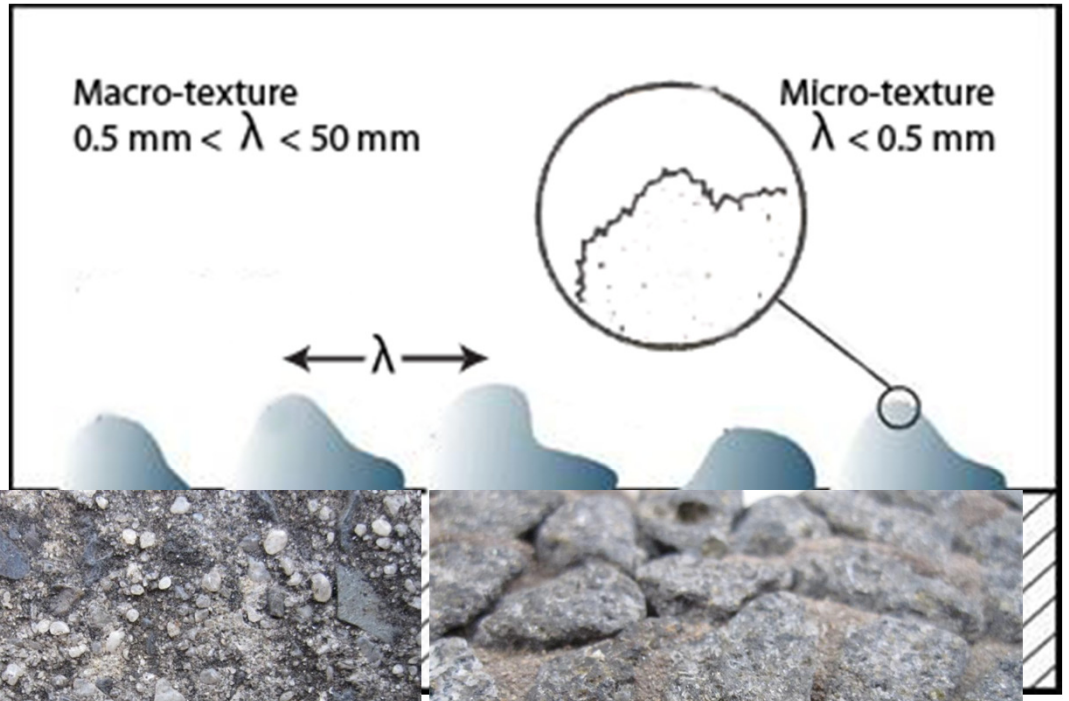
Overview of presentation

- Section 1 – Background
  - What is texture?
  - The quandary
  - A solution
- Section 2 – Results
  - A tale of five lasers
  - Outcomes
  - Where to from here?

Section 1: What is texture?

