

An Acousto-Electromagnetic Method for Detecting Buried Objects

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A hybrid technique is presented that simultaneously uses both electromagnetic and acoustic waves in a synergistic manner to detect buried land mines. The configuration of the system currently being studied is shown in figure 1. The system consists of an electromagnetic radar and an acoustic source. A surface acoustic (Rayleigh) wave is induced in the earth by means of a stationary transducer on the surface of the earth. The transducer is placed near the region being scanned for mines and directs the surface wave into the region being scanned. The surface wave interacts with the mine and causes both the mine and the surface of the earth to be displaced. The displacement of the mine is different than the earth, because the acoustic properties of the mine are quite different than those of the earth. The displacement of the surface of the earth when a mine is present is different than when it is not present because of the waves scattered from the mine. The electromagnetic radar is used to detect these displacements and, thus, the mine.

Both experimental and numerical modeling is being performed to investigate this technique. The experimental model consists of an electrodynamic transducer to induce the surface wave, a tank filled with damp sand to simulate the earth, a simulated mine, and a radar mounted on an automated positioner to measure the vibrations. Experimental results obtained with this system are presented for both anti-personnel and anti-tank mines. The interaction of the acoustic waves with the mine can be seen in the results. The results look very promising; we have been able to detect both simulated anti-tank and anti-personnel mines.

A two-dimensional FDTD model for the acoustic waves has been developed. The results from the FDTD model are in fairly good agreement with those from the experimental model. The numerical model has been a useful aid in understanding the interaction of the acoustic waves with the mine. Results obtained with the FDTD model are presented that show the interactions of the acoustic waves with the mine.

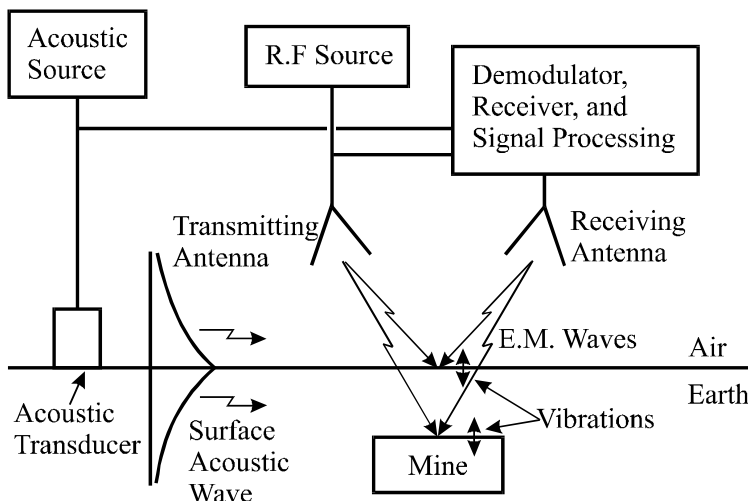


Figure 1. Acousto-electromagnetic mine detection system with the acoustic transducer placed on the surface of the earth.