

# MARA NORD PROJECT 2010-2012

## GPR in Quality Assurance of New Asphalt Pavements

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**INTERREG  
IV A NORD**



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# Wp 5 objectives

- Improve the reliability of the current void content method used in new asphalt pavement quality assurance measurements
  - The current regression model used in Finland in GPR void content calculations was introduced by Mr. Petri Roimela in 1997.
  - Influence of environmental factors (for example temperature)
- Investigate the possibility to abandon asphalt core samples when defining the voids content by using GPR method
  - The use of the calibration plate
- Method development
  - Using more than one core sample
  - Other instructions for future measurements

$$\text{void} = 272.93 e^{-1.3012 k \epsilon_r}$$

# Laboratory measurements & tests

- Asphalt plates (OAMK)
- Laser scanning (RAMK)
- Troxler (RAMK)
- Environmental factors, e.g. temperature (RAMK)
- Percometer (RAMK)
- GPR (RAMK)
- Core samples (OAMK)



# Field measurements

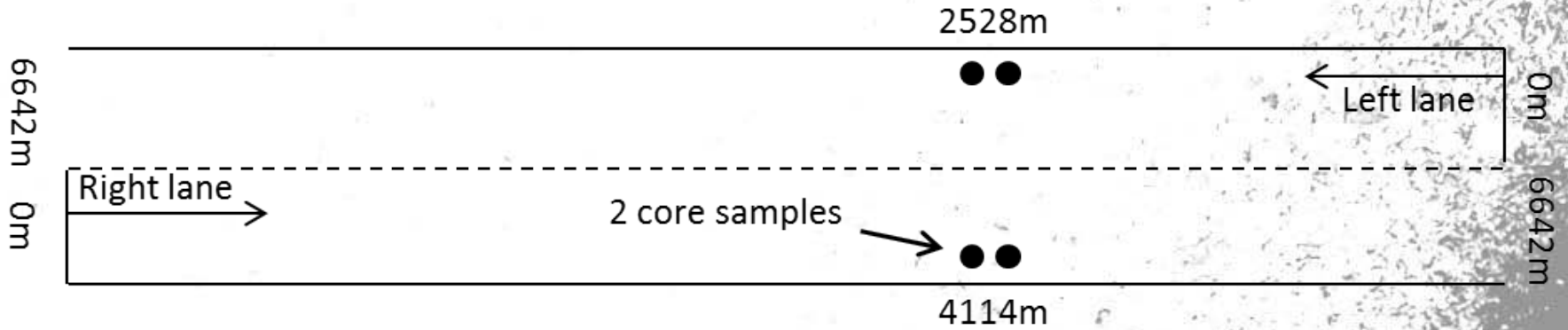
Comparative GPR survey tests in Seinäjoki region

- Roads 18 and 725
- Lines 6642m and 6852m, both lanes were measured (right wheel path)
- 4 GPR operators, 5 different GPR equipment