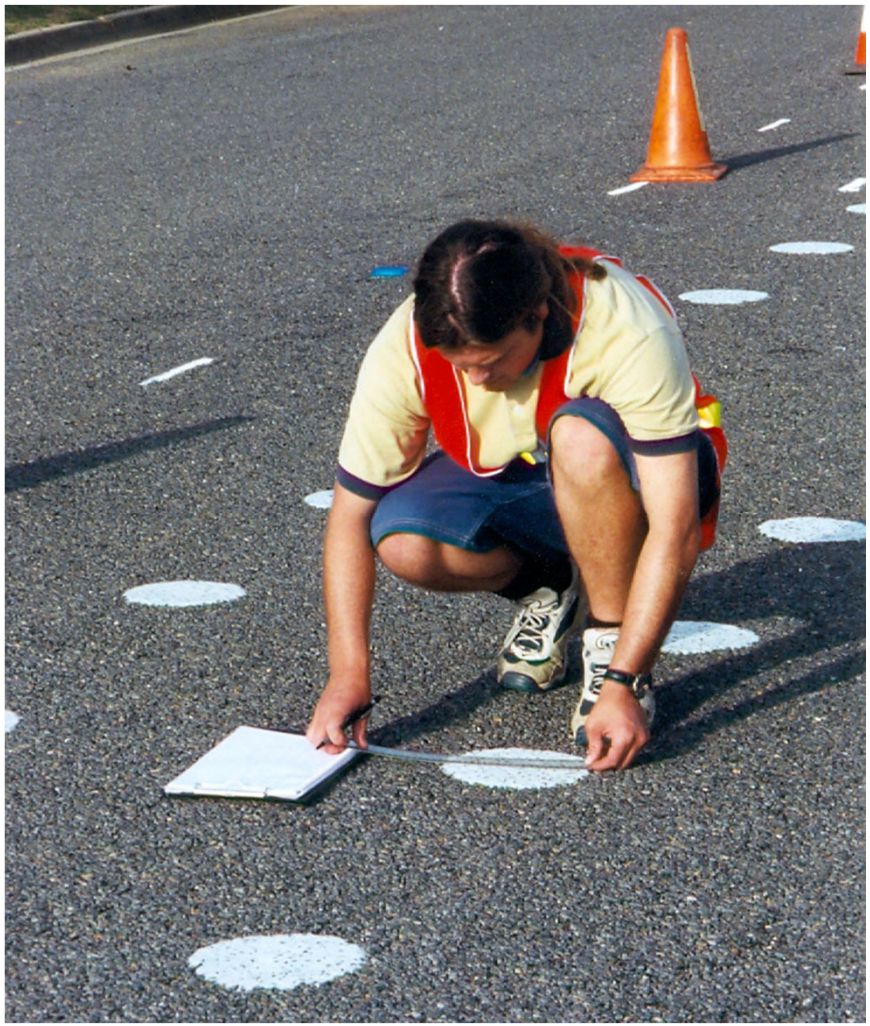
Texture is categorised by wavelength

- micro
- macro
- mega

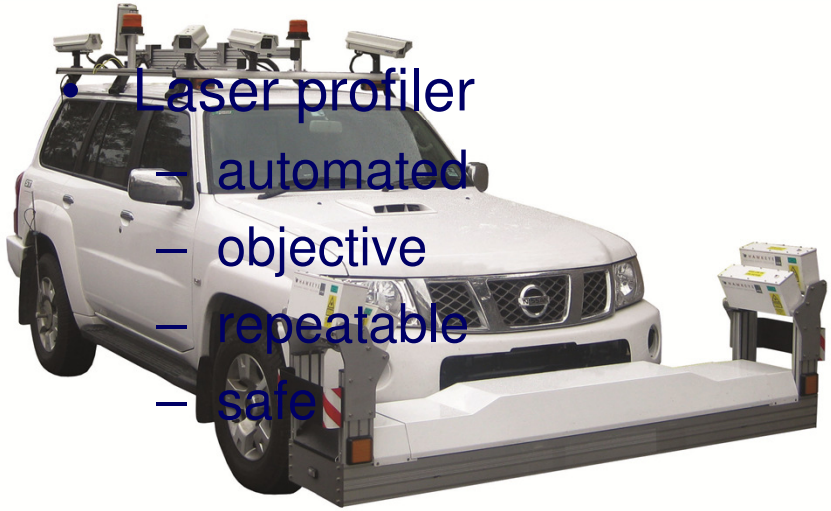


How do we measure texture?

- Project level
  - manual
  - safety issues
  - subjective



How can we measure texture faster?

