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THE REPRODUCIBILITY OF TEXTURE PROFILES AND THE PROBLEM OF SPIKES

Luc Goubert and Anneleen Bergiers
Belgian Road Research Centre, Belgium
L.Goubert@brrc.be A.Bergiers@brrc.be

Summary

- **Reproducibility of profilometers**
  - **Set up of international round robin test**
  - **Results**
  - **Conclusions**
- **Spike removal**
  - **A new procedure for removing spikes from a profile**
  - **Validation of the procedure**
  - **conclusions**

Introduction

- **ISO/TC43/SC1/WG39 "Characterization of pavement texture using surface profiles": growing concerns about quality of sensors on the market**
- **Quid precision of measurements?**

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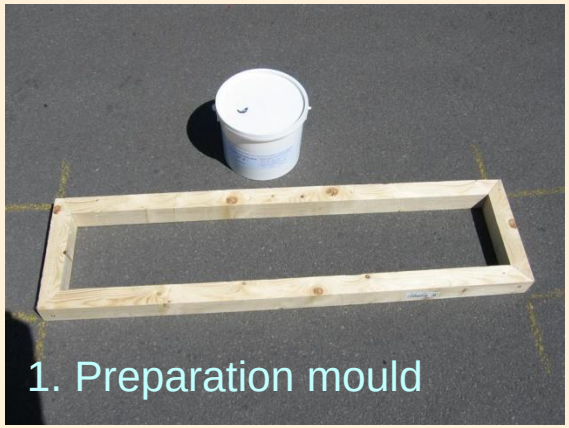
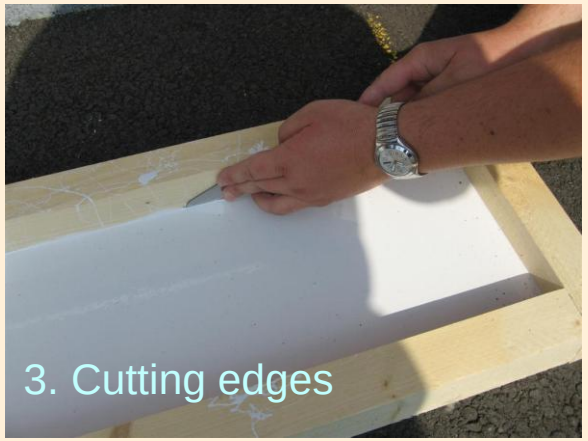
RRT: production of road samples


1. Preparation mould


3. Cutting edges


2. Pouring silicone - curing


4. Removal from mould

RRT: production of road samples (2)

5. Preparation of epoxy pouring

6. Pouring of epoxy

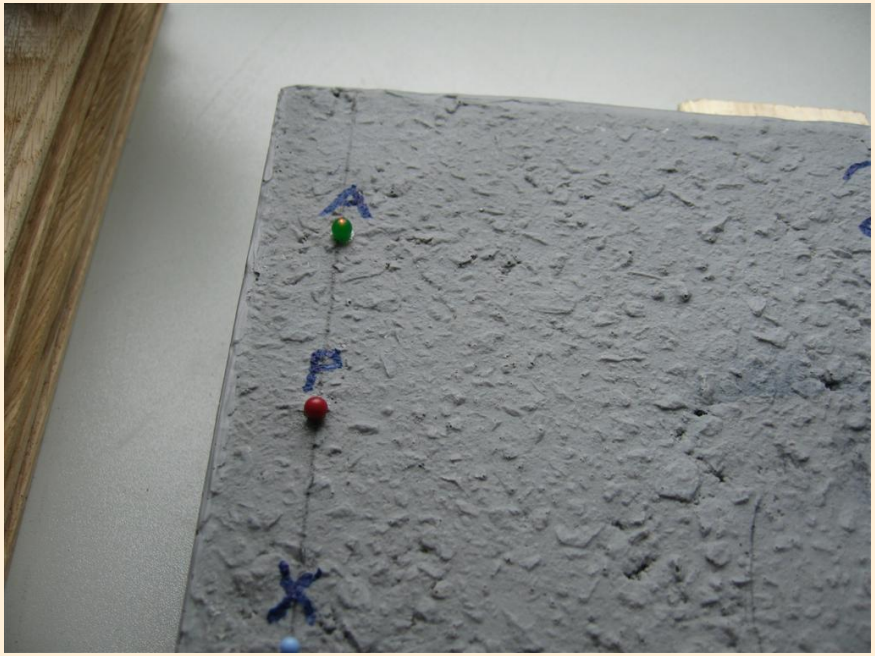
RRT: production of road samples (3)

