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Detection of a Misaligned Broken Pipe by Electromagnetic Interaction

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The study we are presenting concerns electromagnetic scattering of a plane wave due to the presence of a misaligned broken pipe buried in a half-space occupied by cement and by asphalt/ground, for civil-engineering applications. In order to simulate a realistic scenario, the pipe is supposed cylindrical and made of metallic or poly-vinyl chloride (PVC) material whose electromagnetic properties are known in the literature and dimensions are the most used in civil-engineering applications. We consider the longitudinal axis of the pipe running parallel to the air-cement interface. We suppose, after the break of the pipe, that the longitudinal axes of the two parts move on a plane parallel to the separation interface, in opposite directions.
The study focuses on the electromagnetic response of the scattered electric field along a line above the interface of the media considering different distances between the longitudinal axis of the tubes in two cases: PVC and metallic material. To accomplish the study, a commercially available simulator based on the Finite Element Method (FEM) is adopted and a circularly-polarized plane wave impinging normally to the interface is considered. This kind of study could be useful for monitoring the status of buried pipes using ground penetrating radar (GPR) techniques in many applications of Civil Engineering without the need to intervene destructively in the structure.

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