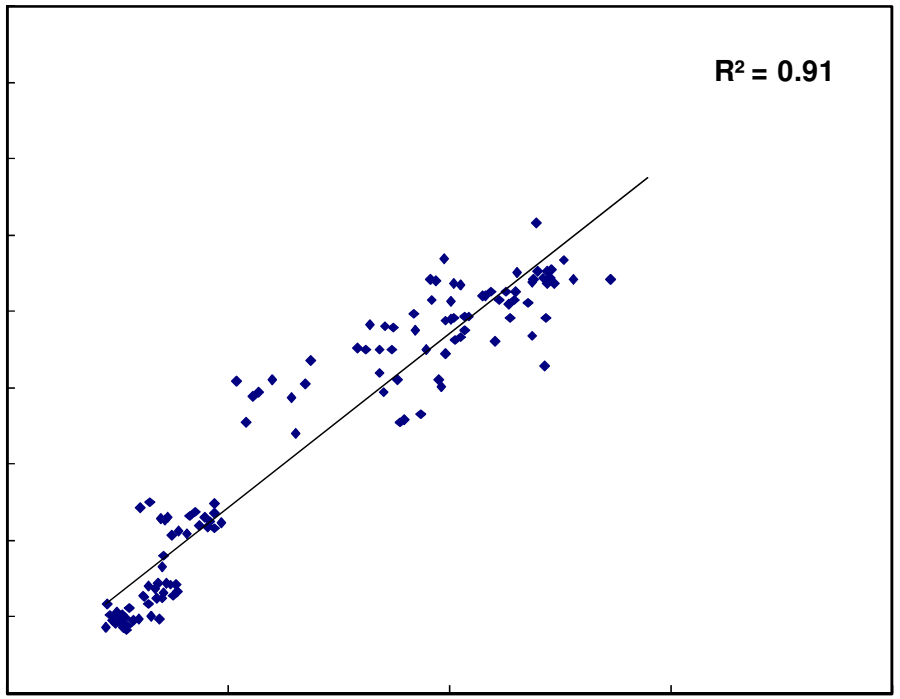


- Laser profiler
  - automated
  - objective
  - repeatable
  - safe

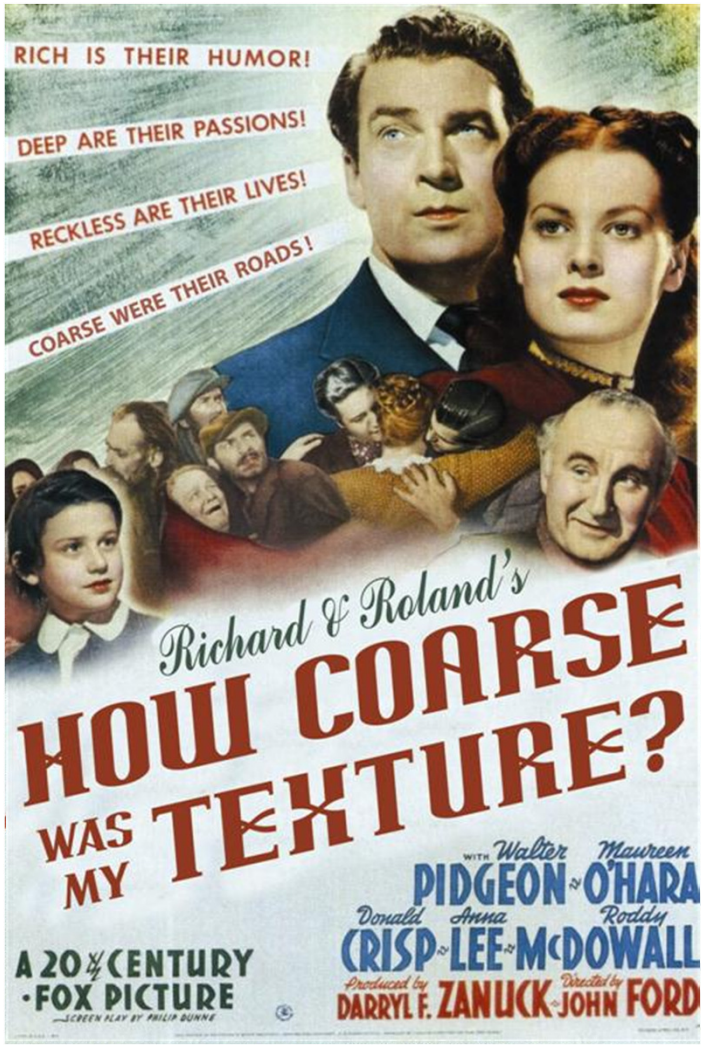
- Outputs
  - mean profile depth (MPD)
  - sensor measured texture depth (SMTD)

Texture verification

- Various sites & equipment
  - expensive
- Outcome
  - linear relationships
- Observation
  - variation in relationships



The quandary



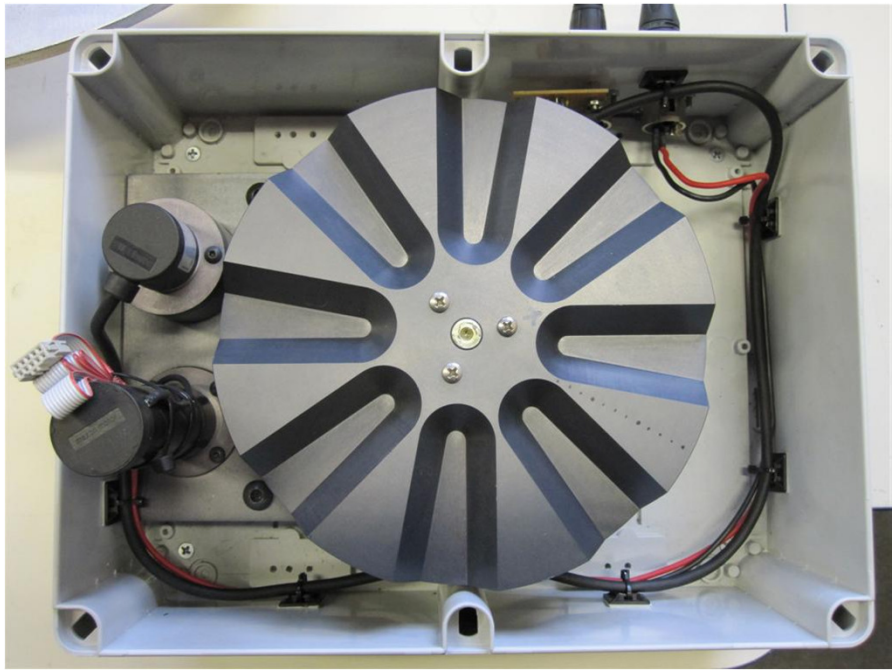
In a nut shell….

There is a lack of a verification procedure that provides an absolute ground truth measurement of texture that is

- traceable
- verifiable
- precise
- accurate etc.

