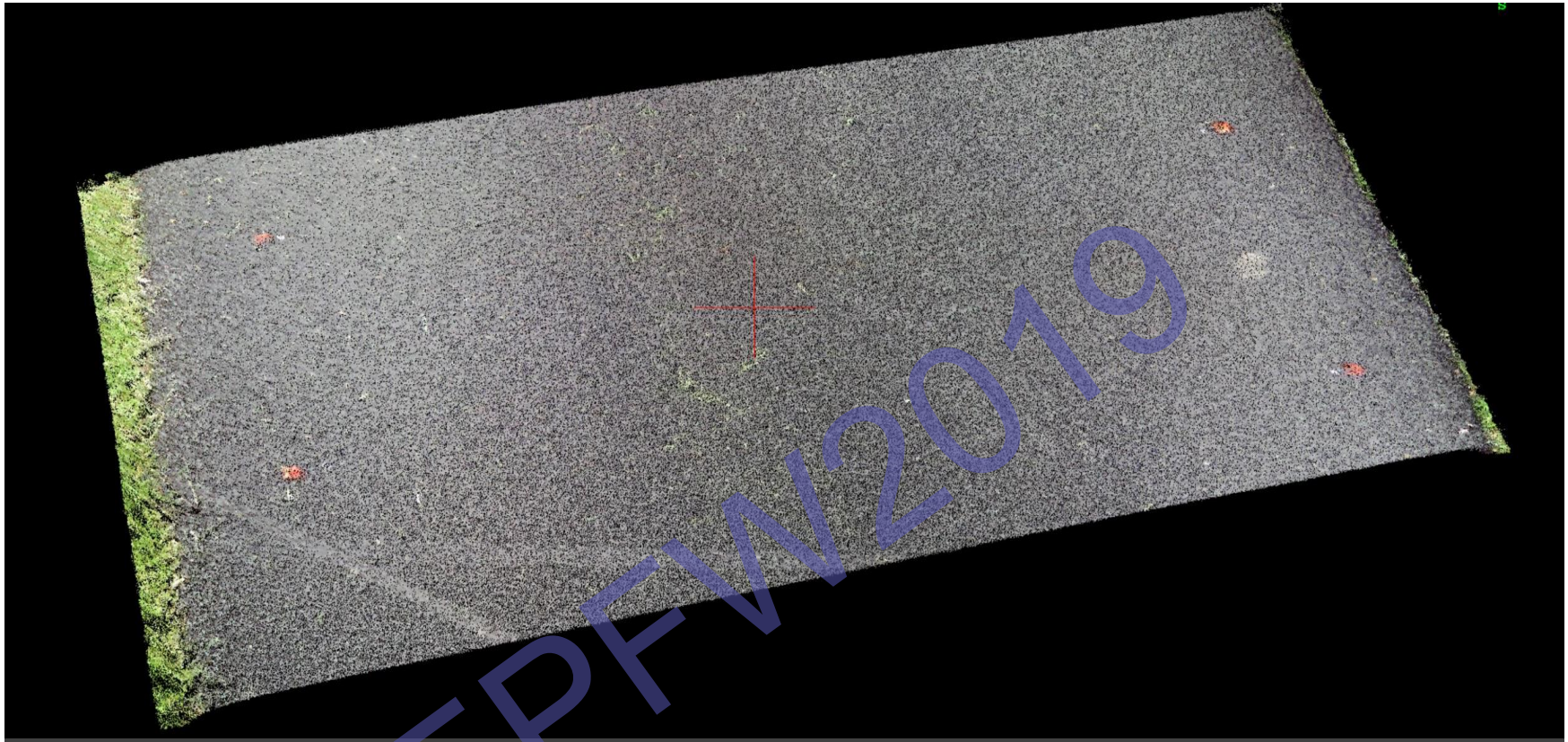


Measuring macrotexture effectively in the field using 3D non-contact techniques

Northumbria University
NEWCASTLE

Vikki Edmondson

BSc MEng, CEng, FICE, MIStructE, FCIHT, FIHE, FCMI, CMgr, PGCE, FHEA

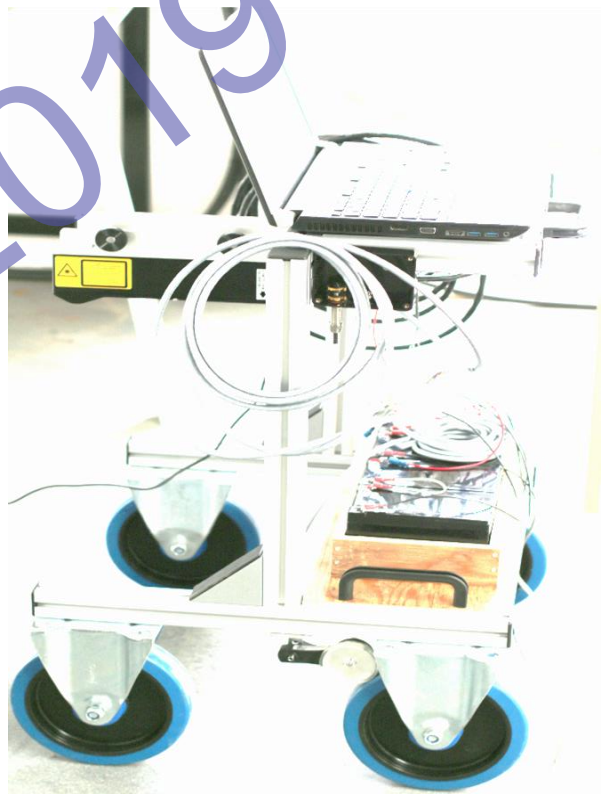
Introduction and some examples of equipment available

Northumbria University NEWCASTLE

Non-contact measurement of macrotexture is being researched to inform analytical friction prediction methods, without the influence of seasonal variation and machine operating conditions.

Terrestrial Laser Scanner

Structure from Motion



3D Smart Laser Profile Sensor

Field Site

Urban Street, Newcastle Upon Tyne, England

Three existing surfaces considered:

