Structural Health Monitoring of Large Concrete Structures

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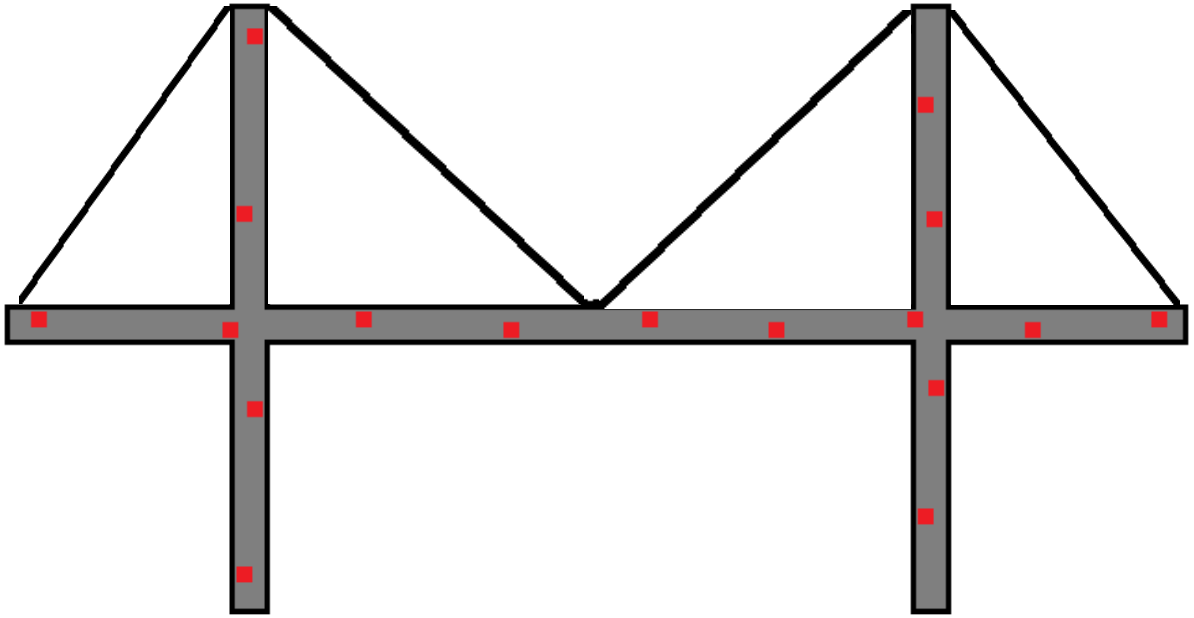
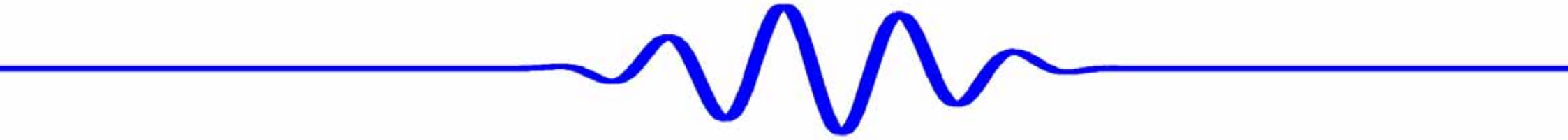
Non-Destructive Testing (NDT)

Structural Health Monitoring (SHM)