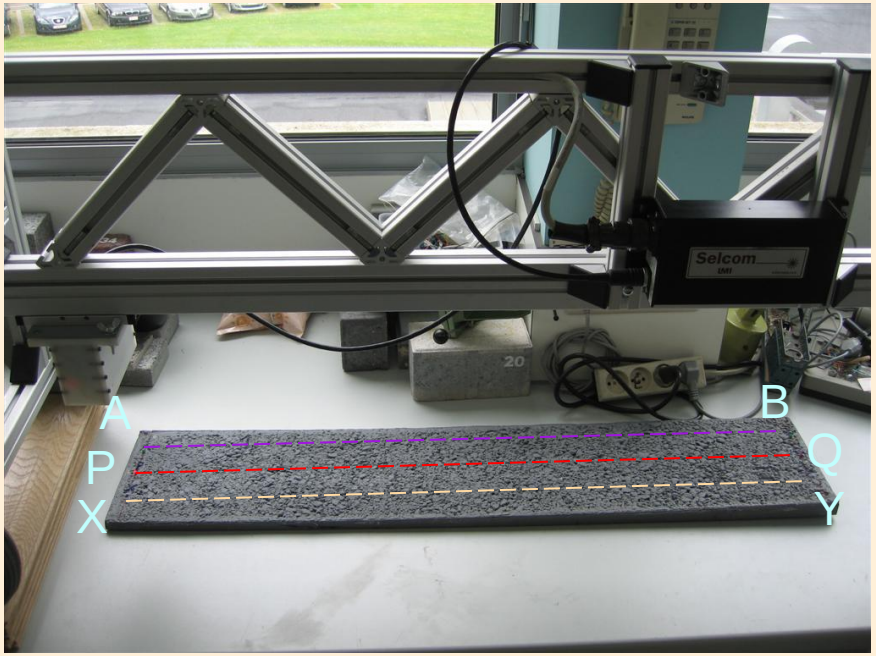
7. Removal from negative mould

8. Finished epoxy piece

RRT: production of road samples (4)

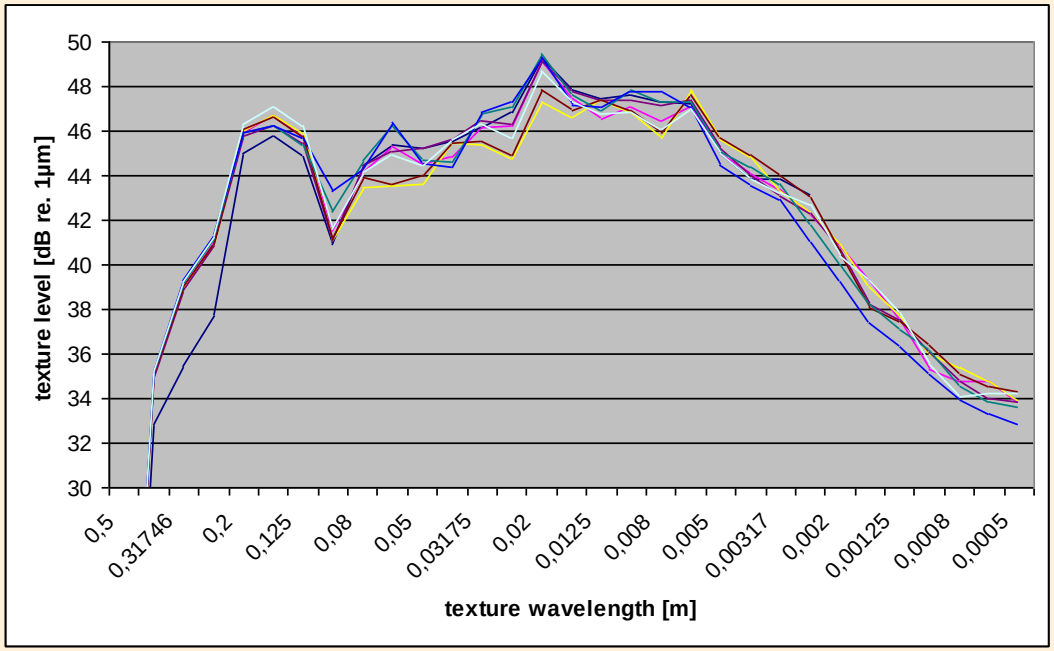
Measurements





Repeatability

- 8 consecutive profile measurements with realignments by BRRC
- Step size is 0,2 mm
- Repeatability better than 1 dB in each third octave band
- Spread probably due to small misalignments



