Antenna Design for the GPR Detection and Classification of Landmines

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An ultra-wideband antipodal vivaldi antenna is designed to cover the frequency band from 1.4 to 8 GHz with -10 dB reflection coefficient. A system of two antennas is used with a ground-penetrating radar (GPR) for the detection and classification of landmines. The testbed model comprises an 80x80x40 cm^3 container filled with soil. The soil is modeled as a material with a permittivity of 2.55, which is typical for dry sandy soil. Electrical models of the most common landmines available in Lebanon are produced and used in an electromagnetics simulation software. As examples, the models of the Gyata-64 and the AP Mine No. 4 landmines are shown in Figure 1.
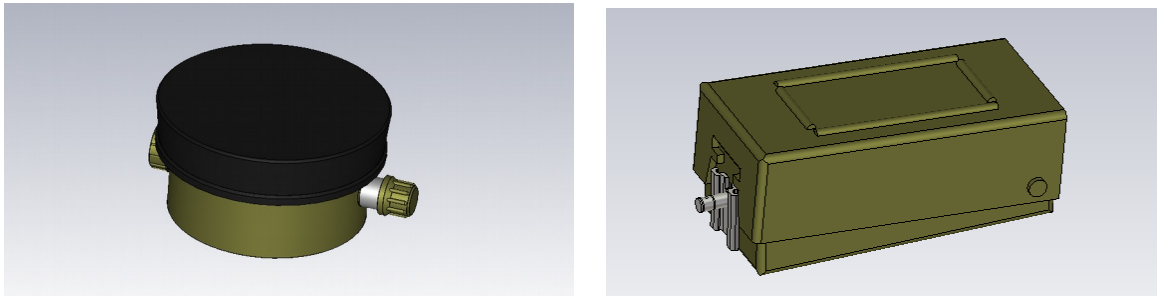

Figure 1: The Gyata-64 Mine and the AP Mine No.4

One of the antennas is used to transmit a gaussian pulse, while the other antenna receives the response from the soil and the landmine buried in it at a specific depth. The responses are different for different types of soil and different landmine types, positions, and depths.

