**Experimental and Analytical Study of Underground Water Pipes Leakage Detection Using Ground Penetrating Radar**

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**ABSTRACT:** Water pipes leakage is one of the problematic issues for current water industry. Leaky pipes not only lead to waste of precious natural resources (e.g.: non-revenue water), they create substantial damage to the transportation system and structure within urban and suburban environments as well. For solving this issue, many non-destructive geophysical techniques have been suggested as tools for detecting water pipes leakage, including electromagnetic or radio frequency devices, acoustic devices, gas sampling devices and pressure wave detectors. In this paper, the feasibility and implications of well-known geophysical tools (i.e. Ground Penetrating Radar) was evaluated through comparison of numerical modelling and physical work for water pipes leakage detection at real world. For this study, finite difference time-domain (FDTD) numerical modelling is used to simulate water pipe leakage condition for obtaining a comprehensive set of simulates images. These images were then compared with the data acquired at the selected site which contains leaky pipes for analysing the functionality of commercially-available Ground Penetrating Radar in detecting water pipes leakage. Through the distinctive signature of leakage of a 300 millimetre (mm) diameter fire hydrant ductile iron (DI/CI) pipe in the radar profile which generated from numerical modelling and acquired from selected site using Ground Penetrating Radar, it shows that the leakage zone is disturbed by the wave reflection caused by saturated soil as compared to the hyperbola signature of intact pipe in the radar profile acquired from both methods. Thereby, the good agreement of distinctive signature of water pipe leakage between the simulated radar profile and commercially-available acquired radar profile, proving that Ground Penetrating Radar is hence a useful geophysical non-destructive water pipe leakage detection approach. With such convincing results shown in this paper, it contributes new valuable addition to the implications of ground penetrating radar to the underground utility mapping industry other than utility detection and localization only.