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Abstract

Detection of buried objects such as pipes using a Ground Penetrating Radar (GPR) is intricate for three main reasons. First, noise is important in the resulting image because of the presence of several rocks and/or layers in the ground, highly influencing the Probability of False Alarm (PFA) level. Also, wave speed and object responses are unknown in the ground and depend on the relative permittivity, which is not directly measurable. Finally, the depth of the pipes leads to strong attenuation of the echoed signal, leading to poor SNR scenarios. In this paper, we propose a detection method: (1) enhancing the signal of interest while reducing the noise and layer contributions, and (2) giving a local estimate of the relative permittivity. We derive an adaptive detector where the signal of interest is parametrised by the wave speed in the ground. For this detector, noise is assumed to follow a Spherically Invariant Random Vector (SIRV) distribution in order to obtain a robust detection. We use robust maximum likelihood-type covariance matrix estimators called *M-estimators*. To handle the significant amount of data, we consider regularised versions of said estimators. Simulation will allow to estimate the relation PFA-Threshold. Comparison is performed with standard GPR processing methods, showing the aptitude of the method in detecting pipes having low response levels with a reasonable PFA.

Keywords: GPR, buried pipes, adaptive detection, covariance matrix, non Gaussian, regularised covariance matrix estimator.

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