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Time domain electromagnetic sensing techniques for underground pipe diagnostics

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Based upon frequency domain integral equation thin sheet theory, comparative numerical modeling using three-component time domain electromagnetic (TEM) receiver was under taken. A forward modeling approach was used to compute the voltage response of half-space containing one or more conductive bodies excited by a bi-polar square wave form. Although this method utilizes conductor scattering, it is particularly useful as a practical use for the non-destructive electromagnetic monitoring of the transport infrastructure consequences from natural disasters. Unlike single component data, results from the three-component data are unambiguous as to the location and orientation of conductors. Measurements with the addition of horizontal- component data for secondary magnetic fields lead a better indication of target location, and target size determination, orientation, and characteristics, especially for the targets in the horizontal plan. I analyze three-axis TEM data from a known well site and detect transient volt anomalies, which are consistent with our theoretical modeling and which can be correlated with well locations in the conductor host. From this and other surveys, it is apparent that there is a lot of useful information in the horizontal components of near-surface TEM surveys. Whilst the vertical component contains stronger anomaly data and provide the best indication on a given target's location, the horizontal component data, can be used to determine size, orientation, and characteristics of targets, especially for targets extending horizon tally (i.e. power lines, sewer pipes, etc.). As a result, the three-component TEM survey is an essential element for high-resolution EM engineering survey.