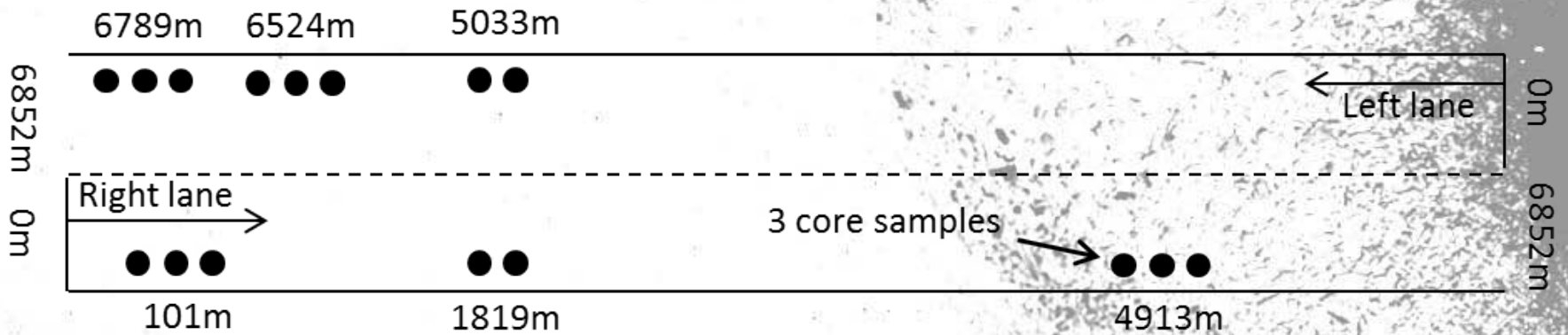


# Core sampling

## Road 18



## Road 725



# Data analysis

## GPR

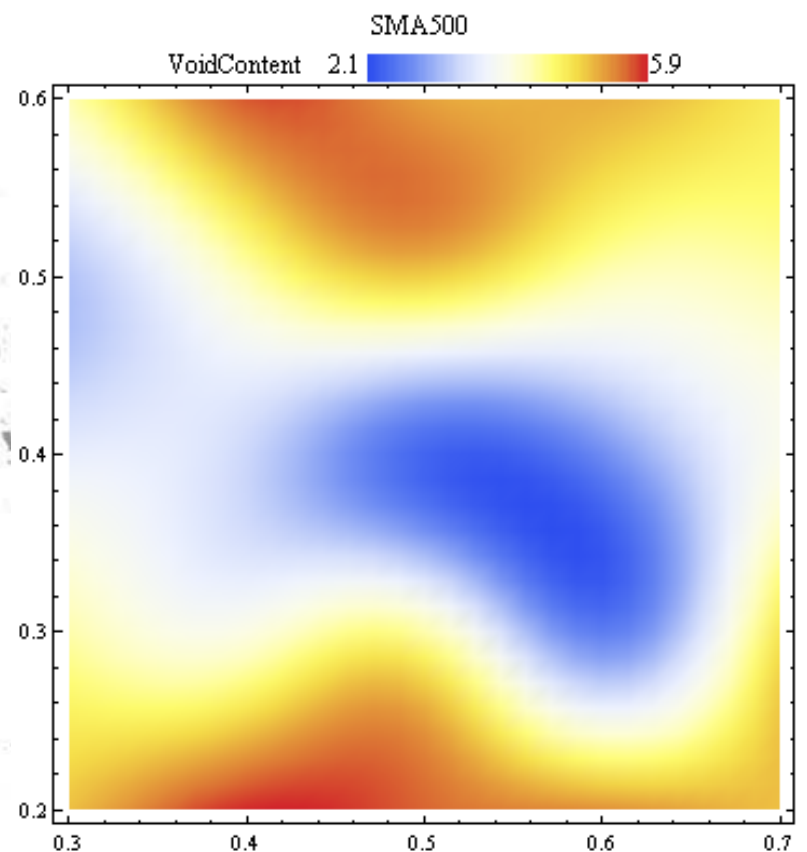
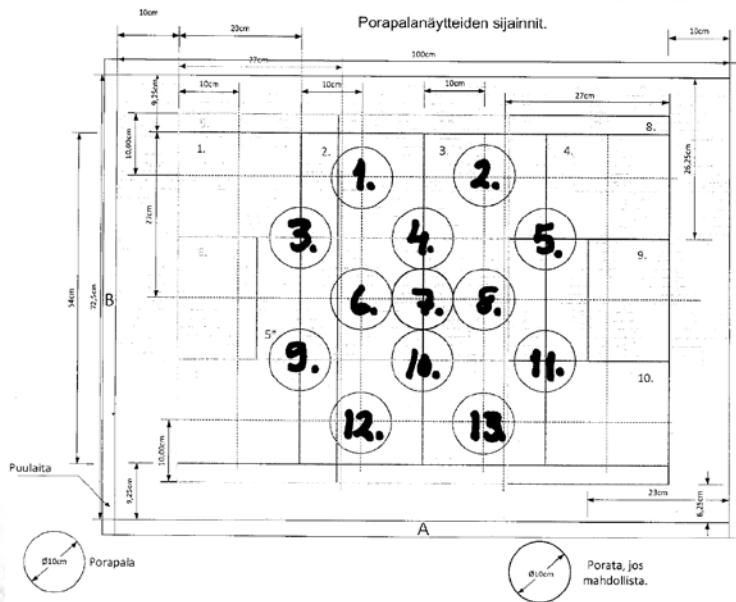
- Processing the GPR data
- Dielectric value calculations
- Void content calculations
- Regression analysis
- Statistical and graphical analysis

## Other measurements

- 3D laser scanning, air water weighing...

# Results - asphalt plate measurements

- The regression model between dielectric value and void content should be based rather on field tests (test site or road sections) than on laboratory test (pavement plates).
  - Size of the asphalt plate
  - Manageability in practise
  - Homogeneity



# Results of field tests 1 / 4

In quality assurance of new asphalt pavement GPR has good repeatability and reproducibility when same reference data is used.

