Magnetic Gradiometer for Breast Cancer Surgery

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Introduction

Purpose: To create a device that will aid in the removal of cancerous tumors

Solution: A magnetic gradiometer to locate implanted magnets in breast cancer tumors

Competitors: Radioactive seeds, RFID tags, metal detectors

Previous Design: 2 HMC1043 sensors, 1.5" spacing

Next Generation Design

Evaluate/Access:

- New sensors which integrate accelerometers, gyro's
- Spacing between sensors: 1", 1.5", and 2"
- Number of sensors: 2, 3, 4
- Sensitivity to various magnets: strong magnets, magnetized/demagnetized objects, regular implanted magnets
- Indoor/outdoor measurements
- Different angle approaches: 90 & 45 degrees

HMC5843 Sensor

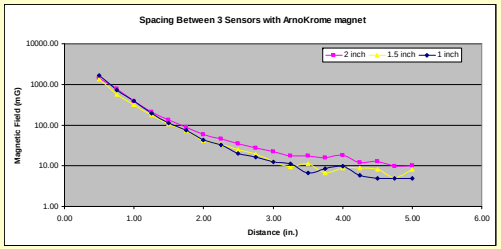
Benefits:

- Accelerometer to measure gravity
- Small size
- Easy to use

Possible Issues:

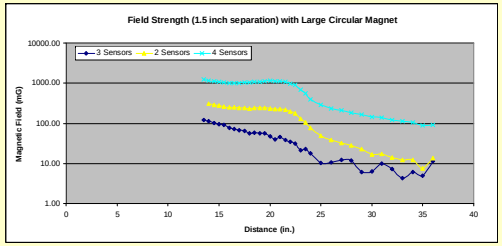
- Hysteresis
- Slow at sampling measurements

Spacing of Sensors



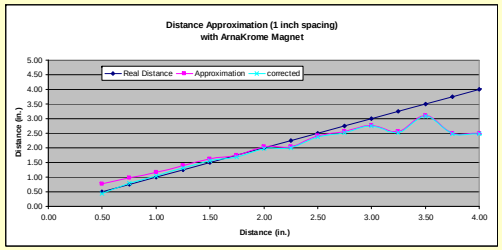
- Between 0.5"-2", the spacing between sensors (2", 1.5" and 1") follow similar plots
- 1.5" and 1" spacing are options for design

Number of Sensors



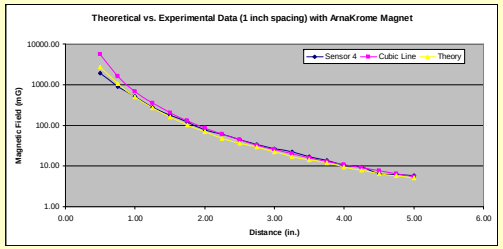
- 3 sensors can cancel out fields from large magnets more than 2 & 4 sensors

Distance Approximation



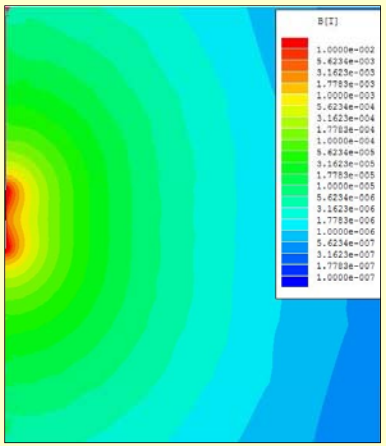
- Actual distance follows corrected approximation from experimental data from 0.5"-2" distance away

Theoretical vs. Experimental Data



- Experimental data follows theoretical data when distance is less than 3"
- Experimental data follows cubic approximation for far field, when distance is greater than 3"

2D Magnetic Field Model



- Represents theoretical uniform magnetic field model of a cylindrical (1mm diameter and 20mm length), ArnoKrome magnet
- Illustrates magnetic field approximation related to 1/(distance^3)