Crack Detection In Buried Pipes Using Complex Resonant Frequencies

Fadi G. Deek* and Magda El-Shennawee
Electrical Engineering Department, University of Arkansas
Fayetteville, Arkansas 72701
fdeek@uark.edu

Naturally occurring resonant poles have been frequently used to detect and classify buried objects. The main advantage behind using such poles is their sole dependency on the underlying geometry of the target object.

In order to identify a buried pipe, the medium will be illuminated with electromagnetic waves. The frequency response will be collected over a sweep of frequencies. The inverse fourier transform will be performed on the acquired data to construct the transient time domain response. Time gating will be applied to extract a window from the late time response to make sure that the excitation has decayed. The time window will be inserted into a Matrix Pencil Method (MPM) algorithm to extract the poles and their residues. The MPM is a MatLab friendly algorithm that has shown higher accuracy and more robustness in noisy environments over other pole extraction techniques.

The contribution of this work is to utilize the complex poles method to detect cracks and defects in buried pipes. This work is motivated from implementing this technique in RFID applications. Such methods are “chipless” in the sense they depend on the geometry of the scatterer for its detection.

A Method of Moments based solver, FEKO, is used as the forward solver. The pipe-soil model will include different soil types such as loamy, sandy and silty. The PEC pipe will vary in geometry from 1 to 5 inches in radius. The burial depth will be between 12 and 24 inches. The material inside the pipe will also be varied from liquids to gases.

A controlled lab experiment has already been setup at the University of Arkansas. It will be used in parallel with the simulations to prove the concept of the proposed method. Results will be presented at the conference.