A new method to measure magnetic flux density B_z in MREIT

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ABSTRACT

We will introduce a new method to measure magnetic flux density B_z in MREIT. The proposed method doesn't use phase distortion effect of B_z on ordinary NMR signal to get it as before, but, utilize frequency distortion that comes from B_z produced by injected current. In this paper, we will analyze the distortion and develop an efficient algorithm to get back B_z.

INTRODUCTION

Magnetic Resonance Electrical impedance tomography(MREIT) has been investigated to get cross-sectional conductivity images of a human body from the measured magnetic flux density produced by injection current [1]-[3].

In MREIT, we are used to calculating magnetic flux density B_z with two K-spaces data from an MRI scanner in the past;

$$\mathcal{S}^{\pm}(m,n) = \int\int_{-\infty}^{\infty} M(x,y) e^{j\delta(x,y)} e^{\pm jB_z(x,y)T_c} e^{j(xm\Delta k_x + yn\Delta k_y)} dxdy. \tag{1}$$

T_c is the current injection time which is a constant. T_c time after we start to apply current, we should stop current injection before starting data acquisition not to spoil position information which is encoded in the NMR signal. Phase distortion on ordinary NMR signal occurs according to amount of injected current. The previous methods utilize these phase distortion effects of magnetic flux density B_z that comes from injected current. Thus, they used echo pulse sequence with T_2 relaxation and difficult to be applied to any other pulse sequence with T_1 relaxation. To get more phase distortion, we need longer T_c, the current injection time, which makes us suffer from attenuation of measured signals. These attenuated signals have been main cause to increase noise in B_z since we have to divide these measured signals to get B_z.

We will introduce a new method to measure magnetic flux density B_z. We don't apply current before data acquisition process, but, start to apply current synchronized with data acquisition. Then, the measured signal will be distorted in frequency according to magnitude of magnetic flux density B_z that comes from injected current. Although

position information is distorted, the distortion must come from magnetic flux density B_z which we added by injection current. We will analyze the distortion to get back B_z from it.

The proposed method utilizes frequency distortion effects of B_z on ordinary NMR signal rather than phase distortion effect of it. It is the main difference between this method and the previous methods. This method doesn't need to divide results from two attenuated signals to calculate B_z. The other advantage of this method lies in its flexibility. In order to get B_z, we are able to use any pulse sequence which offers better signal.

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