NUMERICAL MODELING OF A SINGLE FREQUENCY METAL DETECTOR

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ABSTRACT

In this work, detection performance of a single frequency (narrow-band) metal detector is investigated numerically for a buried conductive object. The numerical solution is based on a full wave analysis of Maxwell’s equations at low frequencies. Finite-Difference Time-Domain method with a concept of the magneto-quasi-static approximation is used for the numerical solution [1], [2]. The problem space in Cartesian coordinates consists of a transmitter and a receiver loop antenna, air-ground interface and a buried nonmagnetic conductive object. The transmitter and receiver loop antenna are modeled as monochromatic magnetic dipoles. First, validation of the time-domain numerical solution is performed by comparing numerical and analytical radiation patterns of a magnetic dipole [3]. Then, the horizontal (spatial) distribution of scattered magnetic fields is calculated. Thus, the detection performance of the metal detector is investigated for the different scenarios of non-environmental and unchangeable parameters (such as the antenna-ground distance and depth of the object).

KEYWORDS - Metal detector, buried conductive object, detection, time-domain numerical methods.