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An Efficient of Chimera Grid Scheme with Spline Interpolation in FBTS Inversion Technique for Extremely Dense Breast Cancer Detection

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Abstract. Microwave imaging system is classified as non-invasive, simple to perform and inexpensive compared to MRI and X-Ray machine. Therefore, the novel idea of this research work is to develop a Chimera Grid Scheme (CGS) incorporate with the microwave inverse scattering technique in a low cost, non-ionising and safe short-range. The CGS with spline interpolation in Forward Backward Time-Stepping (FBTS) inversion technique can determined an accurate result especially for the biological anomalies like breast tumours at an early curable stage due to the high electrical properties contrast between malignant cells and normal cells. The findings showed that the proposed method successfully detected and reconstructed the breast structure in relative permittivity profiles. The quantitative information of reconstructed images, such as location, shape, size and internal composition also can be obtained. Furthermore, the normalised functional error for proposed method was also lower than the FDTD method in FBTS. At 150^{th} iteration, the difference of normalised functional error between these two methods was 1.74×10^{-5}. The result shows that the CGS method in FBTS inversion technique would reconstruct breast composition more precisely.

1. Introduction

The World Health Organisation (WHO) stated that an approximately of 18.1 million new cases and 9.6 million deaths annually caused by global cancer burden [1]. Breast cancer is a most commonly health problem and leading cause of death for women [2]. In a biological aspect, human body cells divide, grow and die in an orderly manner, whereas cancer cells grow due to uncontrolled causes such as heredity, disease as well as external and internal factors [3]. These kinds of cells will form a mass or lump known as a tumour that can be either benign or malignant. There are two main factors that cause cancer-related diseases, specifically: external factors such as infectious organisms, cigarette smoking, excess body weight and unhealthy diet; or internal factors such as immune conditions, inherited genetic changes, and hormones.

As shown in Figure 1(a), benign tumours are an abnormal growth of breast tissues and are not cancerous (e.g. fibro-adenoma, cyst, abscess, fibrocystic disease, and others). These types of tumours can be cured permanently after removal. However, malignant tumours are cancerous. This kind of tumour is an arbitrary shape with a dimpled skin as illustrated in Figure 1(b). Malignant tumours can spread to different organs beyond the original tumour and may be difficult to diagnose due to confusion with other breast problems.

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