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Reflection Coefficient Detection of Simulation Models for Microwave Imaging Simulation System

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Abstract. The study was conducted based on two objectives as framework. The first objective is to determine the point of reflection of the microwave signal when penetrating into the simulation models while the second objective is to analyze the reflection pattern when the signal penetrate into the layers with different relative permittivity, ϵ_r. Therefore, investigation was made on the proposed microwave models to develope the most similar model to the actual human brain. The study proposed two different layers on two different characteristics models. Radius on the second layer and antenna position are the factors for both models. Radius for model 1 is 60 mm with an antenna position 10 mm away, while model 2 is 10 mm larger in size with an antenna adapted closely without any gap between. The layers of the models were developed with different combination of materials such as Oil, Sandy Soil, Brain, Glycerin and Water. Results show the combination of Glycerin + Brain and Brain + Sandy Soil are the most similar model to the actual human brain grey and white matter. The results are very useful in the subsequent studies for future enhancement and development of the models.

Keywords: microwave signal, human-like phantom, relative permittivity, reflection coefficient, CST

1. Introduction

The study proposed a technique by using microwave signal features to discover the human brain characteristics for human brain phantom development. Microwave signal is a radar-based imaging research where a short pulse is transmitted from a single ultra-wideband (UWB) antenna into the human brain phantom. This is a mono-static study where the back-scattering parameters (S-parameters, S_{11}) are detected by the same antenna.

The early stage development of experimental human brain phantom is described in detail in [1,2] while the preliminary development of simulation models is described in [3]. The experimental results from Vector Network Analyzer (VNA) machine [4] were compared to the simulated result from Computer Simulation Technology (CST) software application.

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