



Motivation

The Dutch drinking water network comprises over 120,000 km of infrastructure of which half of it is made of Polyvinyl Chloride (PVC) and over 30% is made of concrete. Installed assets have been degrading and will continue degrading until failure. Due to the unknown state of a large amount of the installed pipes, decision making and budget destination on replacement of assets is challenging. A regular size water company yearly invests over several Million Euros in keeping the water pipes operational.

Non-destructive testing (NDT) has been extensively used in many industries to provide information on the physical condition of engineering components. Demčenko et al.^[1, 2] demonstrated that novel ultrasonic techniques (Diffuse Field DF and Non-collinear wave mixing NCWM) in parallel with conventional techniques are able to detect degradation in PVC and in concrete materials. Further research is needed in order apply these techniques in the water mains.

Technological challenge

Ultrasonic pulse-echo testing has been previously performed in degraded concrete. Figure 1 shows the typical parameter obtained from the recorded signal. However, the signal contains more information that can be extracted by employing signal processing algorithms .

As mentioned, the Diffuse Field (DF) and the Non-Collinear Wave Mixing (NCWM) techniques are able to detect leaching in concrete and ageing in PVC, with higher sensitivity than the pulse-technique under laboratory conditions. Nevertheless, field conditions always differ from the ideal situation.

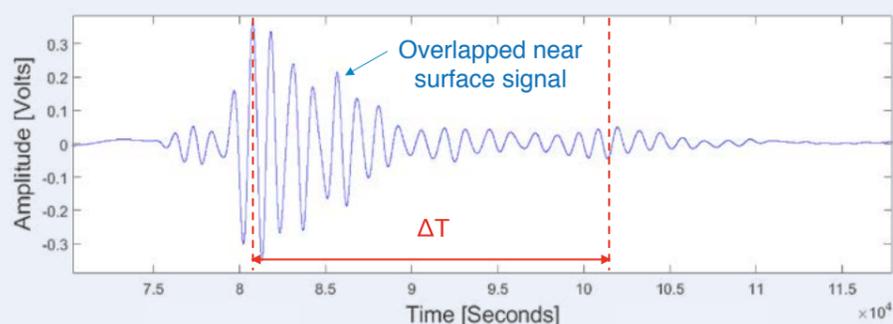
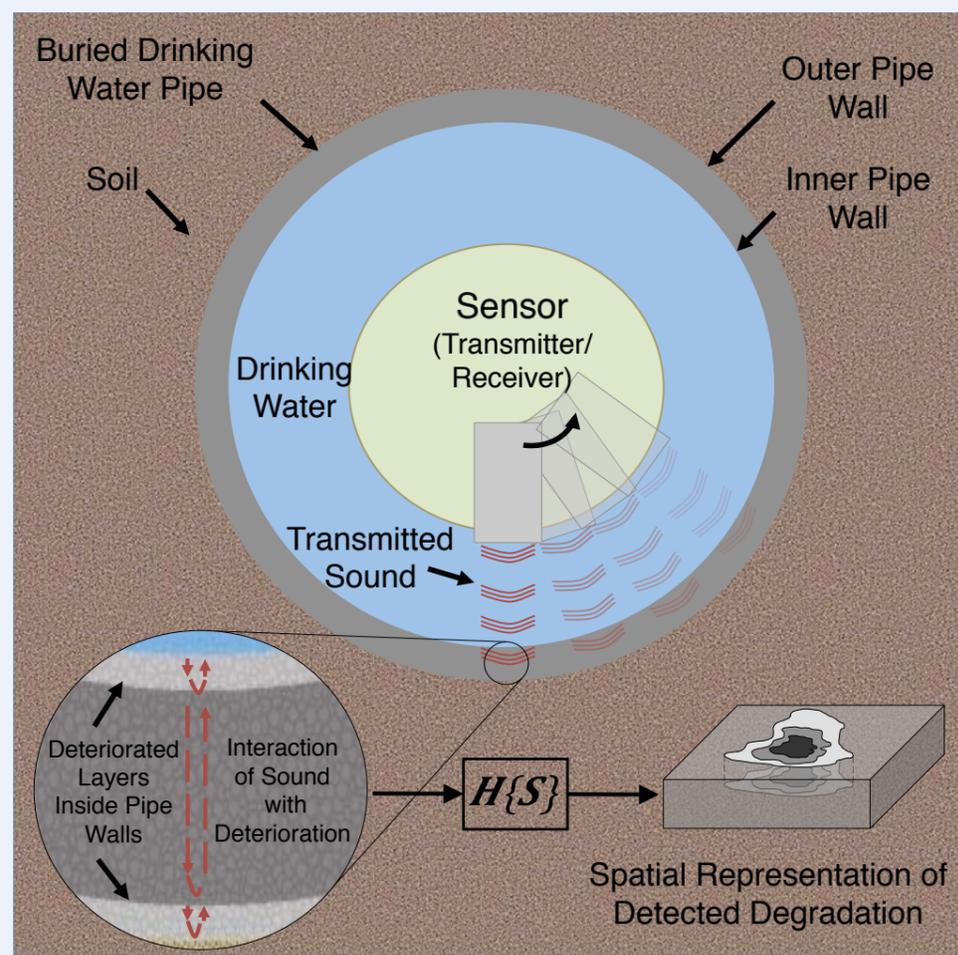


Fig 1. Recorded signal from a 1 MHz ultrasonic wave travelling through a 40 [mm] thickness concrete specimen with 3.5 [mm] degradation depth.



Research goals

Three main objectives are set for this research:

1. Development of an ultrasonic testing method which is capable of detecting and measuring the degraded condition of a water main section;
2. Investigate the effectiveness of the ultrasonic method under operational conditions;
3. Determine how degradation can be detected throughout the circumference and throughout the longitudinal direction from the ultrasonic measurements.

[1] Demčenko, A., Visser, H. A., & Akkerman, R. (2016). Ultrasonic measurements of undamaged concrete layer thickness in a deteriorated concrete structure. *NDT & E International*, 77, 63-72.
 [2] Demčenko, A., Akkerman, R., Nagy, P. B., & Loendersloot, R. (2012). Non-collinear wave mixing for non-linear ultrasonic detection of physical ageing in PVC. *NDT & E International*, 49, 34-39.