Lab 4: Magnetic Field

1 Assignment

In this lab your team will be investigating magnetic fields. There is Hall effect probe attached to the end of the CNC at your lab station. This probe is capable of measuring the components of the magnetic field in 3 dimensions (x, y, and z). Additionally, your team should have a strong rare-earth magnet, a steel bar, and an aluminum bar.

Your team is tasked with determining the effects that the aluminum bar and the steel bar have on the magnetic field. To accomplish this, your team should:

1. first determine the orientation of the magnetic field produced by your magnet. You should perform several scans (see Section 3.1) of the magnetic field above the magnet to determine this and familiarize yourself with the scan output and plotting options.

2. perform scans with no bar present, with an aluminum bar present, and with a steel bar present. These three scans can then be compared to determine the effects that the bars have on the magnetic field.

2 Deliverables

For your lab report, 10% of the grade will be for following the guidelines in the lab report template. Another 10% will be allocated for the Abstract and Introduction of your report. The remaining percentage will be based on your inclusion of:

- for assignment 1:

    1. *[10%]* a plot showing the field around your magnet
    2. *[20%]* your team's conclusions about how the poles of the magnets are oriented (e.g, where is north and where is south relative to the dimensions of your magnet)

- for assignment 2:

    3. *[12.5%]* a description of the process your team developed to determine how the metals and magnetic field interact. This should include a diagram of the physical setup your team used as well as any calculations performed.
    4. *[12.5%]* plots showing magnetic field strength as a function of position for each scan your team took (i.e., no bar, with aluminum present, and with steel present)
    5. *[25%]* your qualitative conclusions on how magnetic fields interact with the two metals. Your conclusions should be supported by data that *your team collected.*

3 Technical Information

3.1 Performing a scan

To collect data for this lab, you may use the `run_magnet_scan.py` script in the `examples/scanning` directory. This script will measure the magnetic field at many locations (as defined by the script parameters) and write the resulting data out to a .csv file. There are also several plotting options that the script can perform. Your PT should go over the script parameters at the start of lab. Before running the code, you should read through the script to get an idea of what it is doing.

4 Hazard Assessment

- This lab uses **strong** neodymium magnets. Use caution with these magnets and ferromagnetic materials, as they will attract strongly and can easily pinch fingers or break.