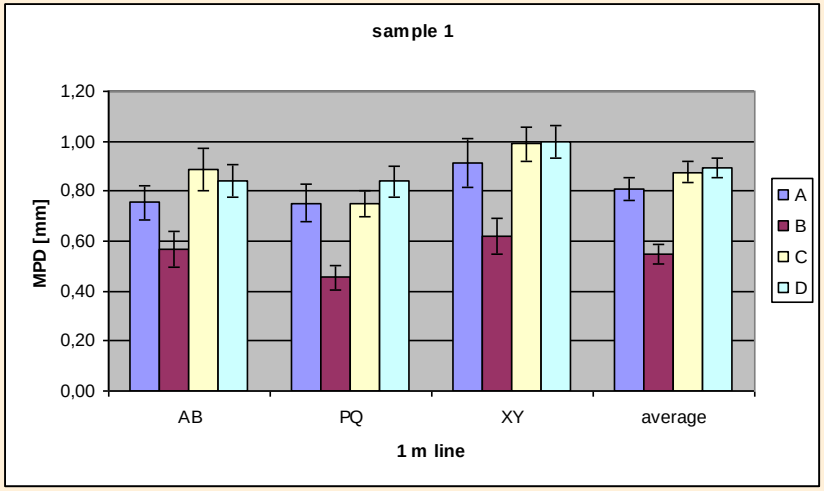
Reproducibility

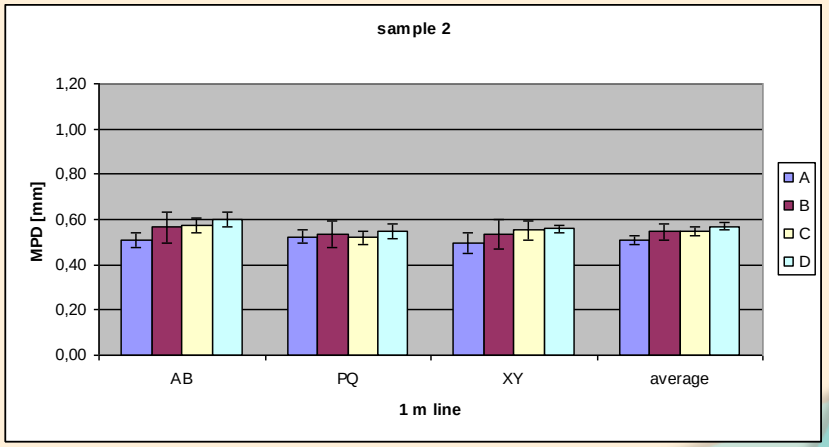
- **Measurement of profiles by four institutes from**
  - **Belgium**
  - **Netherlands**
  - **Sweden**
  - **Japan**

Reproducibility of MPD

For average of 10 MPD values (1 line), reproducibility equals:

- **0,07 mm for sample 1 (11%)***
- **0,04 mm for sample 2 (9%)***

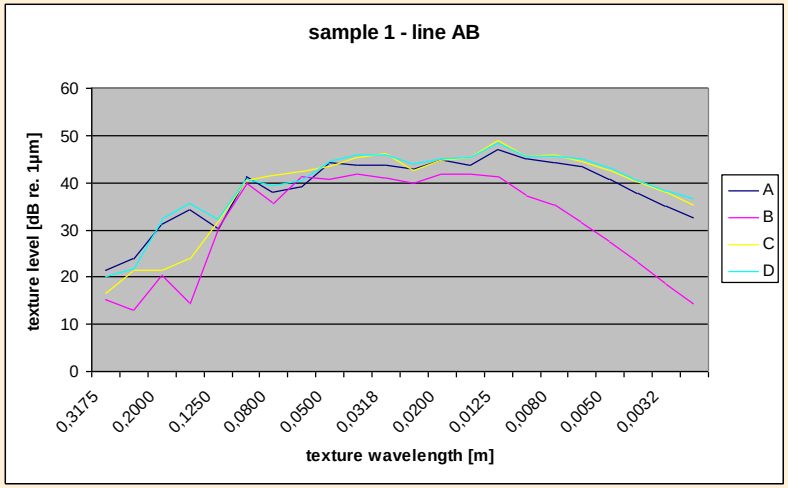


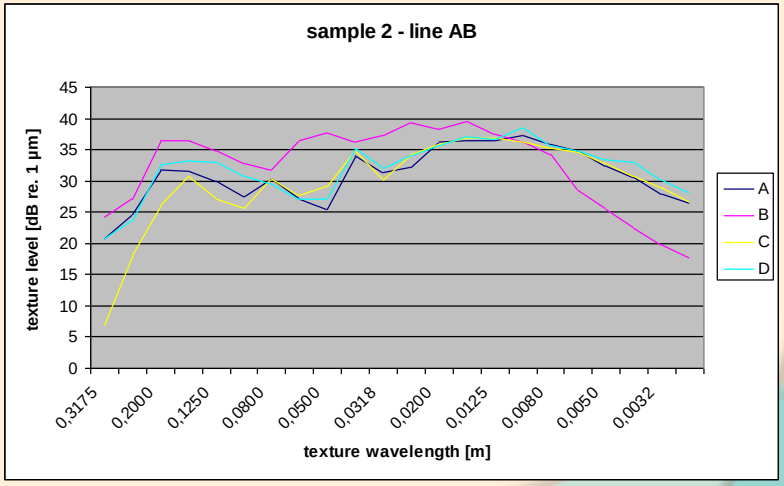


*** after exclusion of erroneous device B**

Reproducibility of third octave spectra

For wavelegths below 125 mm, reproducibily is better than 1,5 dB*





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New procedure for spike removal

