Brain tumor detection and size estimation using microwave imaging

ABSTRACT

This project focuses on developing an antenna that utilising microwave imaging technology for visualising, detecting, and estimating the size of human tumors using simulation approach. A rectangular microstrip patch antenna is chosen for its advantages of low cost, convenience, efficiency, and compactness, offering a non-ionised alternative. To meet the antenna specifications, rectangular slots are incorporated into the design. The antenna performs effectively at 7.5 GHz, exhibiting a return loss of -24.20383 dB, well below the -10 dB threshold. Placing the antenna 15 mm away from the human brain model results in a specific absorption rate (SAR) value of 0.2 W/kg for 10g, indicating its safety for brain imaging. By scanning a human head phantom with and without a tumor, the antenna captures reflected signals from different locations, enabling the generation of tumour images. A 10-mm-radius tumor is introduced to the phantom, and the unique reflected signal serves as an indicator for tumor detection, using the signal without a tumor as a reference. MATLAB software is employed for image processing, allowing the generation of tumour images and the estimation of tumor size. The simulation results demonstrate 63% accuracy in tumor size estimation. In conclusion, the antenna proves to be a safe and effective brain imaging system for tumor detection.