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P-SCAN: DETECTION OF VOIDS AROUND NON-METALLIC PIPES

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ABSTRACT: Non-conductive buried pipe systems deteriorate over time under the action of various applied and environmental loads, chemical and microbiological induced corruptions and differential settlements. A key for effective infrastructure management practices is the availability of reliable and timely inspection data that serve as the basis for the selection of proper rehabilitation/replacement methods. CCTV inspection is limited to detection of visible defects on the inner wall of the pipe. Defects hidden beneath encrustation or a liner as well as voids immediately outside of the pipe are currently difficult if not impossible to detect. It is proposed to develop a novel inspection technology, employing ultra-wideband (UWB) pulsed radar system, for detecting “below surface” defects, corrosion, and out-of-pipe voids in non-metallic buried pipes. The proposed method is very powerful as it is capable of detecting both, variations in material properties and variations in geometrical shapes. For example, a corroded region differs from non-corroded regions by changes in electrical properties, conductivity and permittivity. On the other hand, voids and can be detected by comparing the timing of the reflected signal from adjacent surfaces.

The paper provides an overview of UWB technology and its applications in civil infrastructure. Thereafter, the results of a computer simulation using finite difference time domain (FDTD) analysis of a prototype UWB inspection system, which utilizes a UWB conical antenna, are presented. A novel cylindrical coordinates was developed for the analysis to avoid the stair-casing errors associated with Cartesian coordinates. A mathematical model developed for calculating the pipe wall thickness based on an analysis of the returning signal is also presented.