Hot Rolled Asphalt

Dense Bitumen Macadam

Surface Dressing

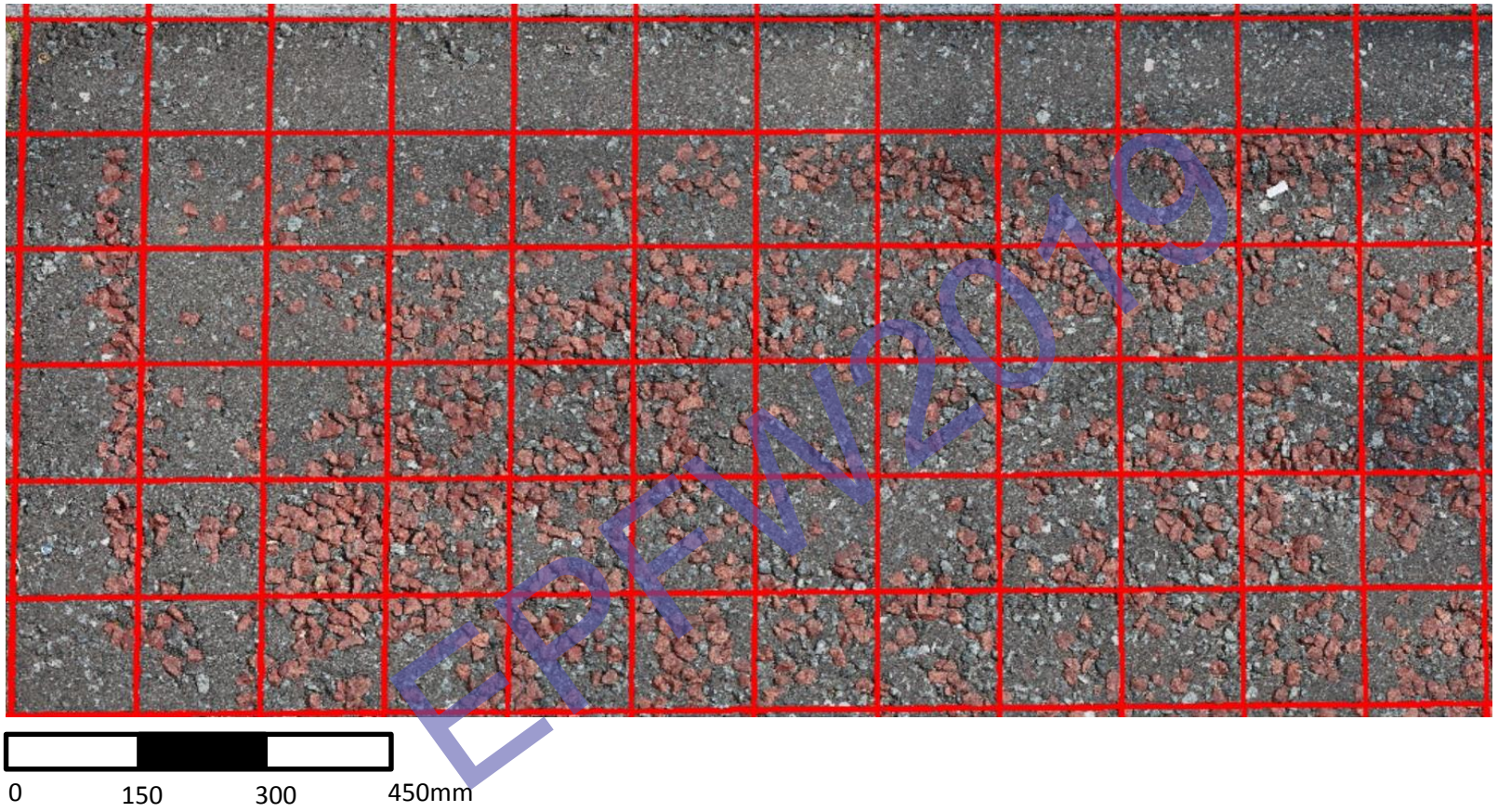
Macrotexture Characterisation

Northumbria University NEWCASTLE

Parameter Symbol	Parameter Name	Description	Calculation Equation
Sq	Root mean square height	Root mean square value of the surface departures within the sampling area.	$S_q = \sqrt{\frac{1}{A}\iint_A z^2(x,y)\,dx\,dy}$
Ssk	Skewness	Defines the shape of topography height distribution as a measure of symmetry about the mean line.	$S_{sk} = \frac{1}{S_q^3}\left[\frac{1}{A}\iint_A z^3(x,y)\,dx\,dy\right]$
Sp	Maximum peak height	Largest peak height within a definition area A.	S_p
Sv	Maximum pit height	Smallest pit height value within a definition area.	S_v
Spd	Peak density	The number of peaks per unit area.	$S_{pd} = \frac{N}{A}$
Spc	Arithmetic mean peak curvature	Measure of the principal curvature of the peaks.	$S_{pc} = -\frac{1}{2}\frac{1}{n}\sum_{k=1}^{n}\left(\frac{\partial^2 z(x,y)}{\partial x^2} + \frac{\partial^2 z(x,y)}{\partial y^2}\right)$

Areal surface texture parameters used to characterize macrotexture.
Parameters are defined by ISO 25178 [1]