- Consider a profile with N points, step size Δx and amplitude z_i for point i
- The procedure is to consider point i as a spike if:

$$\left| z_i - z_{i-1} \right| \geq \alpha \, \Delta x \qquad (*)$$

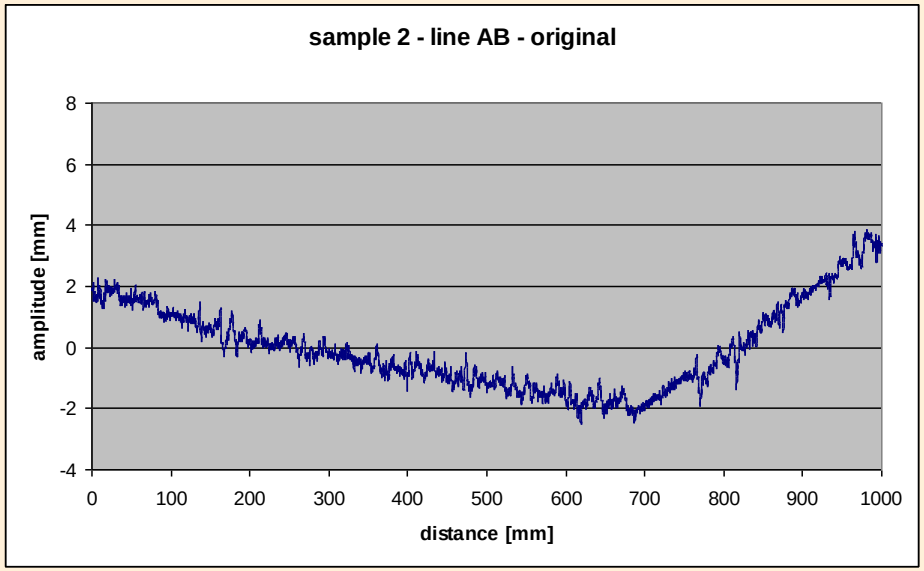
with α a constant which is to be determined

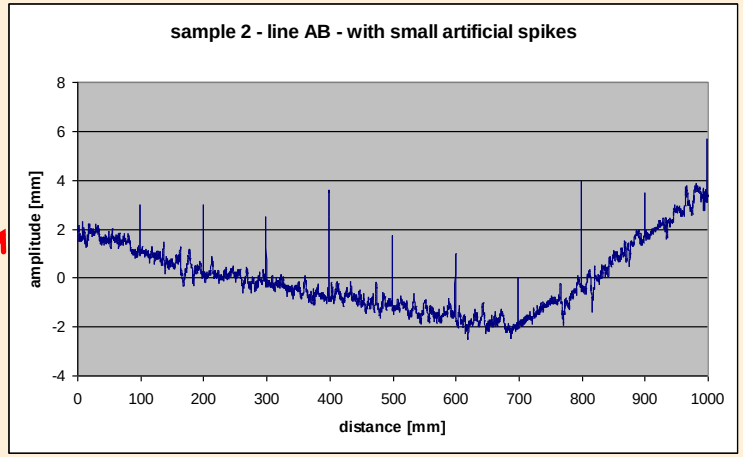
New procedure for spike removal

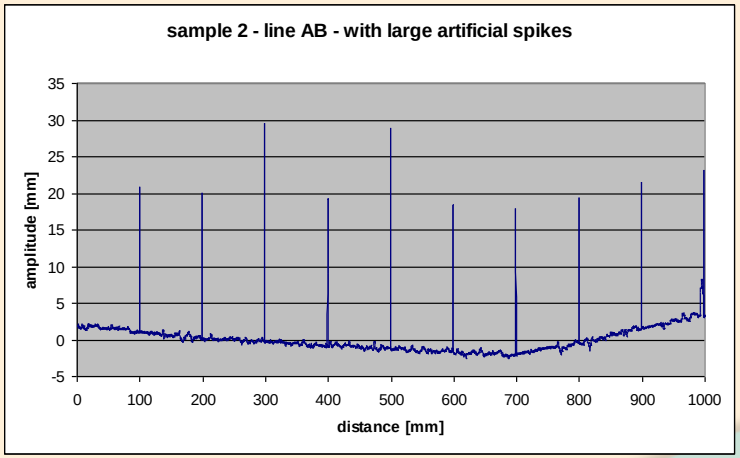
- If the criterion (*) is fulfilled, point i is assigned the status of “drop out” and is consequently treated in the same way as the hardware detected drop outs
- We propose to consider automatically points preceeding and following a drop out also to be considered as drop outs (to deal with transients)