GPR test , Sei

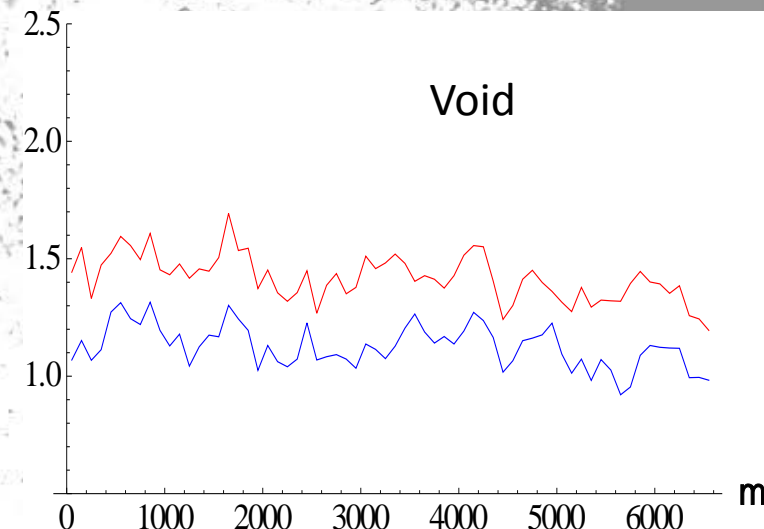
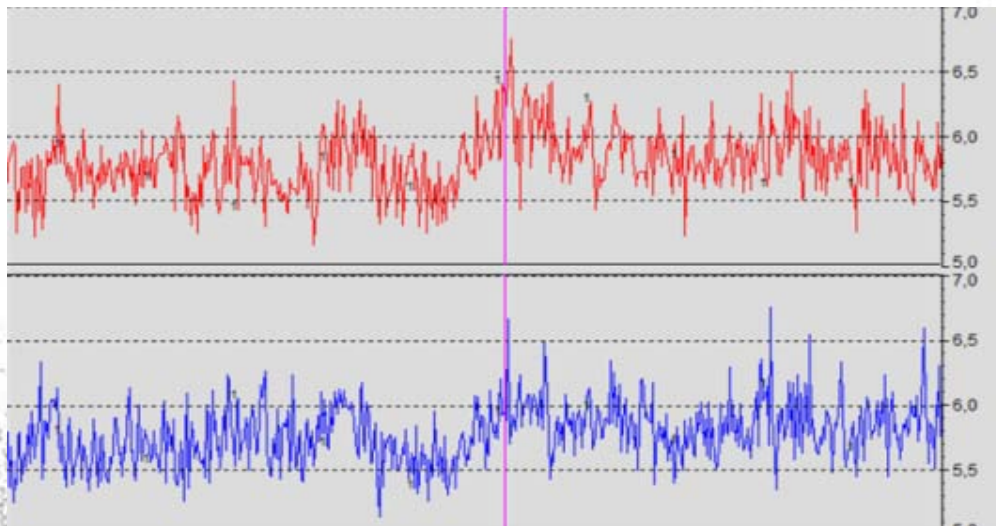
GPR test , Sei



# Results of field tests 2 / 4

As a summary of Mara Nord project WP 5 findings, the following methods for improvements increase the quality of void content measurement results:

- Core samples need to be taken from a location that represents the average level of dielectric value. This means that a preliminary analysis of GPR data needs to be done on site for core sample location determination.
- Core samples should be located where GPR does not detect remarkable changes in dielectric values.



## Results of field tests 3 / 4

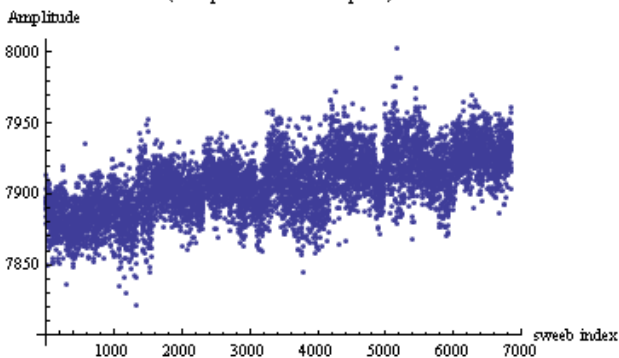
- More than one core sample should be taken from each location.
- There should be core samples taken from each survey line. At least every time when the asphalt mass, working method, base treatment or environmental circumstances change.