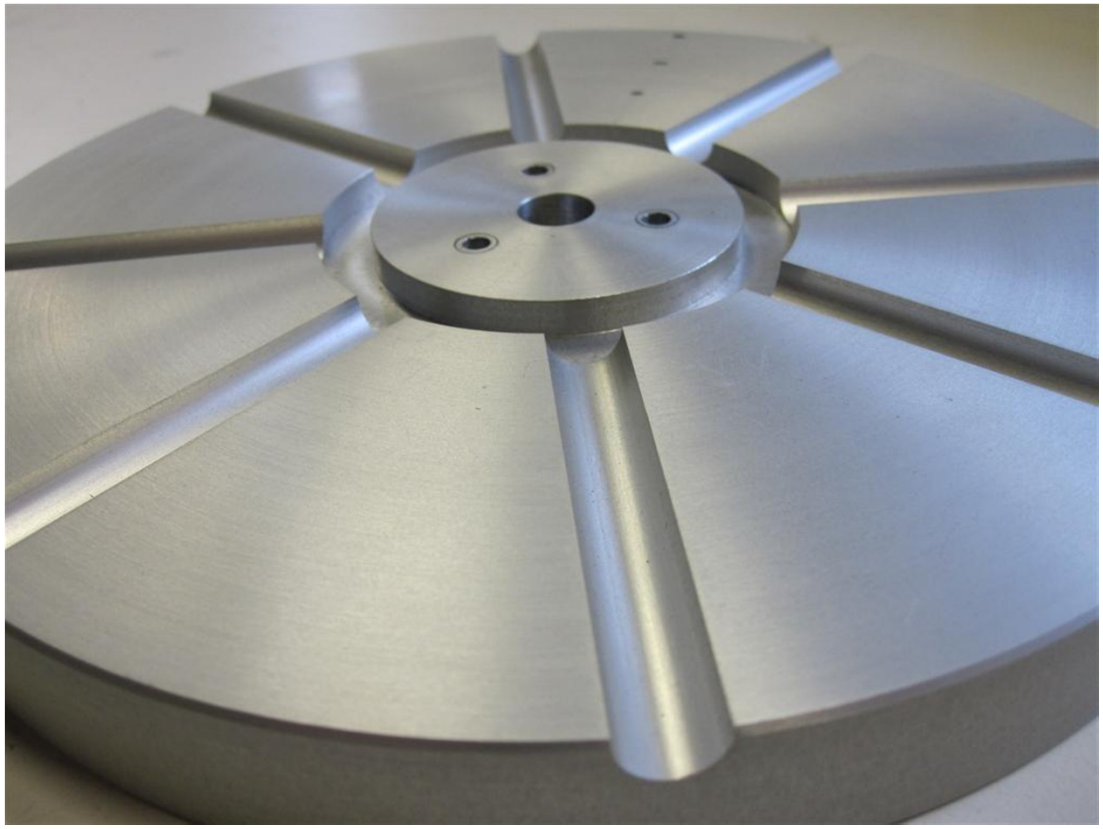
A solution….

The ARRB texture jig



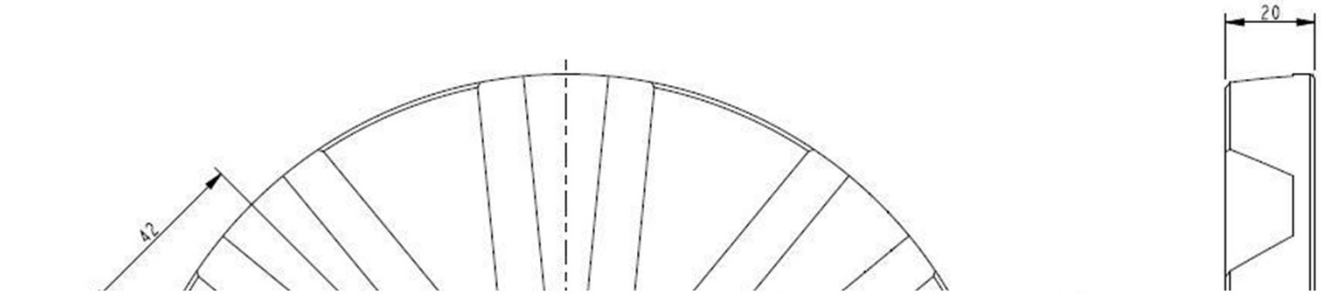
Previously…..

The disks



- Disk A - black
- Disk B - silver

Calculating theoretical texture



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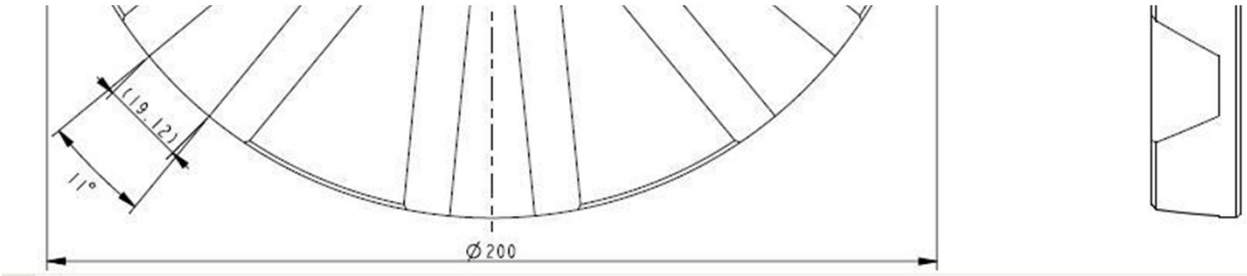
NATA

METROLOGY REPORT

TEST REPORT NO: **723 1535/09** ISSUED: 15.09.09 SHEET 1 OF 2



Theoretical texture values

Disk	Radius (mm)	MPD (mm)	SMTD (mm)
A	55	7.52	6.11
A	75	6.64	6.39
A	95	6.13	6.48
B	55	1.02	1.74
B	75	0.76	1.50
B	95	0.60	1.33

Section 2: A tale of 5 lasers

Commonly used laser types for texture measurements

- 78 kHz analog
- 64 kHz analog high power
- 32 kHz digital CCD
- 62 kHz digital CCD
- 16 kHz analog (SMTD only)

Factors affecting texture measurement

- Operating speed
- Internal electrical noise of sensor
- Signal noise due to vehicle vibration
- Laser spot size
- Output data rate

Effect of speed

MPD

Speed difference	Digital 62 kHz	Digital 32 kHz	High power analog	Low power analog
23.9	-0.014	-0.011	-0.020	0.014

SMTD

Speed difference	Digital 62 kHz	Digital 32 kHz	High power analog	Low power analog	16kHz analog
23.9	-0.134	0.049	-0.056	-0.057	-0.016

