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Title of Thesis: Microwave Remote Sensing Techniques of Water Pollution Detection

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ABSTRACT

Environmental pollution is considered a major problem in the modern world. It includes air pollution, water pollution and sound pollution. The detection and control of pollutants in water have great importance. Recently, many parts of the world are suffering because of a lack of clean water. Contaminants present above a certain level in water are extremely harmful to human beings' health. Water pollution is detected in laboratories, where small samples of water are analyzed for different contaminants. However, testing for all known water contaminants over a wide area is a complicated and expensive process. The prime objective of this study is to detect water pollution in underground pipelines. The analysis is based on proposed electromagnetic models and experimental data taken under laboratory conditions. Detection of pollution is based on the contrast in the dielectric permittivity between contaminated and clean water. The modelling process includes multiple reflections within each layer, and it has the flexibility to include more complicated structures. Water pollution can be detected by observing the variation of reflected signals from subsurface structures. The complex dielectric permittivity of different types of pure water and polluted water is measured as a function of frequency and analytically represented by Debye and Cole-Cole fit models. The advocated microwave technique, discussed in this thesis, is a potential tool for the detection of water pollutants. Results of this work show that microwave sensing is able to accurately discriminate between clean and polluted water. The current study can also serve as a useful tool to extract more detailed information about water properties in underground pipelines. A wideband GPR antenna with half and defected ground plane for buried object detection is designed. The antenna offers wide bandwidth from ٠,٥ GHz up to ٣ GHz which is suitable for ground penetrating radar (GPR) system to detect water pollution in under the ground pipelines. Full wave analysis of a prototype laboratory model of a pipe buried in sandy soil were used to investigate the potential of using ground penetrating radar to detect water pollution in the underground distribution system. A series of simulations of water pollution detection model were conducted to determine the validity and effectiveness of GPR technology in detecting water pollution in underground in plastic pipes.

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