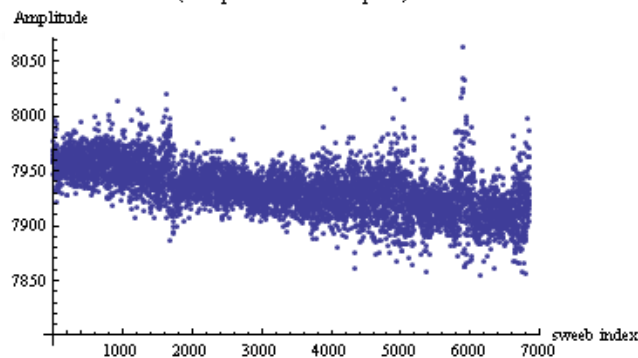
# Results of field tests 4 / 4

- In case traffic compaction has been realized the possibility to place survey line between wheel paths needs to be examined.
- To avoid significant differences in dielectric value level in separate surveys metal plate measurement should be done in the same circumstances as void content survey.
- GPR operator needs to monitor GPR data whether long term changes in direct pulse amplitude appear and these changes need to be taken into account in dielectric value calculation.

Op B Vt18 dir 1 first survey  
Variation of direct pulse amplitude  
(max peek – next min peak)

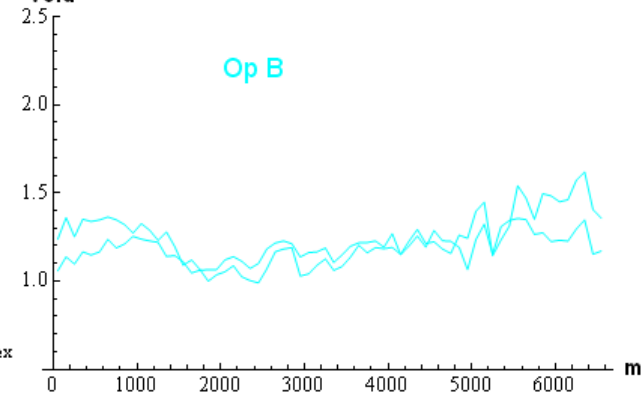


Op B Vt18 dir 1 second survey  
Variation of direct pulse amplitude  
(max peek – next min peak)



GPR test, Seinäjoki 24.8.2011

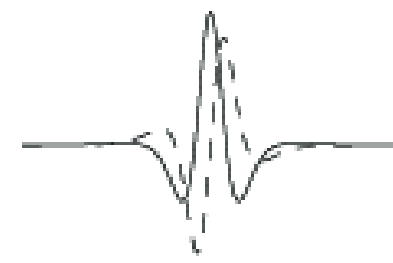
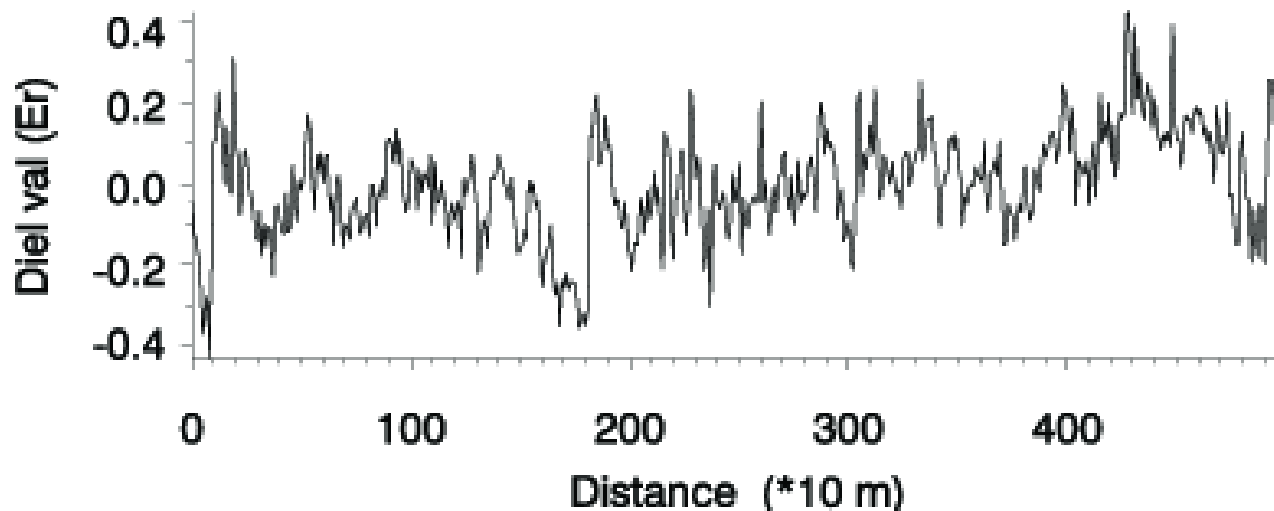
Vt18 direction 1 with repetition : Void(%), 100 m average  
Void



# Future research

- Homogeneity is an alternative property for the void content to indicate quality assurance of new asphalt pavement.
- **Wavelet analysis** is one promising method to investigate asphalt pavement homogeneity.
- Long term surveillance of road sections is needed to validate quality assurance methods. For example, in the homogeneity model correlation between statistically significant variations with pavement damage should be determined.