Noise specification

All lasers have different noise characteristics

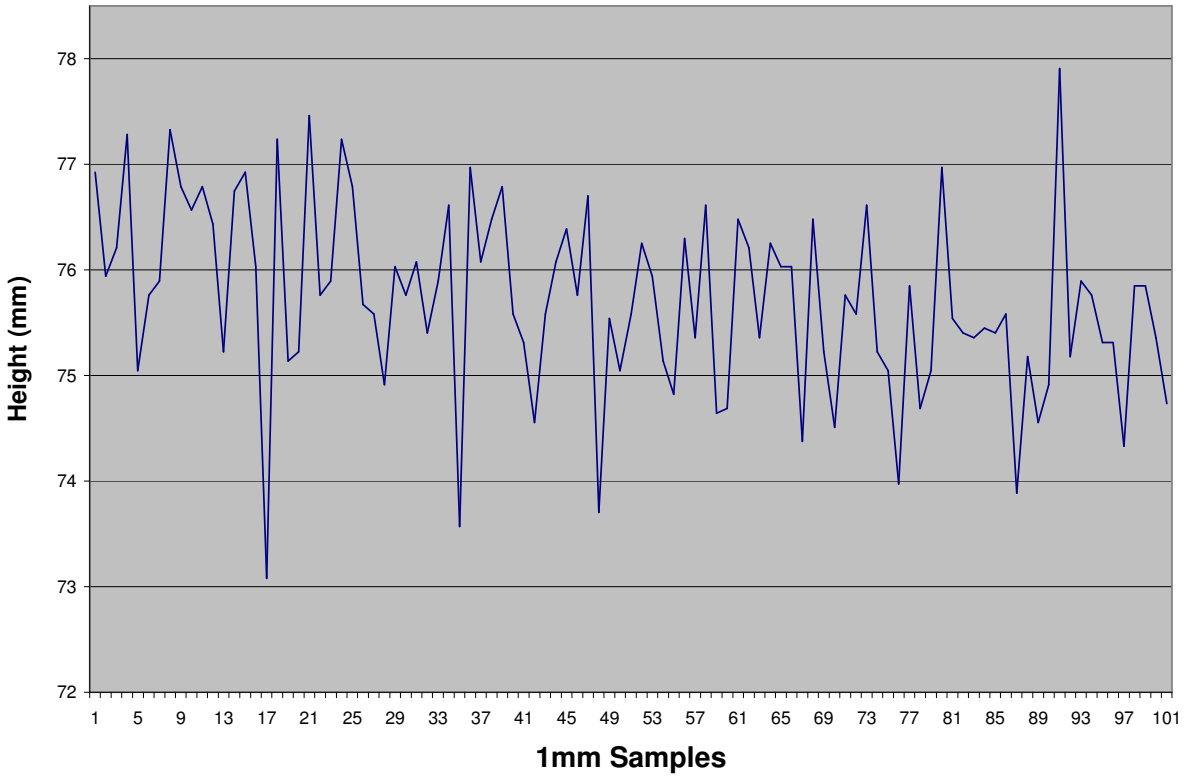
Published specifications for lasers include:

- noise
- bandwidth

However, not included in MPD standards

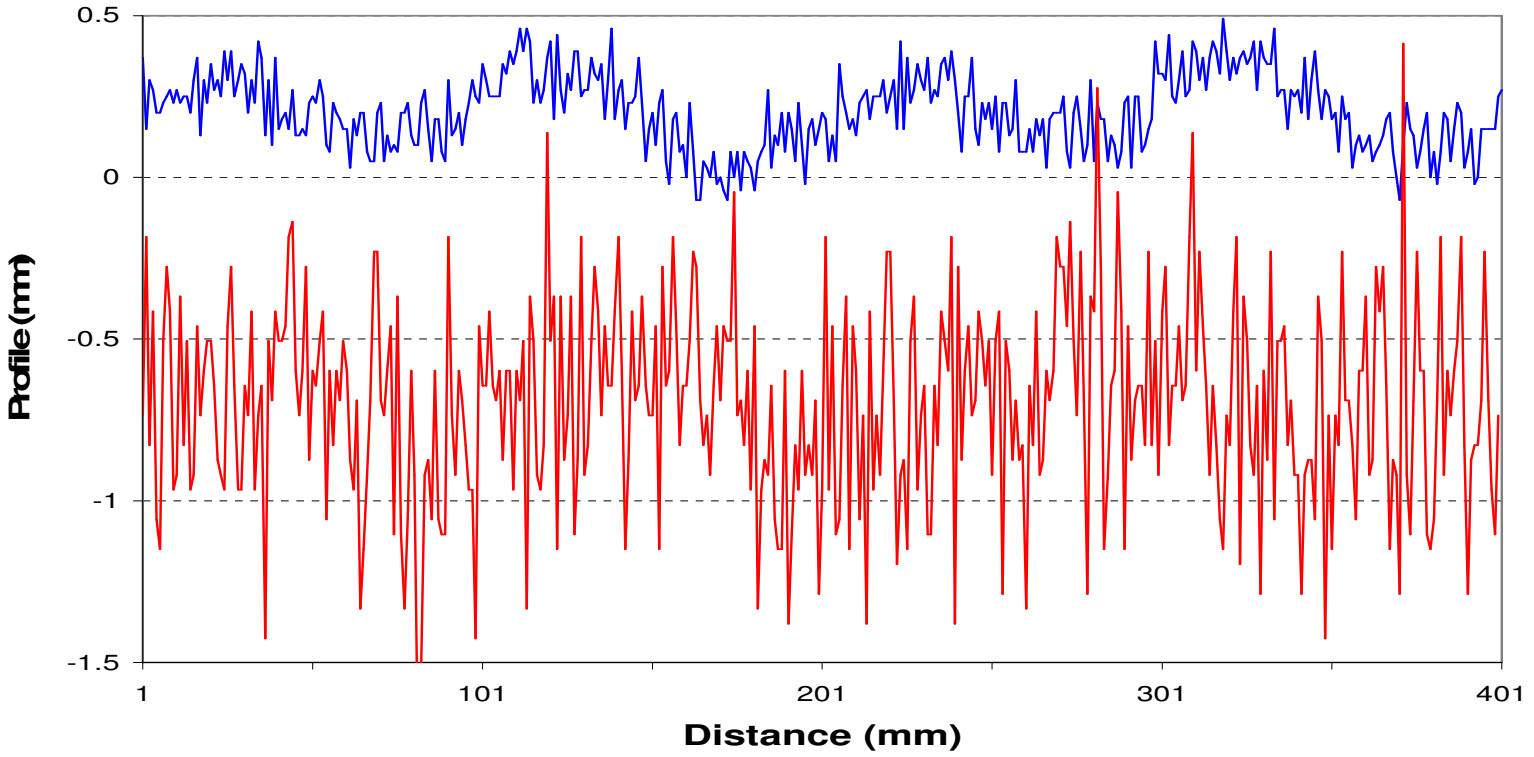
Sensor noise indistinguishable from texture signal

