



Research Assignment - 2009

Title of research assignment

A Magnetic Array Imager for Visualizing Fields

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Research abstract

Magnetic fields arise from the presence of magnetic materials, from the response of materials to applied fields, or from the flow of electric currents. They are used for direction finding (using the earth's field), for medical diagnosis (Magnetic Resonance Imaging), and for a wide range of electrical devices including motors, relays, and generators. Some conjecture that they have health benefits while others are concerned that exposure to magnetic fields can be hazardous. As 3-D structures magnetic fields are difficult to visualize and measure, such that engineers rely heavily on software simulations to model and predict fields.

Recent projects at Boston University have used magnetic field sensors based on the Hall effect, giant magneto-resistance and giant magneto-inductance. The size and cost of these sensors are falling. They have low power needs and do not require cooling. Building a magnetic imager with one or more of these devices would provide a simple means for viewing field structures. Such a device could serve as a diagnostic tool, a teaching tool, or a means to detect or even spatially characterize magnetic materials embedded in other substances. If an active magnetic probe were combined with a field imager, detection could be more sophisticated and penetrate more deeply.

Research activities/experience

This design study will be conducted in the High Tech Tools & Toys Lab and in other electronics and project areas at Boston University. It will involve the use of electronics CAD software to create a printed circuit board holding a small (5x5) array of magnetic field sensors - each of which would be a sensing voxel in the eventual 3-D image of the field. The sensing circuits are standard, and the data will be interfaced to an industrial data acquisition

board or similar system. The voxels will be collected and displayed using common instrumentation software such as MATLAB or LabVIEW. A few classic fields or magnetic targets will be constructed as phantoms to test the imager.

Expectations of RET

An RET participant should like building things and have persistence when attacking a multi-step task. They will have to work with other researchers and be able to ask for help when moving outside their experience. Teachers will practice the engineering design process as they create and test this imager instrument. There is a level of craftsmanship involved in some of the assembly and soldering, but prior electronics experience is not required. Teachers will learn to use electronics test equipment like oscilloscopes and meters.

Special skills or interests that would help a RET participant with this assignment (i.e., an interest in physics, experience with specific laboratory equipment, etc.)

A hands-on person would be best for this project. The ability to visualize 3-D structures would help, as would a willingness to learn new software tools. There will be some programming, but there are many examples to guide that part of the work.

Lab safety/issues unique to this laboratory. A general Lab Safety Overview will be presented by Environment Health and Safety to both RET and YSP participants prior to the beginning of lab assignments.

No particular safety issues beyond normal low voltage laboratory electronics.

Suggested literature to be reviewed prior to beginning this research assignment.

There are a variety of excellent technical notes on magnetism and sensing magnetic fields from Honeywell and other magnetic sensor vendors.

Research/Lab Summer Hours 9:00 a.m. – 5:00 p.m. Monday through Thursday
 Monday through Friday

Scheduled Research/Lab Meetings : p.m. – : p.m. Daily Wednesday To be
 Monday Thursday determined
 Tuesday Friday

Lab/research project URL

Not at this time.

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