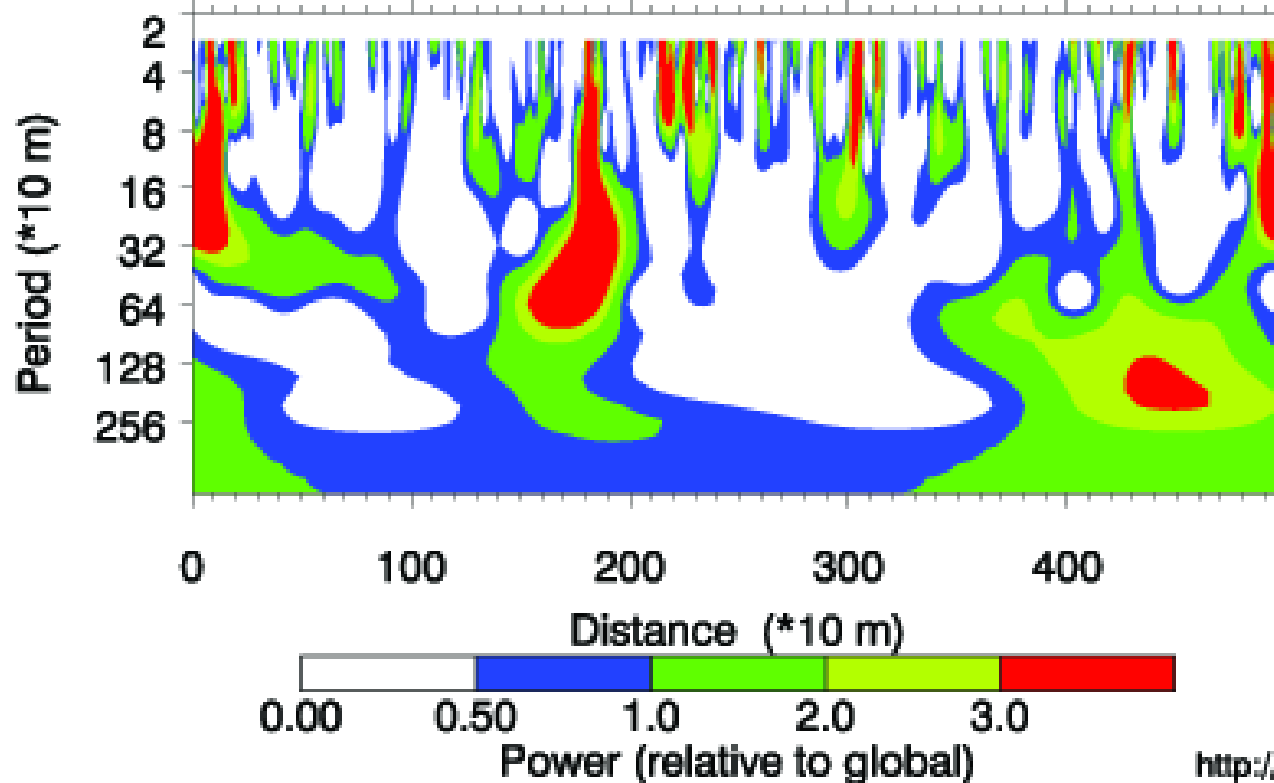
a.  $E_r$  variation (10 m avg) around the mean



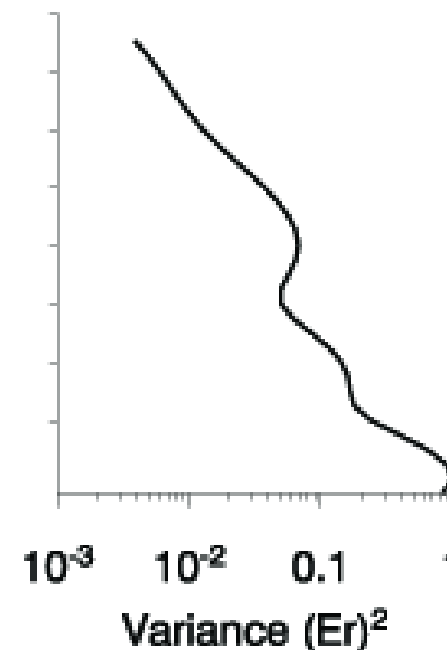
Paul 4

Real (solid) Imaginary (dash)

b. Wavelet Power Spectrum (normalized by global)



c. Global Wavelet



# THANK YOU!

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