Texture is a random signal…..



…..similar to noise

Flat disk noise measurements

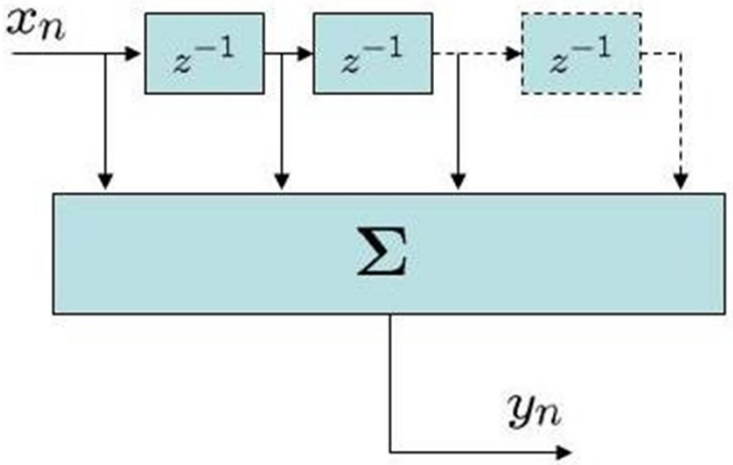


Digital laser 32 kHz

Low power analog laser

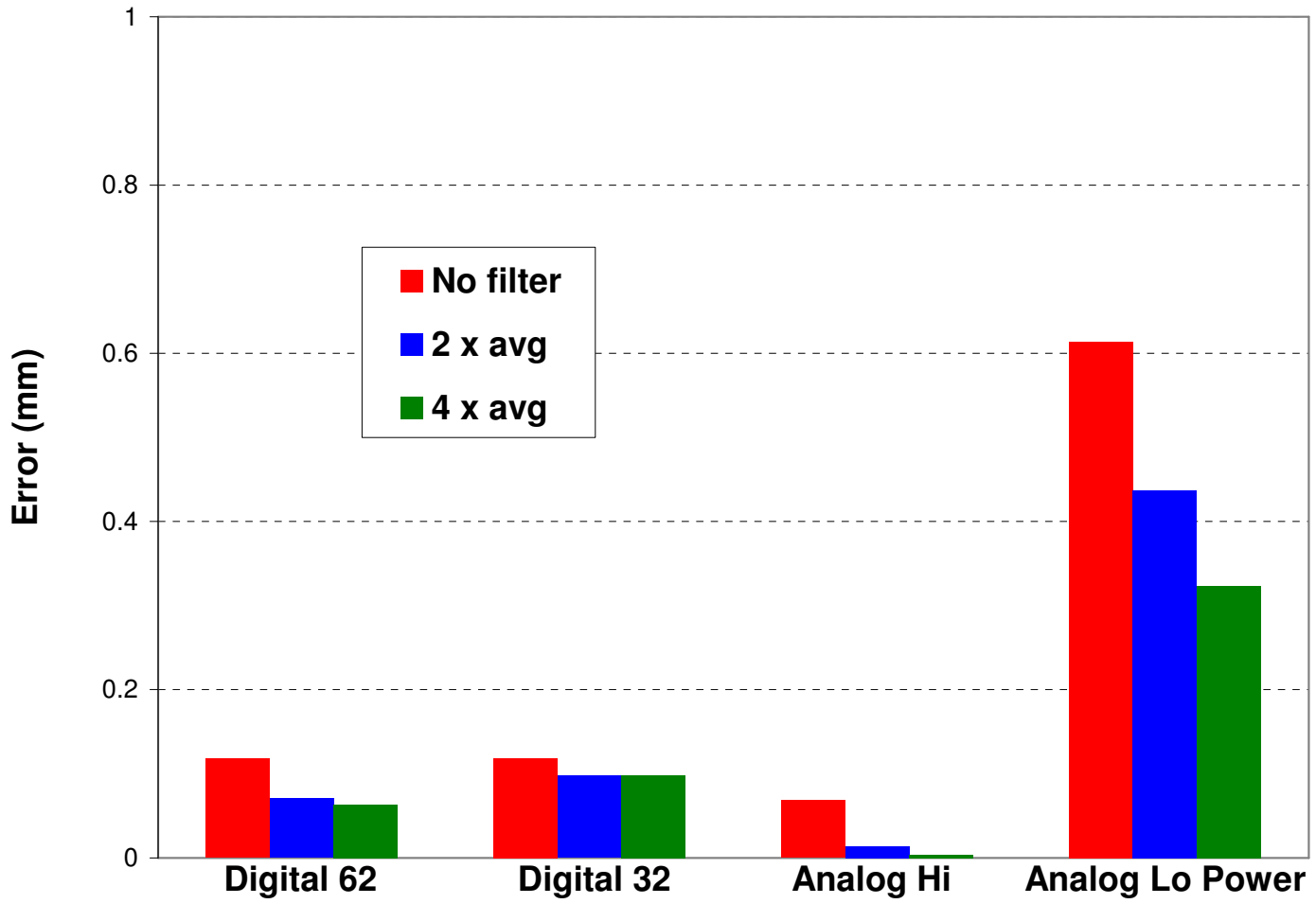
Effect of filtering

- ISO 13473 recommends low pass filtering
- Implemented simple low pass moving average filter using 2,3 and 4 samples