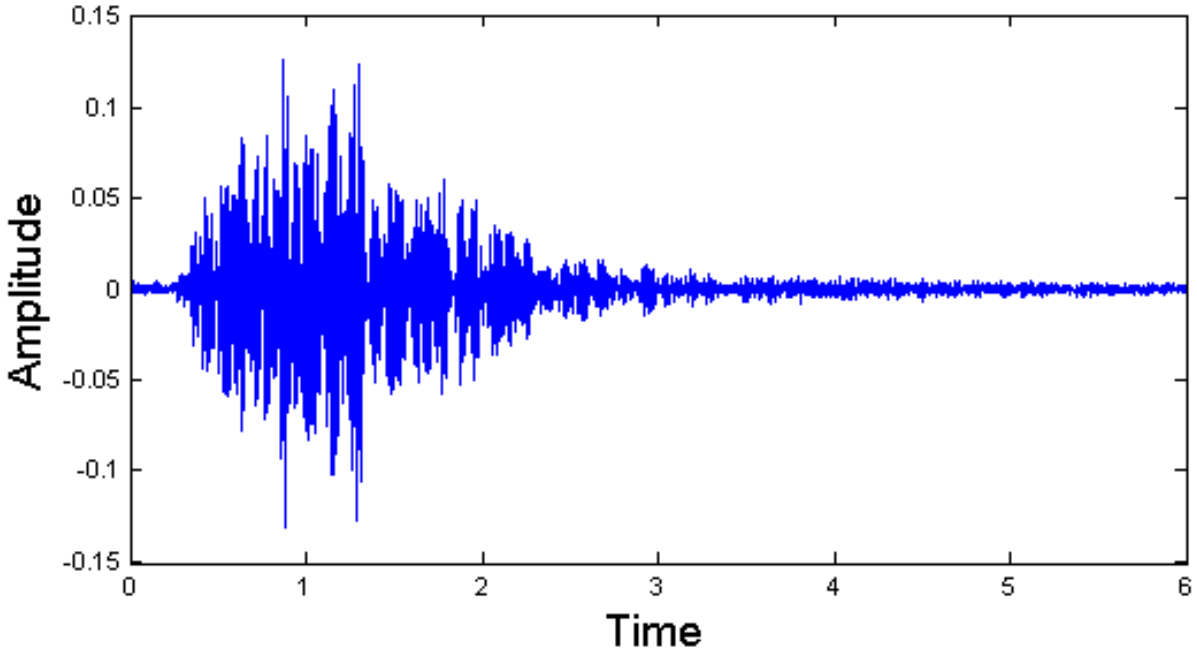


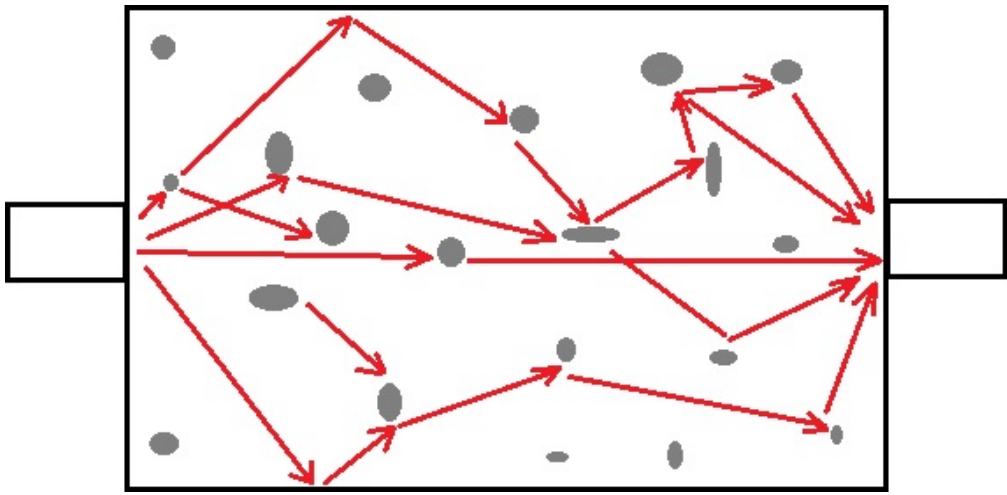
Ultrasonic waves

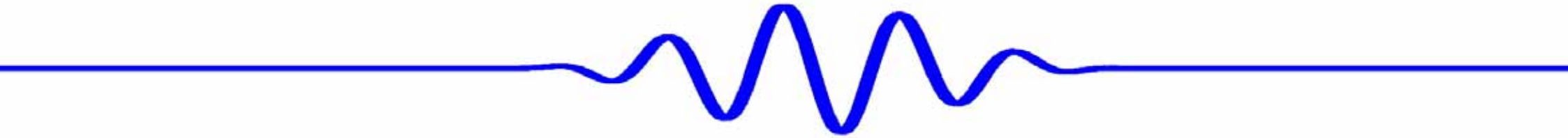
- Velocity
- Attenuation
- Nonlinearity



