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# USE OF THE MAGNETIC FIELD GENERATED BY THE INTERNAL DISTRIBUTION OF INJECTED CURRENTS FOR ELECTRICAL IMPEDANCE TOMOGRAPHY

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Injected currents applied during a 2D EIT investigation generate magnetic fields which are perpendicular to the imaging region. Such magnetic fields in theory can be measured using magnetic resonance tomography. In this study use of this magnetic field, generated by the injected currents, for the purpose of reconstructing the conductivity distribution is studied. Sensitivity matrix relating the magnetic field to the element conductivities is calculated using the Finite Element Method. It is shown that for adjacent-drive adjacent-measurement strategy of data collection the sensitivity of measurements to inner conductivity perturbations are still small. Therefore sensitivities are recalculated for uniform current distribution in the imaging region in which case uniform sensitivity distribution is achieved.

## Introduction

It has been shown that the magnetic fields generated by quasi static bioelectric currents and by RF currents can be measured using Magnetic Resonance Tomography. Extension of such methods to AC currents at frequencies used for EIT has yet to be accomplished. The magnetic field must be measured in three directions so that the currents can be calculated. MRI however is geared to measure the magnetic fields along the direction of the main DC field of the magnet (z-direction). Therefore in this study the relation of the z-component of the magnetic field to inner conductivity perturbations is studied.

## Methods

For any given injected current boundary profile, inner potential field is calculated using FEM with 1016 elements and 541 nodes. In each element derivative of the field distribution is taken to obtain the electric field and the current density. This current density, which is defined for all elements, is mapped to a 101x101 cartesian grid and Biot-Savart law is used to calculate the z-component of the magnetic field at any one of these grid points. In practice due to computation time limitations the magnetic field is calculated at a 11x11 sub-grid.

## Results

Internal current distribution for a conductivity of 0.002 S/cm and an injected AC current profile the magnitude of which has the angular dependence of (1mA)·sin($\theta$), where $\theta$ is defined with respect to the x-axis. For this current profile the internal current distribution is in the y-direction and is uniform. The magnetic field generated by this current distribution is small in the central regions and increases towards the periphery in the x-direction. To calculate the sensitivity of this magnetic field to conductivity perturbations, conductivities of various regions were perturbed. For a central, circular region of diameter of 1.6 cm (the diameter of the imaging region is 24 cm), and for an increase of 10% of conductivity, the

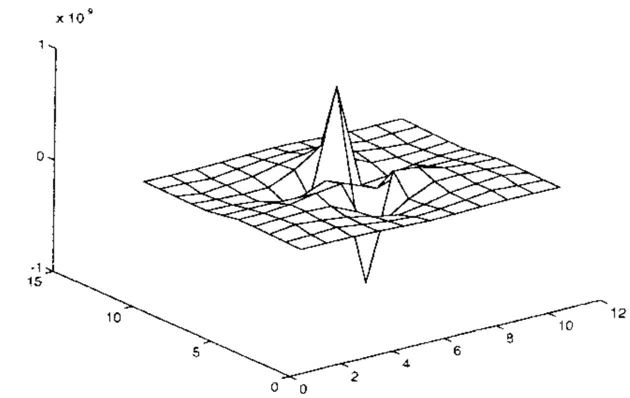


Figure 1 Change in B field for a central conductivity perturbation

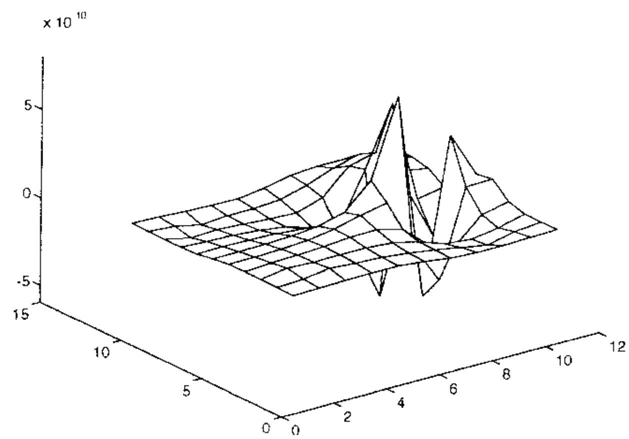


Figure 2 Change in B field for an intermediate conductivity perturbation

perturbation in the magnetic field is drawn in figure 1. For an intermediate object of slightly larger diameter, the perturbation in the magnetic figure is given in figure 2. It is observed that the perturbation in the magnetic field is similar in magnitude and also very similar in shape. Thus the sensitivity patterns to the above conductivity perturbations were similar. This behaviour was observed for the whole imaging region. With this behaviour of the sensitivity matrix, it is expected that uniform spatial resolution can be obtained if conductivity distribution is reconstructed using magnetic field measurements.