Extracting Landmine Characteristics Using Electromagnetic Techniques

A Thesis Submitted to Faculty of Science-Ain Shams University for The Degree of Master of Science (M.Sc.) in Physics

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ABSTRACT

More than 70 countries suffer from around 100 million landmines all over the world. There are two steps to get rid of the landmines; firstly detect and allocate the position of them then removal step. Ground Penetrating Radar (GPR) technique is considered a promising technique for landmine detection and wide range of detection applications. It can detect both metallic and non-metallic landmine. The GPR systems subjects to R&D in various challenges in order to enhance the efficiency of the whole system. Current research is performing on both hardware as well as software like antenna and algorithms respectively.

This thesis cover the hardware development representing in proposes Ultra Wideband (UWB) antenna design. The reported design has wideband, high gain and high directivity. The new configuration achieves unidirectional radiation characteristics maintaining the circular polarized (CP) radiation characteristics. The whole configuration is optimized using particle swarm optimization algorithm to achieve the optimal bandwidth, gain and axial ratio (AR). It satisfy some requirements that's render it good candidate for GPR systems. The proposed antenna is simulated using Finite Integration Technique (FIT) and fabricated using photolithograph technique. The performance of the antenna is analyzed in terms of S_{11} parameter, gain, directivity and axial ratio. The measured results are in a good agreement with the simulated. The proposed configuration offers -10 dB return loss bandwidth of 540 MHz over the frequency range (0.8- 1.34 GHz) with~ 50.5% operational bandwidth and 3dB AR bandwidth of 295 MHz for (0.97-1.265 GHz) with approximate percentage of 26.4%. Furthermore, the maximum gain over the CP-operated bandwidth close to 8.86 dB, at frequency 1.05 GHz, is obtained.

Finally, the proposed antenna design is utilized within virtual experiment to extract electromagnetic EM characteristic signatures of a buried object like landmine in sand box. It is anticipated that this antenna is suitable for GPR applications as well as for employment in landmine detection at depths reach to 60 cm.