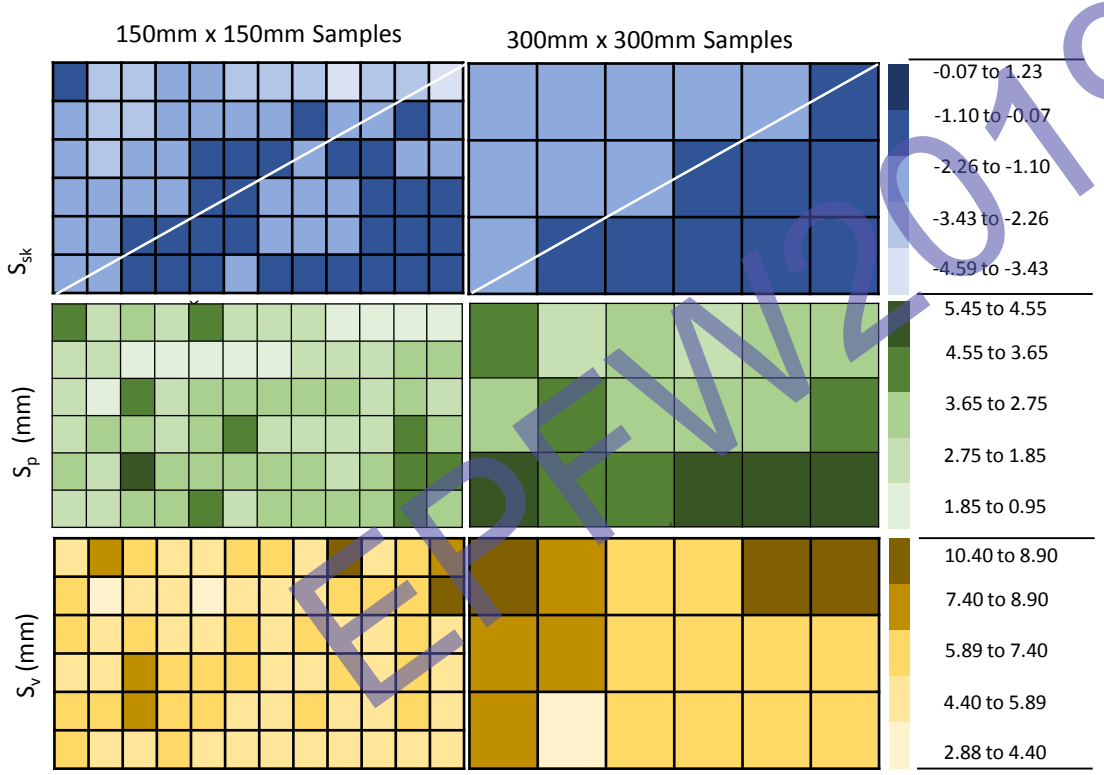
Spatial Variance Study



Digital image of a 1.8m x 0.9m area of Hot Rolled Asphalt considered in the study.
Seventy-two 150mm x 150mm samples and eighteen 300mm x 300mm samples captured using Structure from Motion.

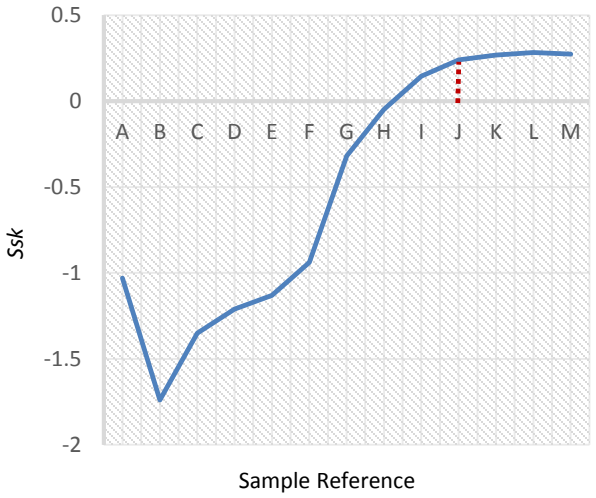
Initial Results

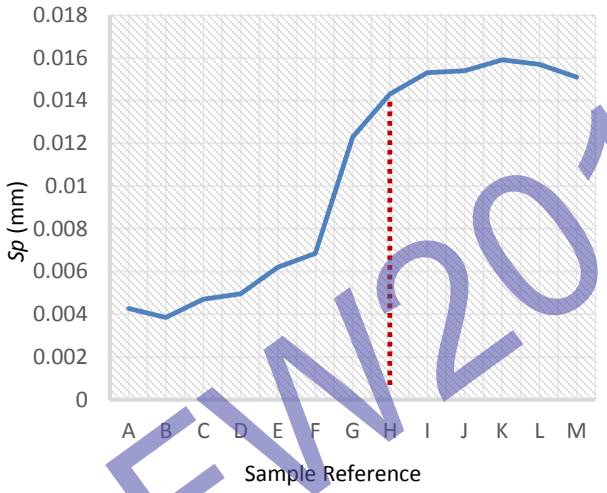