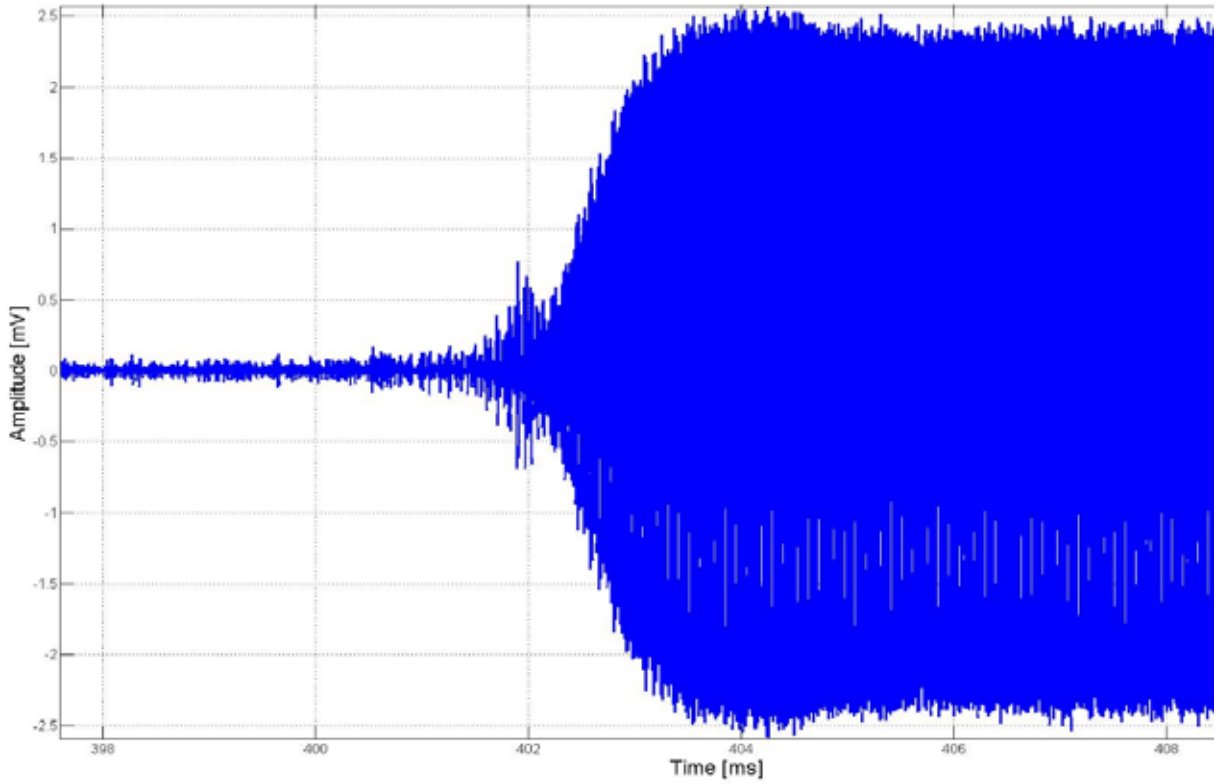
Coda waves

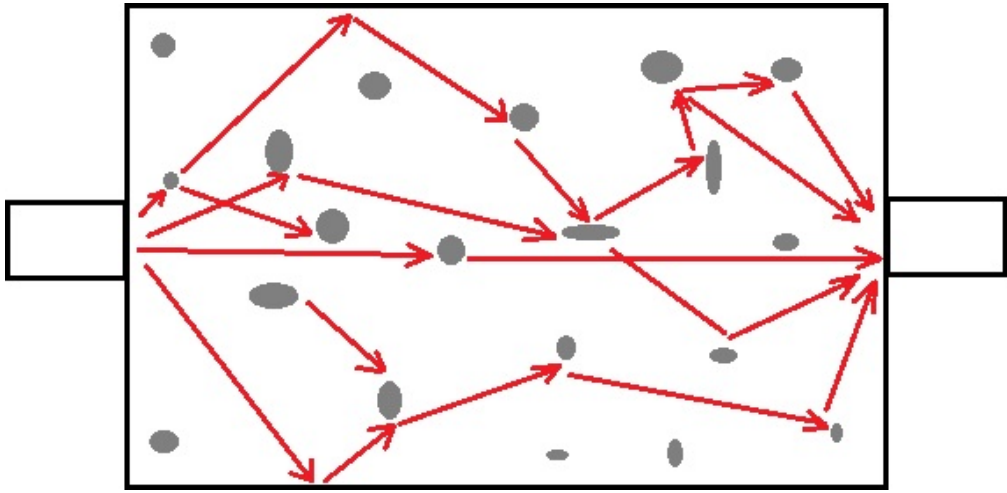






Continuous waves





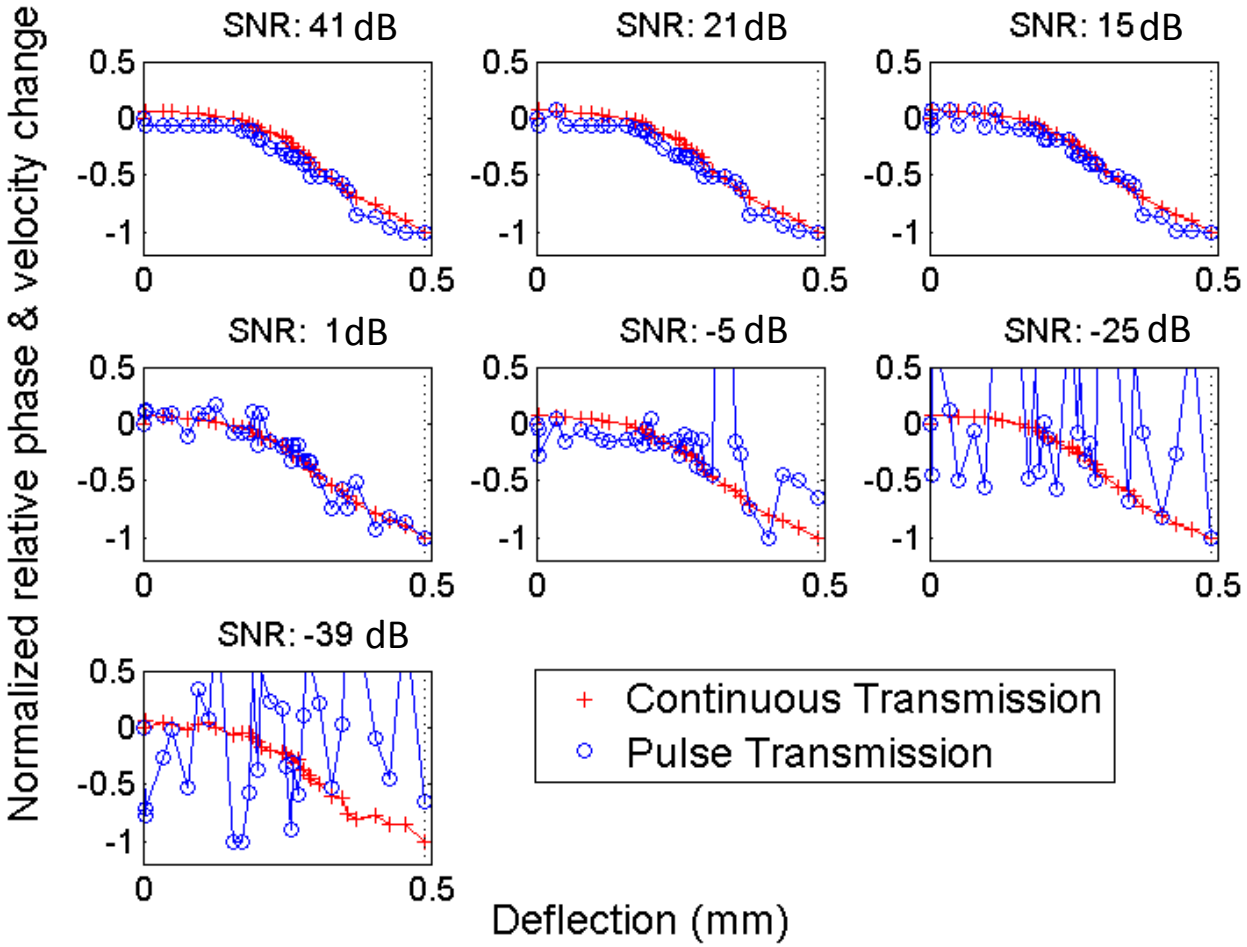
Continuous waves - Lock-In amplifier

Signal Recovery 7210 Multi-channel lock-in

- ”Locks in” on a reference signal
- Measures **amplitude** and **phase** relative to reference signal
- Samples signals with extremely low SNR

