

FINAL REPORT: Development of Combined Imaging and Focused Hyperthermia System for Cancerous Tumors

Principal Investigator: Pallavi Dhagat, School of Electrical Eng. & Computer Science

Award Details

This proposal was submitted in response to the General Research Fund (GRF) in Fall 2011. The award, in the amount of \$10,000, was announced on December 13, 2011.

Research Objective

The goal of this proposal was to develop a technique for imaging magnetic nanoparticles with a spatial resolution of 1 mm or better.

Brief Summary of Research

Magnetic nanoparticles can be coated with ligands that attach specifically to cancer cells thus allowing a tumor to be magnetically labeled. This opens the possibility of imaging the tumor by generating a 3D map of the magnetic nanoparticle distribution. Further, the particles may themselves be used to locally heat the tumor destroying the cancerous cells without damage to the surrounding healthy tissue.

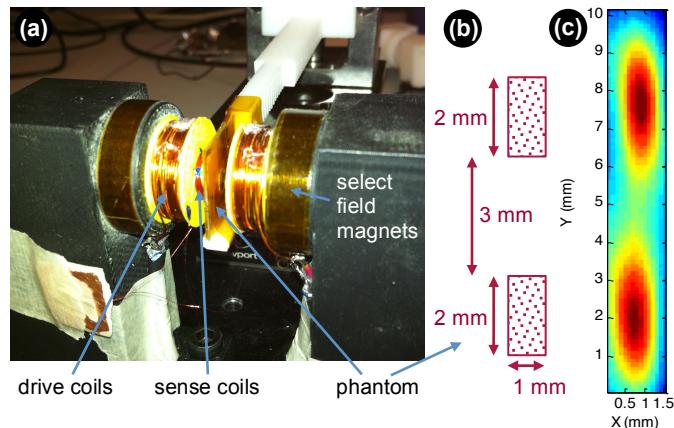


Fig. 1. (a) Imaging setup using opposing permanent magnets. The drive and sense coils are also shown (b) Layout of the imaging phantom (c) 2D scan showing approximately 1 mm resolution.

The figure above (1a) shows the system implemented, with support from the GRF award, for imaging the magnetic nanoparticles. The particles are detected inductively using an arrangement of drive and sense coils, which were designed and optimized for the proposed application. Phantoms, to mimic cancerous tumors, were prepared using nanoparticles dispersed in gel and placed on an x-y stage to facilitate scanning during imaging. Custom instrumentation and image processing algorithms were developed to create the images as shown in Fig. 1c.

Our ongoing efforts are focused on measuring the temperature change within the phantoms as the magnetic nanoparticles are used to generate heat under varying conditions e.g., particle concentration within the phantoms, strength and frequency of the the *ac* magnetic field used to excite the magnetic nanoparticles.

Expenses

The GRF funds were expended on supplies, parts and machining services needed to build the demonstration system.

Results

The results from this work were presented at a scientific conference and were used to establish preliminary results in a **successful** interdisciplinary proposal to the National Science Foundation:

- STUDENT PRESENTATION AT A SCIENTIFIC MEETING

S. Mulley, D. Miller, H. Song, P. Dhagat, A. Jander, and T. Vu, "*Scaling of Magnetic Particle Imaging for Sub-micrometer Resolution*", presented at the 13th Annual Meeting of the Northwest Section of the American Physical Society, Corvallis, 2011.

- NSF AWARD, "MAGNETIC NANOPARTICLE MICROSCOPY OF LIVING ORGANISMS"

Investigators: Pallavi Dhagat, Jeffrey Greenwood, James Hutchison & Albrecht Jander
Amount: \$450,000 Duration: May 2013 – April 2016

We continue to pursue additional external funding opportunities based on the results from this GRF-funded research, including the Keck Foundation, NSF-NIH Interagency Initiative: Smart and Connected Health, NSF IGERT and NSF Instrument Development for Biological Research.