Spatial variance of S_q, S_p and S_{sk} over a 1.8m x 0.9m area of Hot Rolled Asphalt surfacing for 150mm x 150mm and 300mm x 300m samples, data captured with Structure from Motion.

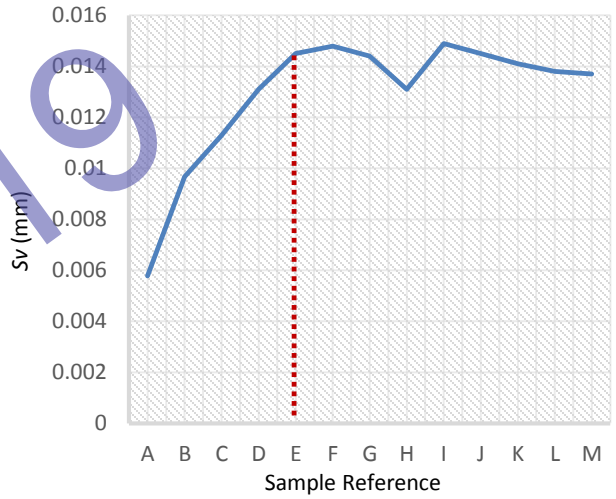


Each colour represents a 20th percentile of the overall maximum parameter value, and thus illustrates the variability of the parameters.

