Magnetic Field of Two Coils

Jordan Jaross, jordan.jaross@gmail.com
La Canada High School, Class of 2021
USC Viterbi Department of Electrical Engineering, SHINE 2019

Introduction

In my lab the research being done is based around using magnetic fields. Medical scientists have created a variety of miniature medical devices, such as endoscopes, biosensors, and drug delivery systems. These devices have the potential to be extremely beneficial, but only if they're where they're supposed to be. In order to try and see these devices more clearly, a new microchip has been developed which can imitate nuclear spin, which is what is detected in an MRI. This microchip allows us to see the devices with great precision but how do we see it? That is done by using magnetic field gradients, which is just a magnetic field that changes in strength over a distance. But how do we create a magnetic field gradient? That is question I investigated this summer.

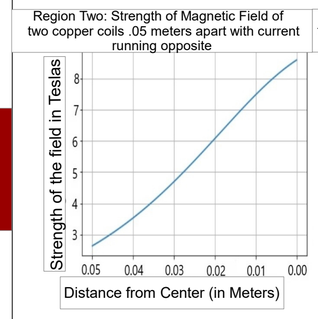
Objective and Impact of my professor's research

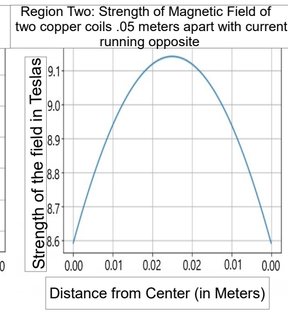
My professor's research is about trying to see small medical devices inside of people with great resolution by utilizing a microchip that can mimic nuclear spin. Nuclear spin is what is measured in MRI. This technology has the potential to help lots of people potentially avoid surgery and give them effective treatment. If they have an implant, such as a pacemaker, that's malfunctioning, there is now some way of starting to troubleshoot what's wrong with it without jumping straight to surgery. This research would make sure the device do its job as well as it can without causing the person it's treating too much trouble.

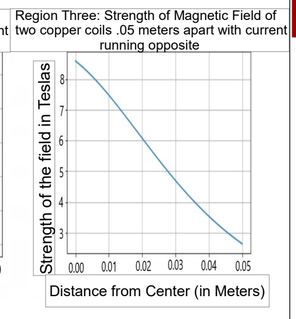
Skills Learned

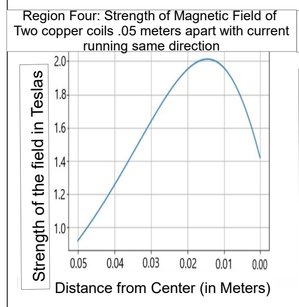
This program has taught me many things. I learned how to research open ideas on my own more effectively than ever. I've never been turned loose with only a general idea of what I want to accomplish and been able to go about it any way I want before. It's fun and taught me that not everything has to be spelled out directly for me to be able to succeed. I'm capable of teaching myself things, and given time, I will eventually be able to put the pieces together. I taught myself how to use python for data processing and was able to produce graphs of the data that I wanted.

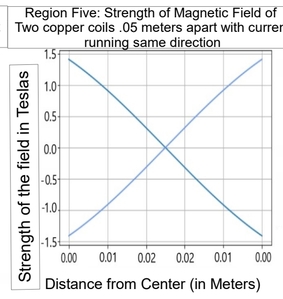
These graphs below illustrate the strength of a magnetic field at a certain point in space at the center of a magnetic coil, in a system with two magnetic coils spaced five centimeters apart. There are graphs for The field if the currents are traveling in opposite directions, or in the same direction, and they tell how the difference in the direction of the current effect the field's strength.

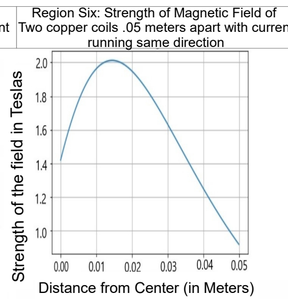


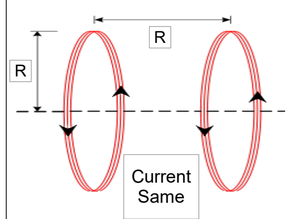




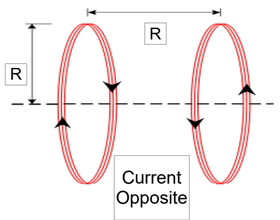








The figure to the right is a visual interpretation of the first three graphs and the figure to the left is a visualization of the last three graphs.



How this relates to my STEM Coursework

In my time at SHINE I have learned a lot of valuable skills and lessons. Going forward, I will now have the ability to do data processing in python, the confidence in my ability to research on my own, and the knowledge that I can effectively teach myself. At my school I can take my new abilities to work with python and apply them to helping my school's engineering club. To help the people at my school recognize how important this coursework is, I will bring back some of the public speaking practice I got from the elevator pitch exercise, and use that to effectively explain my work to them.

My advice to future SHINE students

My advice to any future SHINE students would be to be patient and ask questions. At the beginning things can be kind of slow and you might not like it at first, but it get better after a few weeks when you really settle into a flow. Asking questions that you have is really helpful, don't just do what you think is right and then have to re-do it later. Ask your professor and the people in charge, they often have office hours for a reason.

Acknowledgments

I would like to thank my professor and mentor, Dr. Manuel Monge, my SHINE lab-mate, Dhruv Aggarwal , and our program coordinators, Dr. Katie Mills, and Dr. Megan Herrold.