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Multifrequency Microwave Imaging for Brain Stroke Detection

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Abstract: Early diagnosis of stroke with timely treatment could reduce adult permanent disability significantly [1]. Conventional medical imaging tools such as X-ray, ultrasound, computed tomography (CT), magnetic resonance imaging (MRI) and positron emission tomography (PET) have been widely used for diagnosis of brain disease. However, each of these methods has some limitations. X-ray imaging produces harmful radiation to the human body and challenging to identify early-stage abnormal tissue due to the relatively small dielectric proprieties contrast between the healthy tissue and abnormal tissue at X-ray frequencies [2]. PET provides useful information about soft tissues, but it is expensive and produces poor resolution. CT and MRI are unsuitable for continuously monitoring strokes due to produce harmful radiations (CT), expensive (MRI), time-consuming and not easy to develop a portable system [3,4]. Therefore, develop a new screening method is urgently needed to improve the effectiveness of disease detection.

Microwave imaging is a relatively new non-invasive and cost-effective method for imaging of breast and brain tissues, which has continuously attracted many researchers' interests over the past two decades [5,6]. The authors previously developed a holographic microwave imaging (HMI) method for dielectric object detection with a particular focus on brain stroke [7]. This paper investigates the feasibility of multifrequency HMI for brain stroke detection. A numerical system was developed to demonstrate the proposed theory. Various experiments were carried out to evaluate the performance of the proposed method. Results of experiments carried out using multifrequency HMI have been compared with the results obtained by using single frequency HMI. Results showed that multifrequency HMI could detect strokes and provide more accurate results of size and location than the single frequency HMI algorithm.

Keywords: Microwave imaging; brain stroke; holographic microwave imaging; dielectric object

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