



Lab 4: Magnetic Fields Student Handout

The Project: Magnetic Field Mapping

Magnetism plays a major role in products and tools used in the modern economy. From electric motors, to anti-lock brakes, or magnetic resonance imaging to microphones, magnetism is applied and controlled for important uses. Company X wants you to develop an algorithm to map the magnetic fields of different sources. It will be important to show how fields interact with multiple sources and how various parameters affect magnetic field generation.

Your team has now been hired to develop a method for mapping magnetic fields.

Equipment:

- Camera
- CNC
- Magnets
- Magnetic Field Probe
- Raw Bar Stock

Possible Needed Techniques:

- Properties of Magnetic Fields
- Permeability for different magnetic materials
- Basic Python Commands

Pre-Lab Organizational Questions:

1. The Earth's magnetic field protects its surface from harmful high energy radiation. How will you characterize this magnetic field and eliminate its effects from your measurement?
2. You will need to characterize the magnetic field from a magnetic. How will you move the magnetic field probe to get an accurate characterization of the field behavior?
3. Materials can interact with magnetic fields in different ways. How can you design an experiment to see how these materials behave differently under the influence of a magnetic field?
4. Magnetic fields are vector fields. How do they change when multiple sources are used to create a magnetic field?



Lab 4: Magnetic Fields Student Handout

The Requirements:

In order to demonstrate that you can accurately monitor and analyze a magnetic fields, we ask that your team complete the following:

1. Map the magnetic field of a simple bar magnet. Determine if there are any background sources present in your field. If so, map them and determine what they are.
2. Map the magnetic field of several different magnet configurates.
3. Map the interaction between the magnetic field and several pieces of raw metallic stock.

Presentation of the solution:

Your team must prepare a design presentation, given to a member of Company X on the approach that you are using for this project. The presentation may be given by the team as a whole or by a single member of the team chosen by the Company X administration. The presentation must include:

- A description of the basic physics principles used in your project. These should include equations for predicting how magnetic fields from different sources interact as well as equations for predicting the magnetic fields generated from current carrying wires.
- A set of plots demonstrating the mapped fields, showing relative magnitude and direction.
- Compare the expectation for the fields with the measured values. How does the magnetic field behave when more than one magnetic source is involved?
- Discuss how different materials interact with magnetic fields. Provide a hypothesis as to why you think certain materials behave differently under the influence of the magnetic field.
- Discuss any sources of error or variance that you had to overcome in creating a successful monitoring algorithm.