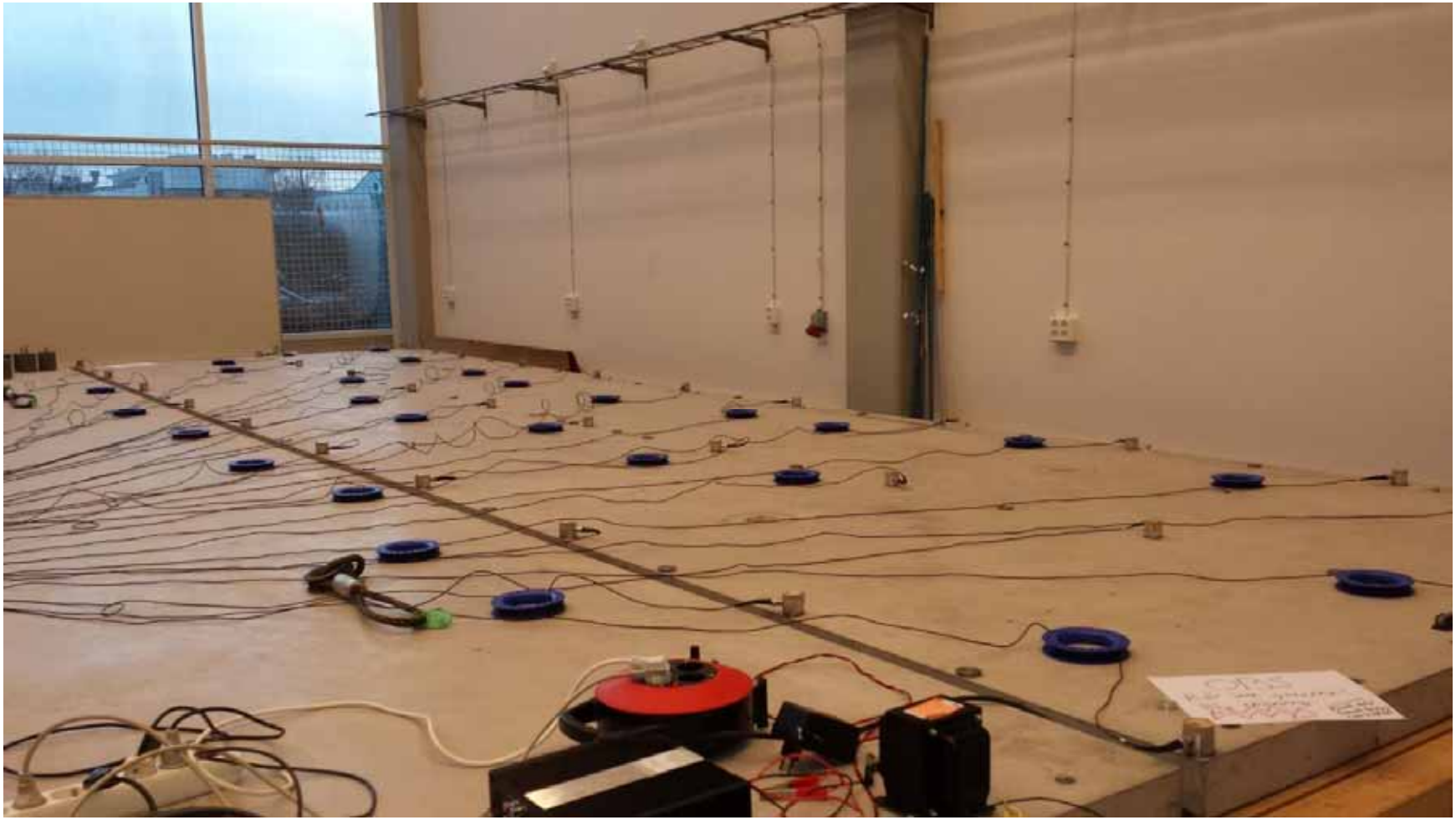
Pulsed vs Continuous waves

Pulsed vs Continuous waves