Testing the procedure/determining α

"small spikes",
2 – 3 mm

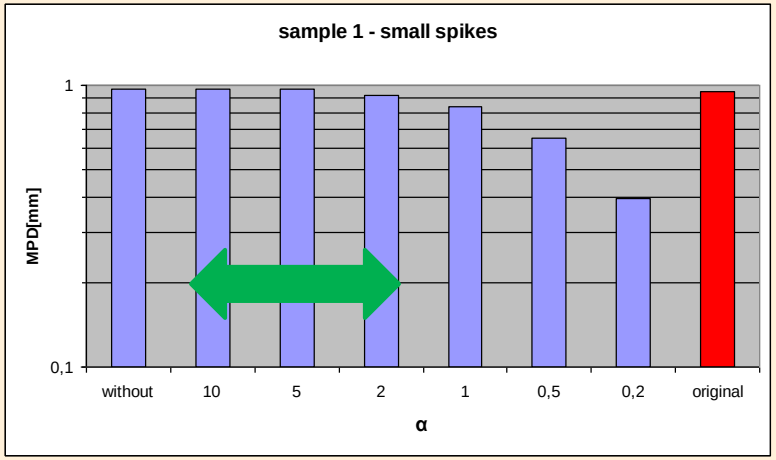


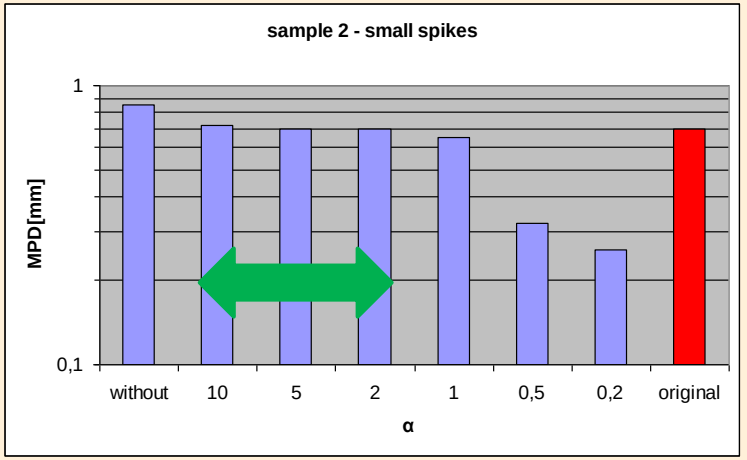


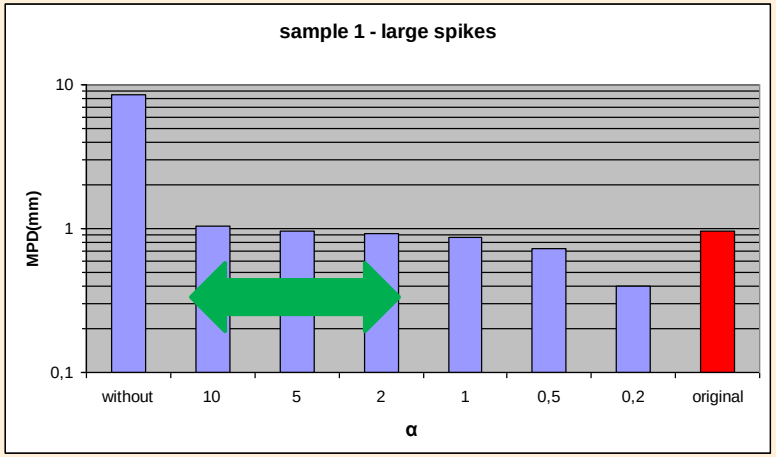


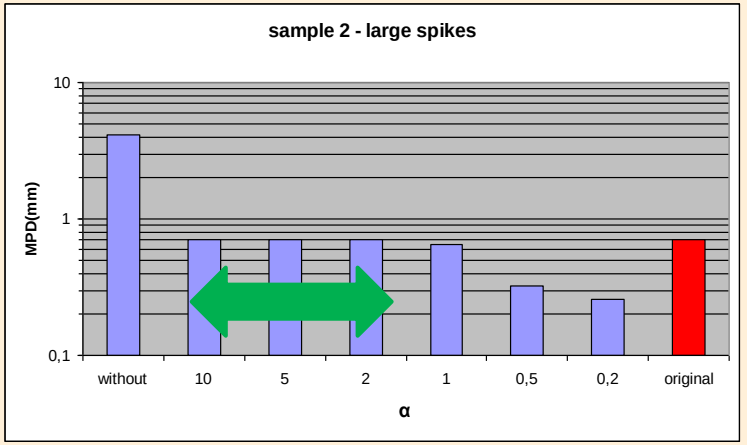
"large spikes",
20 – 30 mm

Testing the procedure/determining α (2)