Initial Results



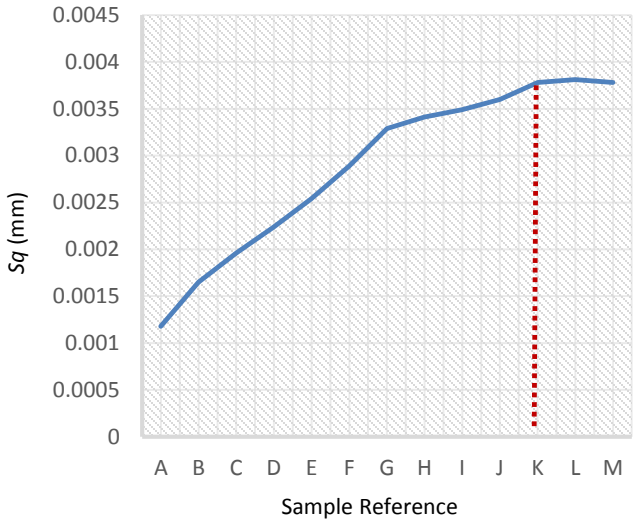


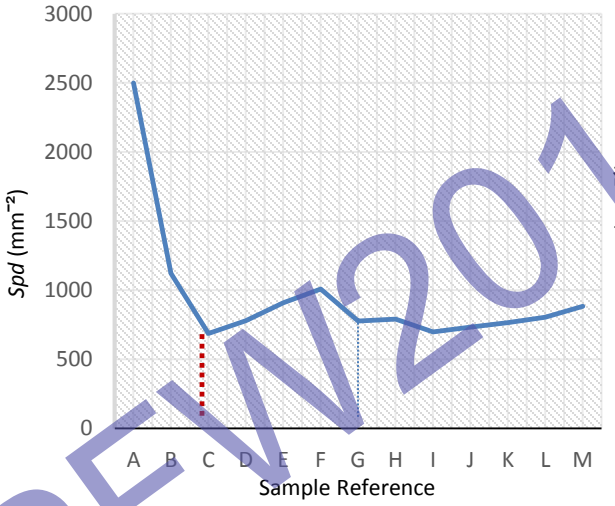


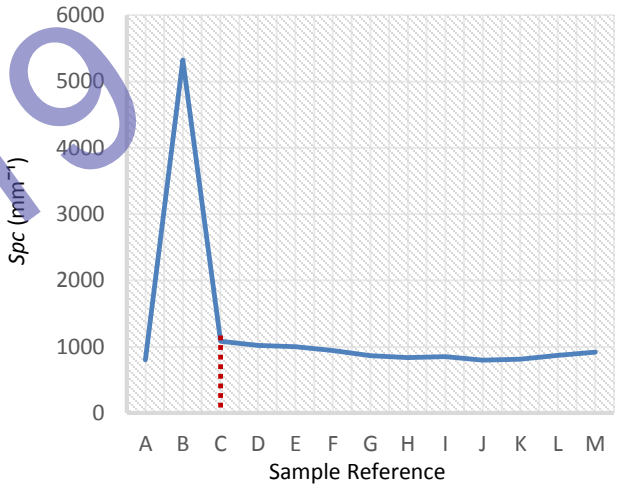
Sample Reference	Size (mm)	Sample Reference	Size (mm)
A	150 x 150	G	1050 x 1050
B	300 x 300	H	1050 x 1200
C	450 x 450	I	1050 x 1350
D	600 x 600	J	1050 x 1500
E	750 x 750	K	1050 x 1650
F	900 x 900		

The influence of upscaling sample size on areal parameters S_{sk} S_p, and S_v for an area of Hot Rolled Asphalt surfacing captured with Structure from Motion.

Initial Results







Sample Reference	Size (mm)	Sample Reference	Size (mm)
A	150 x 150	G	1050 x 1050
B	300 x 300	H	1050 x 1200
C	450 x 450	I	1050 x 1350
D	600 x 600	J	1050 x 1500
E	750 x 750	K	1050 x 1650
F	900 x 900		

The influence of upscaling sample size on areal parameters S_q, S_{pd}, and S_{pc} for an area of Hot Rolled Asphalt surfacing captured with Structure from Motion.

In conclusion

- Areal parameters considered demonstrate sensitivity to sample size, raising questions over the adequacy of a typical 150mm x 150mm or smaller pavement specimen size.
- Initial research suggests that the deployment of wider scale approached are required in order to appropriately capture functional areal parameters

Questions?

References

[1] ISO 25178 Part 2, Geometrical product specification (GPS) – Surface texture: areal part 1: terms, definitions and surface texture parameters. International Organisation of Standardisation. (2012) [Online] Available at: https://www.iso.org/standard/42785.html (Accessed 27th January 2018)