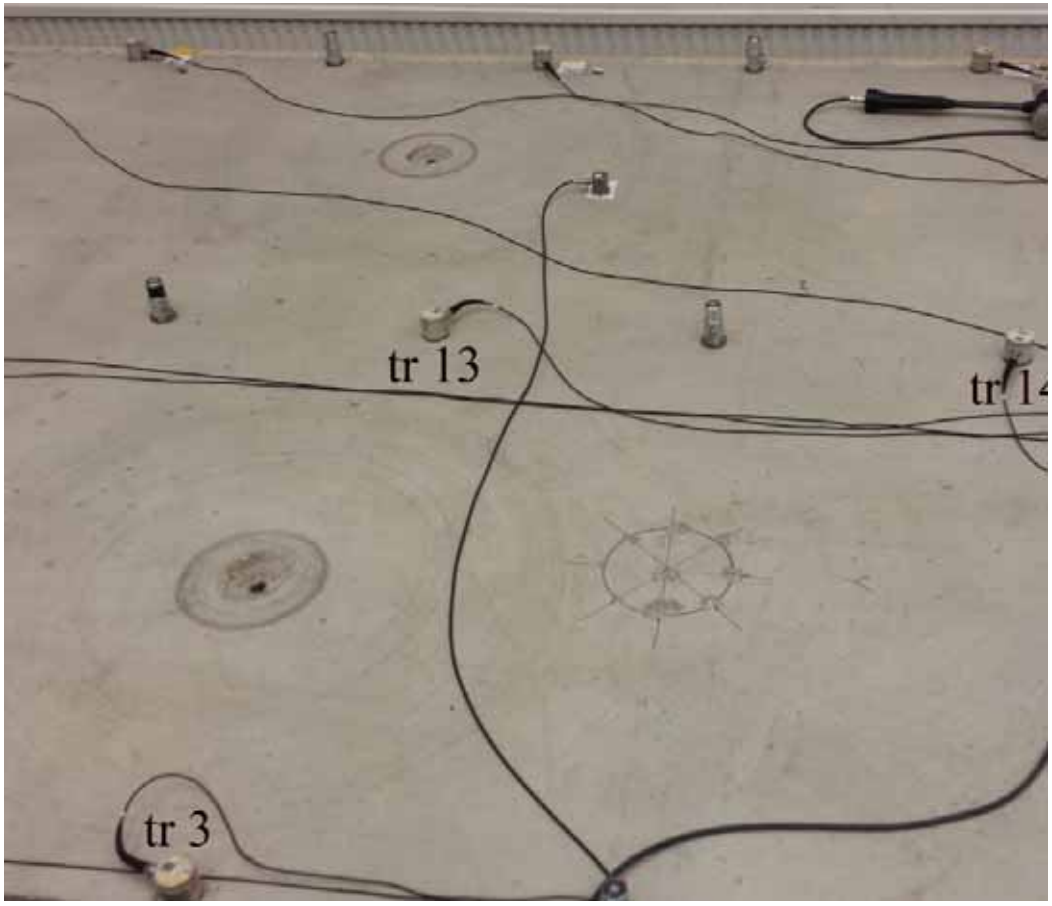


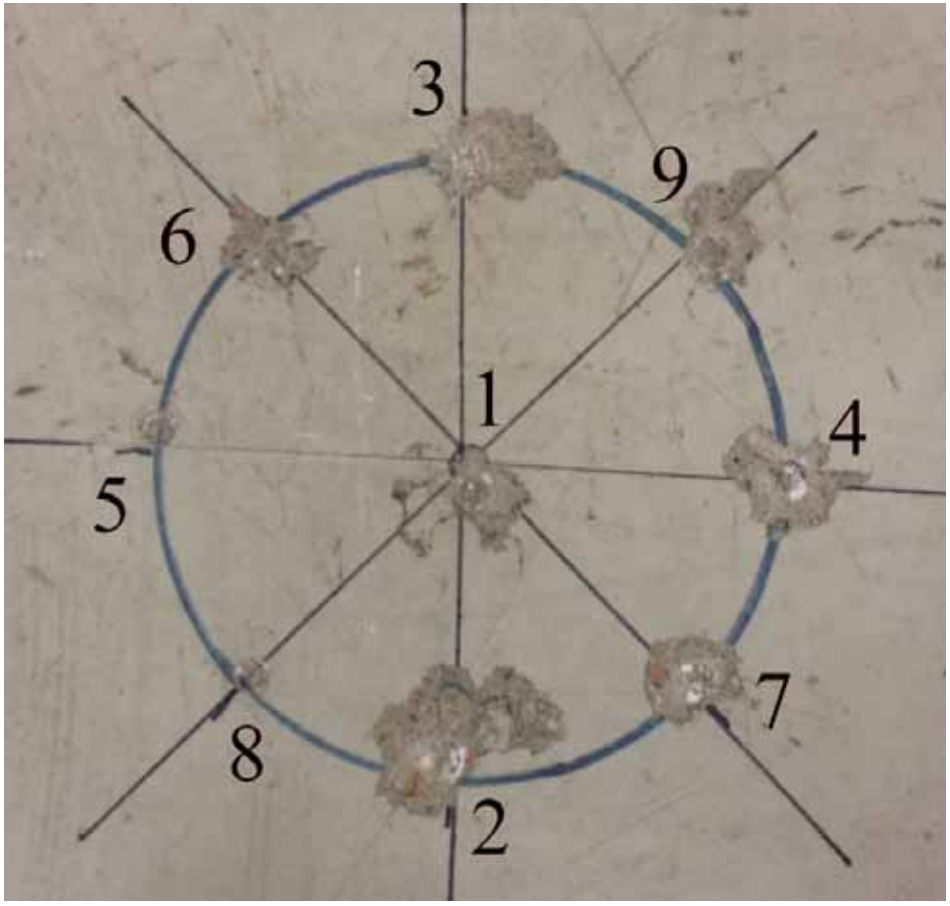
[40 dB = 100x]