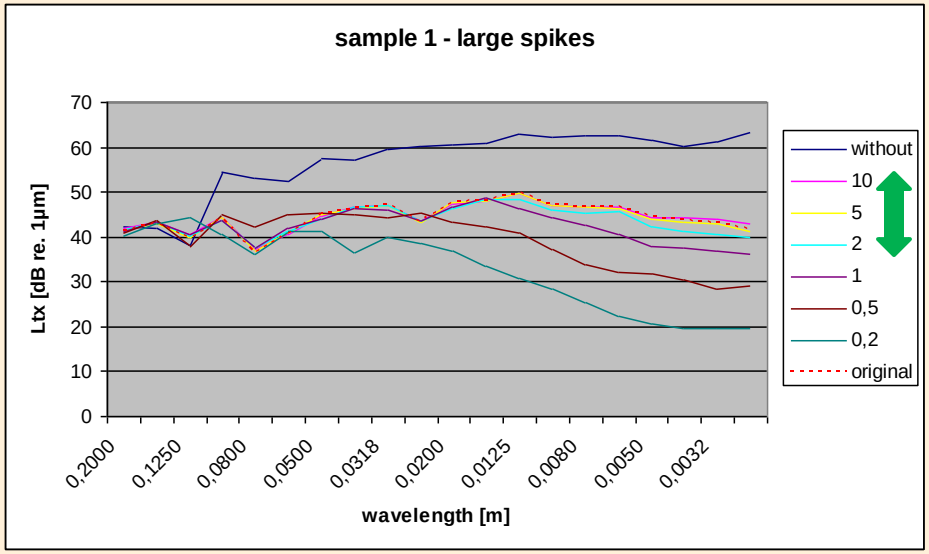


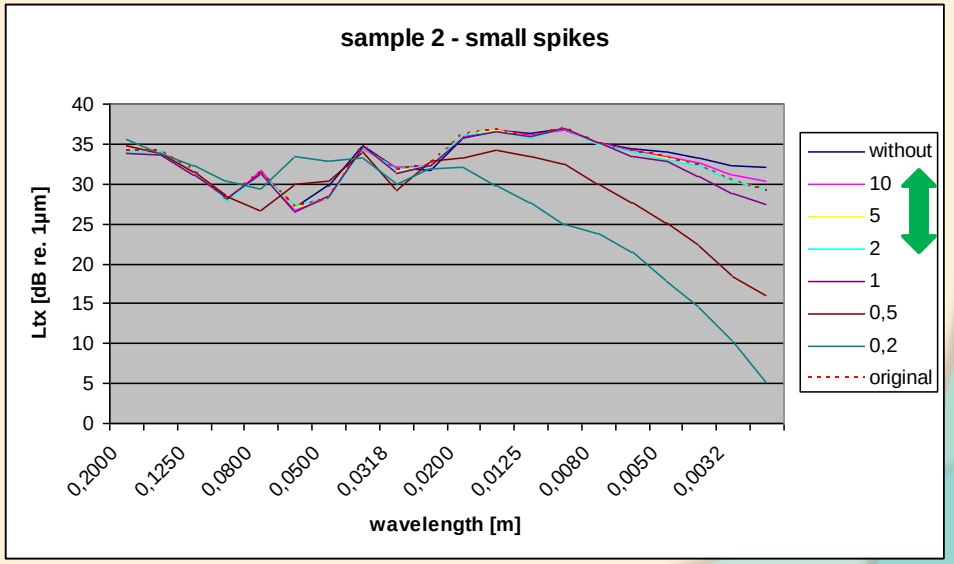




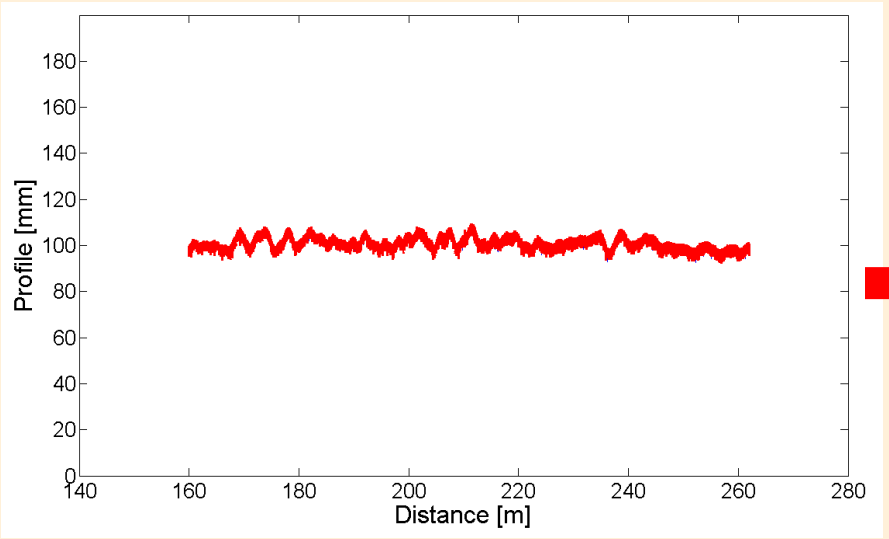


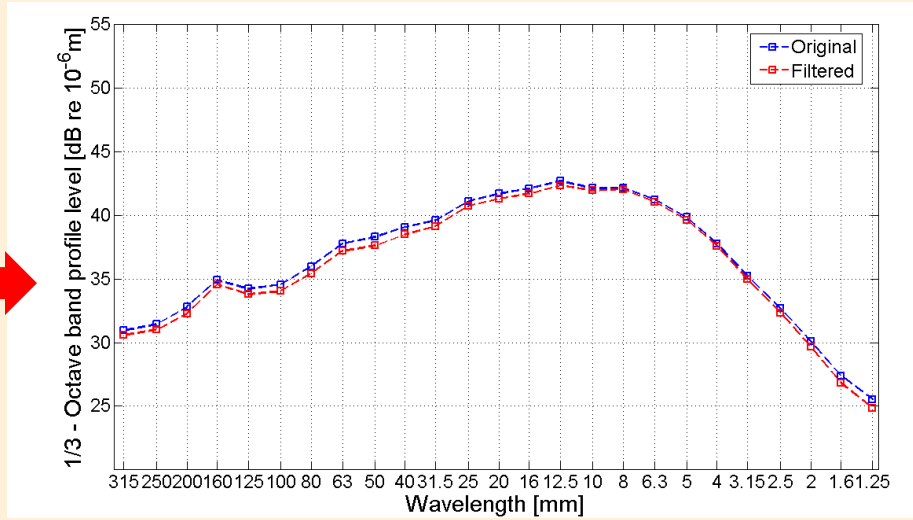