Moving average filter

Accuracy of MPD measurements

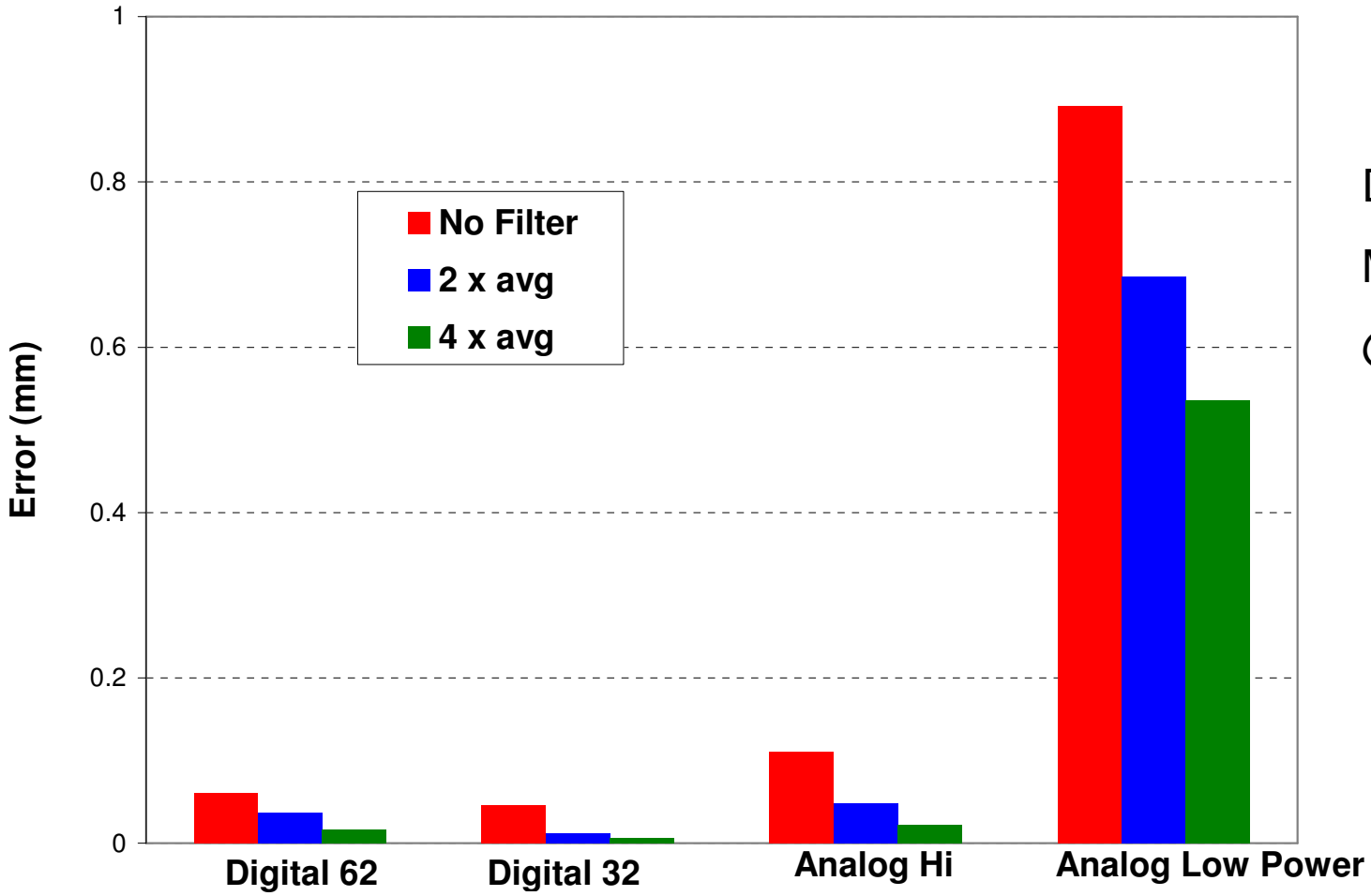


Disk A

MPD = 7.52 mm

@ 110 PCD

Accuracy of MPD measurements

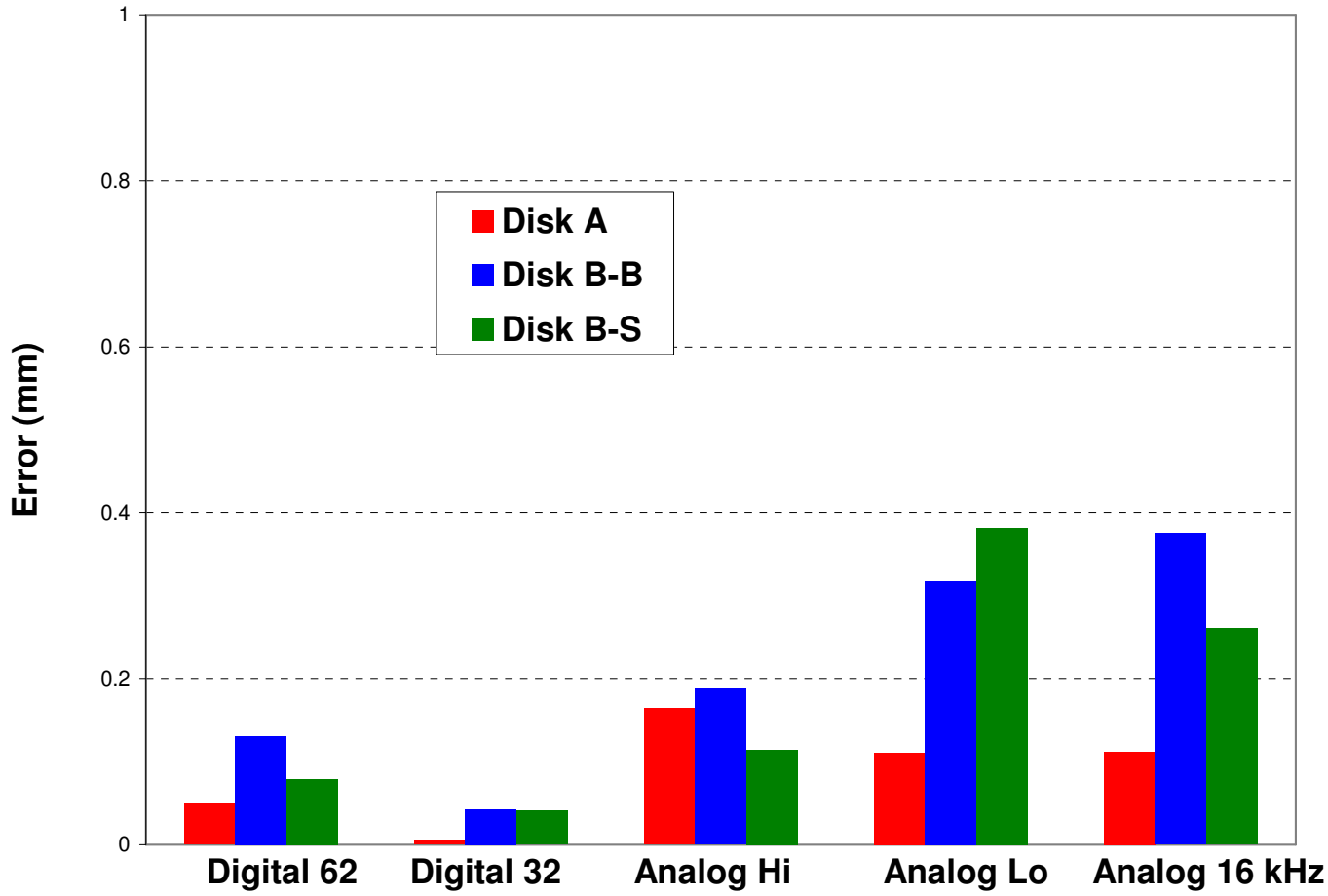


Disk B (black)

MPD = 1.02 mm

@ 110 mm PCD

Accuracy of SMTD measurements



Disk A SMTD = 6.11

Disk B SMTD = 1.74

110 mm PCD

Conclusions

Aim is not to make recommendations on a particular laser.

Rather, provide method for objective measurement of:

- noise performance
- dynamic performance
- absolute accuracy
- speed dependency
- surface colour effect

Lasers still need on-road evaluation

Future work

- Designing further test disks. Possibly rounded with lower profile
- Try more realistic light colour
- Repeat at various heights throughout the laser's range
- Increase test speed

Thank you