Transducer network

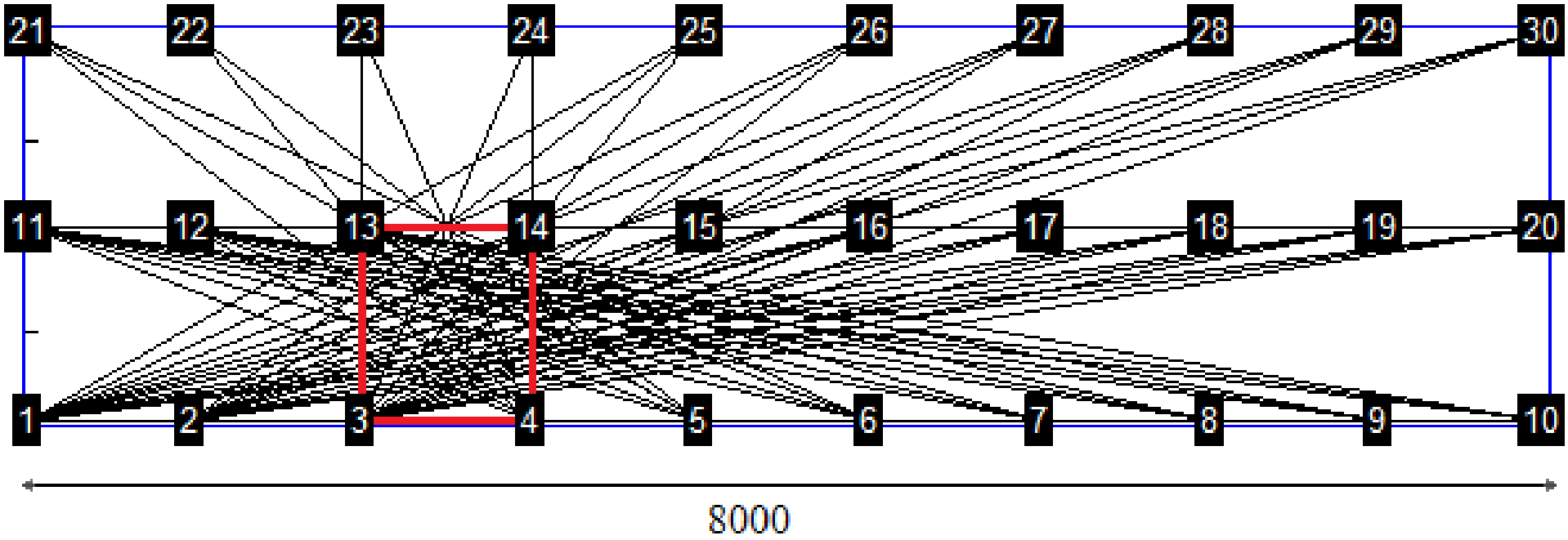


Transducer network

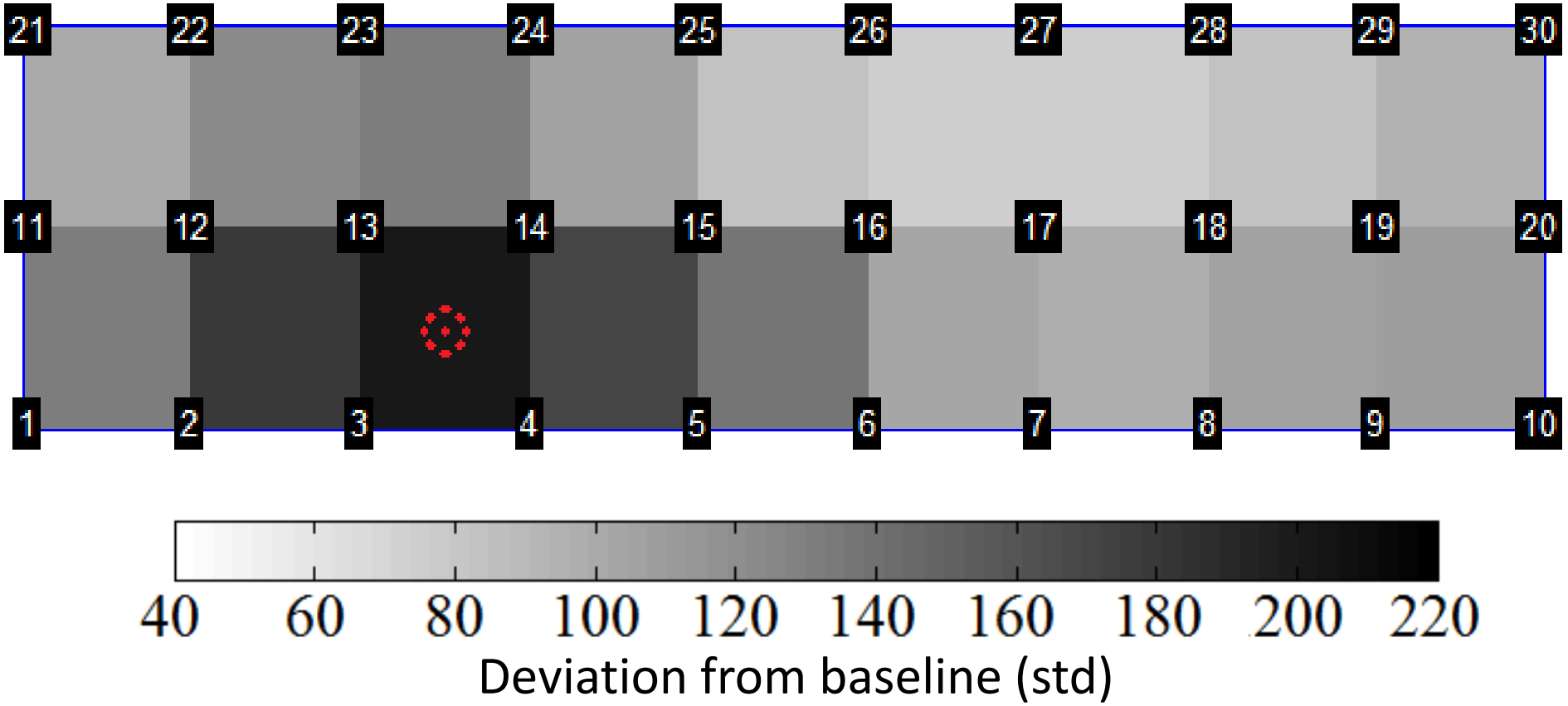




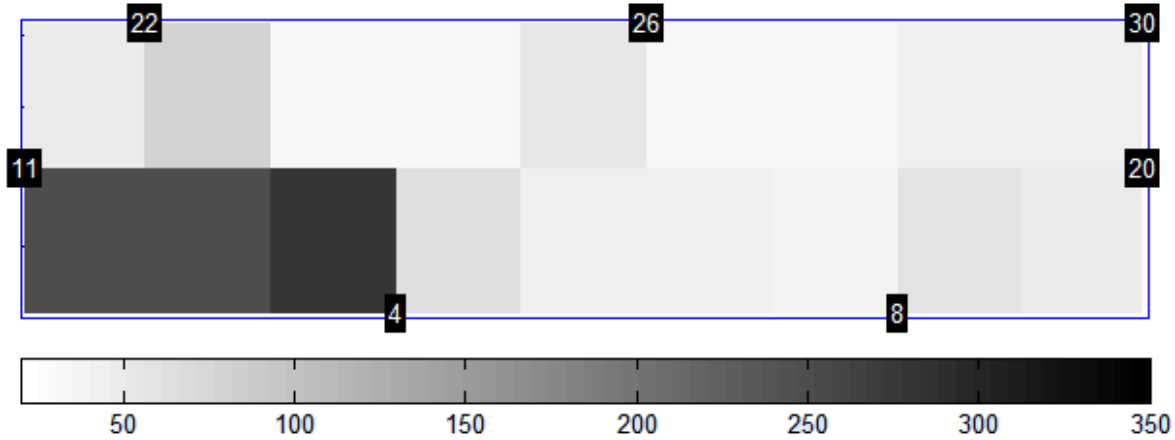
Transducer network



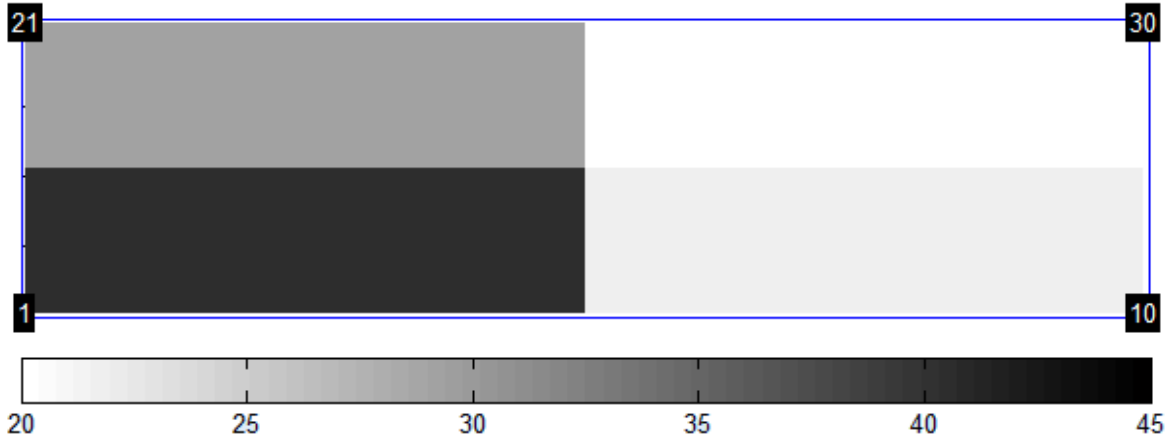
Transducer network



Transducer network



Deviation from baseline (std)



Deviation from baseline (std)

Conclusions

- Diffuse wave fields suitable for SHM of concrete.
- Continuous wave transmission potential for greater distances or higher frequencies at given distance.
- ”Small” damage (~cm) detected over ”long” distance (>8 m).
- 50 kHz waves can be used for localization through tomography .

Thank you!

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Hoover Dam – Colorado River, USA