Testing the procedure/determining α (3)



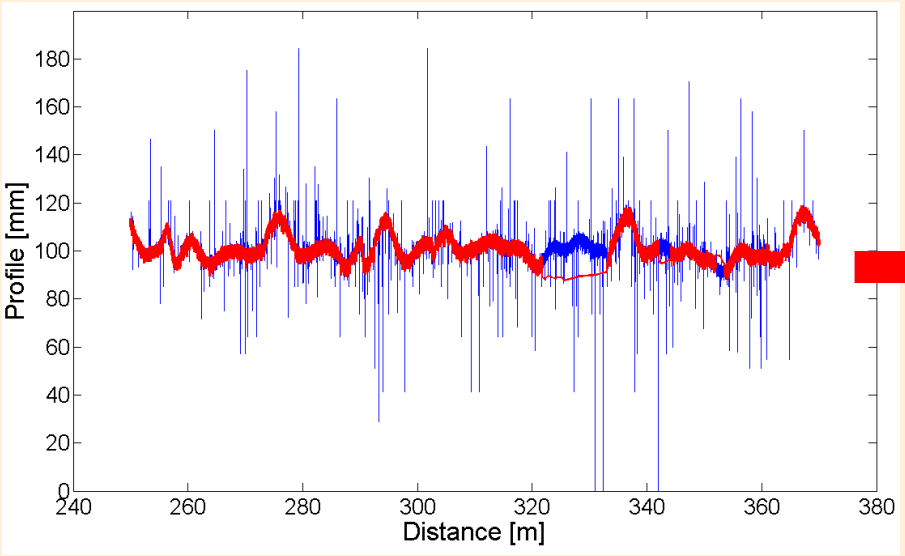


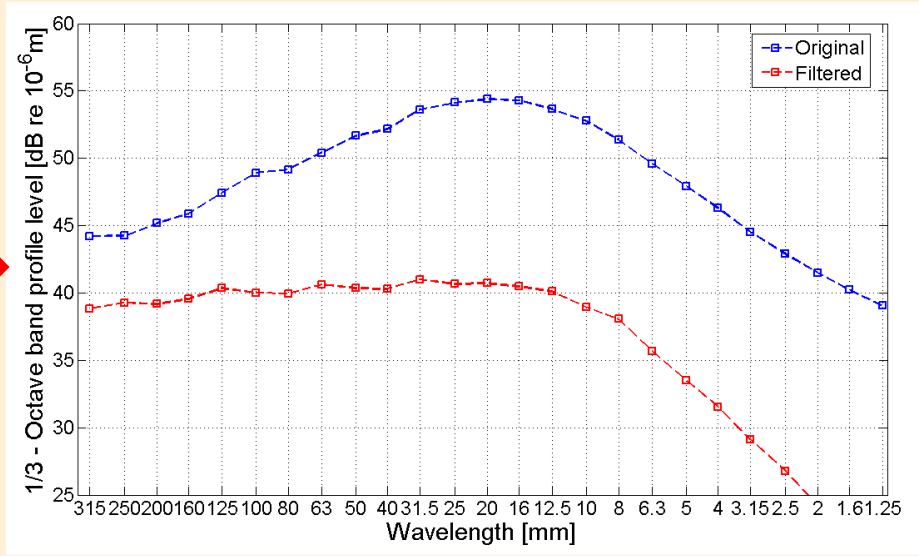
Example from practice...