Figure 2 shows the testbed model including the two vivaldi antipodal antennas, the soil, and a landmine buried in the soil. Figure 3 shows the received pulses due to the soil alone, the soil with the AP Mine No. 4 centered below the antennas at a depth of 5 cm in the soil, and the last one is for the soil with the Gyata-64 landmine at the same depth. Clearly, these obtained responses are different, and they will be different for each new landmine type. Collecting and saving the responses of the most common landmines helps to classify an underground target and make a decision about its nature, whether a landmine or not. Several classification algorithms are being applied to the database of obtained responses and their performances tested. The most appropriate algorithm will be used for the detection and classification of landmines.
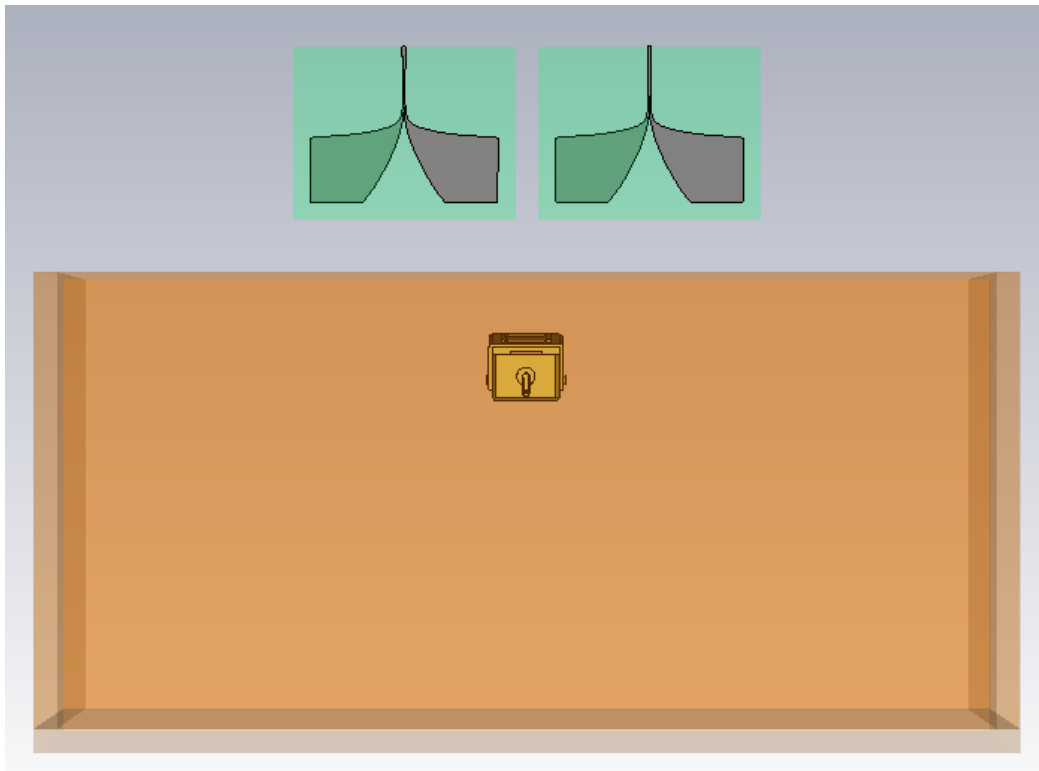
Figure 2: GPR testbed including the two vivaldi antipodal antennas placed above the soil containing the AP Mine No.4
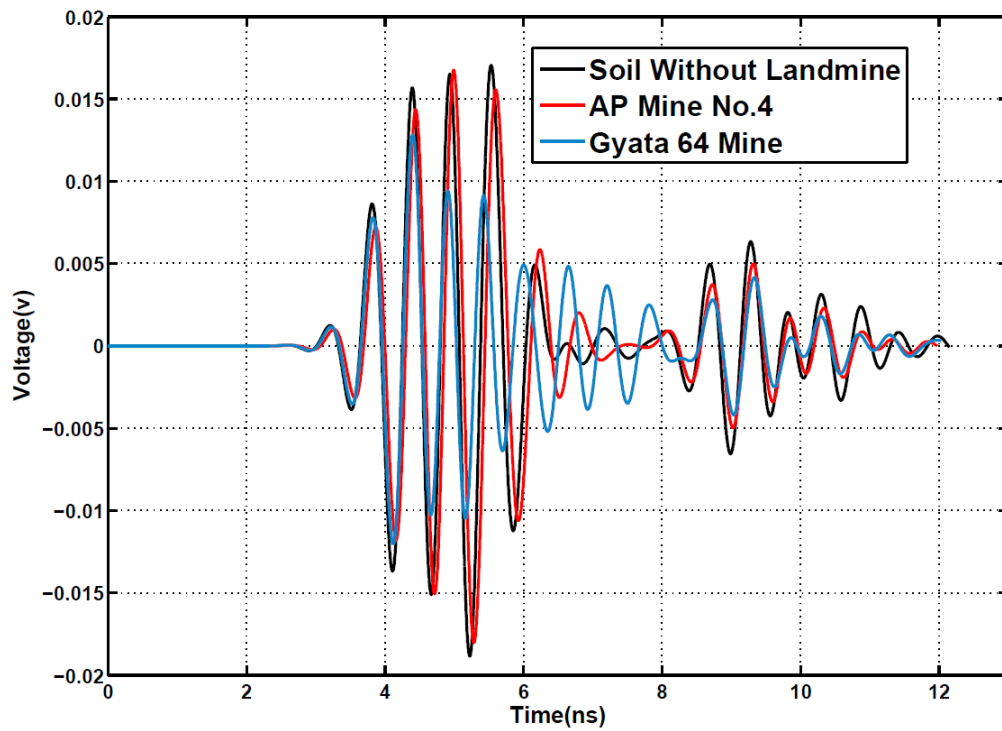

Figure 3: Different responses of the soil and the two landmines