Modelling the Radio Imaging Method using Electric Dipoles in a Homogeneous Whole Space

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Abstract

The Radio Imaging Method (RIM) is a tomographic geophysical method used to delineate areas of interest between boreholes. Utilizing electromagnetic radiation in the radio frequency, conductive bodies can be found due to attenuation of the signal. However, information as to how the RIM signal changes when the system parameters change or the rock properties change is not well documented. Having a better understanding of the impact of these changes would assist in interpretations of RIM data. To address this issue, a simulation of a RIM system was created in Matlab®, wherein the transmitter is represented as a harmonic electric dipole. The receiver borehole can be placed anywhere in the model space, and the response that would be measured can be simulated. This basic model allows an investigation of how the response changes due to three different types of variables: 1) The material of the system that the radiation passes through is governed by the conductivity, dielectric permittivity, and magnetic permeability; 2) The geometry of the system can be represented by the distance between, and the angle of, the two boreholes; And 3) the radiation is defined by the transmitter's frequency, current, and size. Several key conclusions have been made. For most parameters, the highest or the lowest frequency give a much greater amplitude response than any other frequency. The assumption that the transmitter can be approximated as an infinitesimal dipole was validated for most cases, except extremely conductive systems. An angled borehole causes a shift in the peak position of the amplitude response, and in some cases, creates a secondary peak. An understanding of these results, and others that can be obtained from the model, will assist in the interpretation of complex situations.