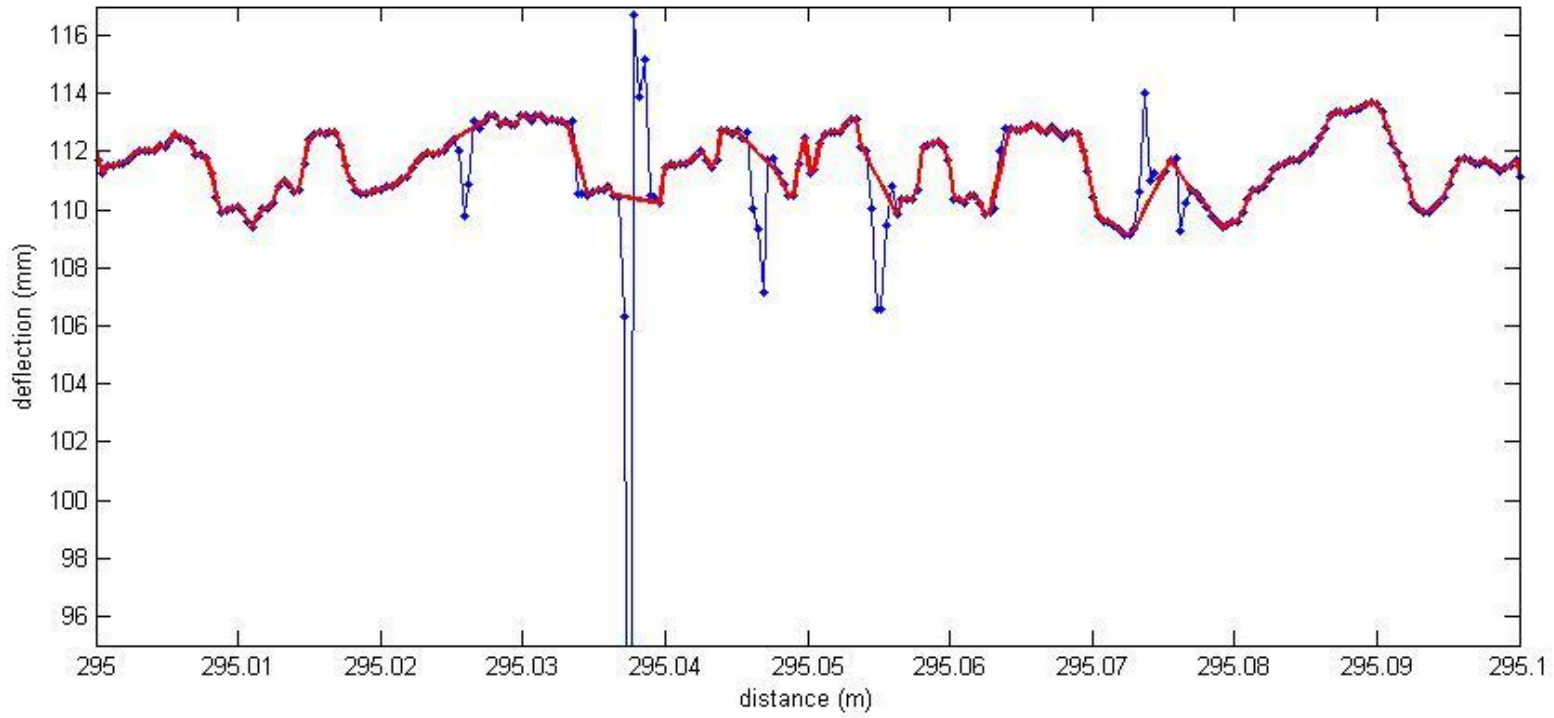


Example from practice... (2)





Example from practice... (3)



Conclusions

- Reproducibility laser profilometers
  - MPD: ± 10 % (66 % c.i.)
  - 1/3 octave spectra: ± 1,5 dB
- Post processing procedure with α = 5 appears to work fine in examples to remove erroneous spikes
- … but it is not a “magic stick” to make correct profiles from unreliable data