

To: Dr. Carson
From: Javan Jake
Date: 3/2/25
Subject: Homework 3: Self-Learning Report

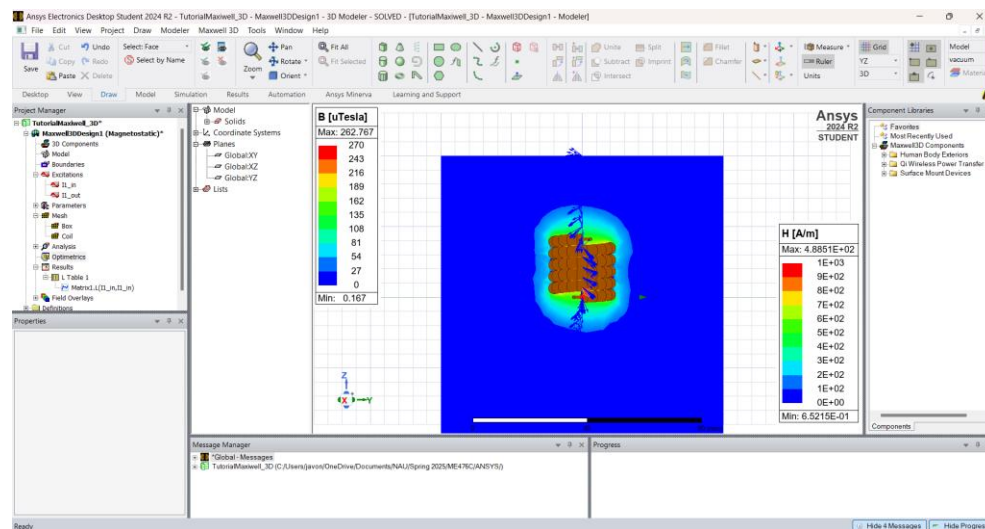
Introduction to Ansys Electronics Desktop for Capstone Project

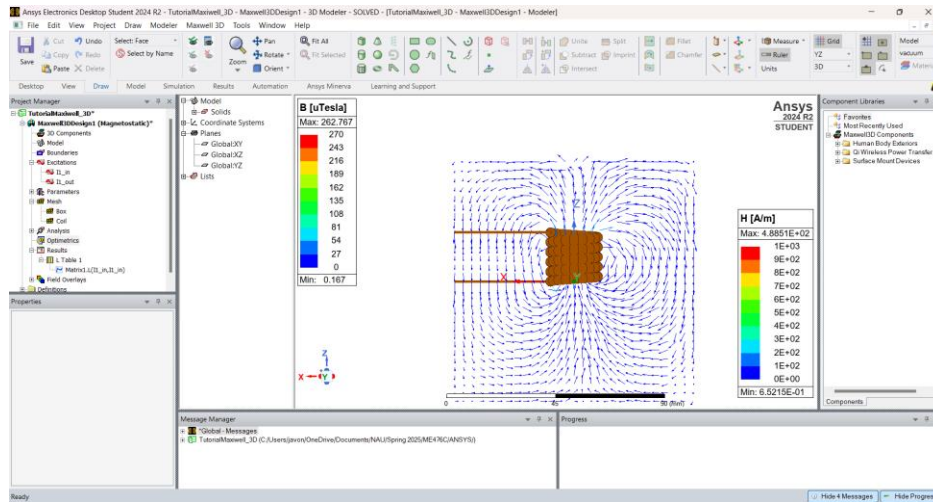
Introduction

For my self-directed learning experience in ME 476C – Capstone, I chose to learn the basics of Ansys Electronics Desktop, specifically using Maxwell 3D. My goal was to understand how to model and analyze electromagnetic systems to aid in the design and optimization of our capstone project's generator. This skill is crucial for improving our ability to model, simulate, and refine our design for efficiency.

Learning Process

To gain foundational knowledge, I downloaded Ansys Electronics Desktop Student – Free Software [1] and followed a YouTube video [2]. The time spent on learning Ansys is approximately 4 hours.





During this process, I first learned how to create 3D models of electrical components within Maxwell 3D. The tutorial guided me through defining the geometric structure of objects, assigning material properties, and ensuring proper boundary conditions. This step is essential in designing our generator, as it allows us to build an accurate representation of its electromagnetic components.

Next, I explored how to apply excitations and parameters, which define the electrical and magnetic properties of the system. Excitations include the application of voltages, currents, and magnetic fields necessary for electromagnetic analysis, which I used to only conduct current from the tutorial. Parameters allow for adjustments to the model, enabling efficient testing of different design configurations without manually rebuilding the model each time. This feature will be valuable for optimizing generator performance.

I then studied the mesh generation process, which is critical for ensuring accurate simulations. The software breaks the 3D model into smaller elements, allowing for detailed numerical calculations. A well-defined mesh leads to precise results, while an improperly configured mesh can result in inaccurate or inefficient simulations. Due to the limitation of Ansys, I could not go into further details of the program since the program is limited for the student version. Learning how to refine and control mesh density will help in improving our generator simulations.

Finally, I learned how to analyze results. Maxwell 3D provides various numerical outputs, such as magnetic field distributions, flux density, and losses. Understanding these results will allow me to assess the generator's efficiency, identify weak points, and make informed decisions to improve its performance. In the following table below, Ansys can gather the data from the model and forming the end result from the tutorial.

L Table 1

Maxwell3DDesign1
Ansys
2024 R2
STUDENT

	r_w [mm]	Matrix1 L:(I1_in,I1_in) [nH] Setup1 : LastAdaptive
1	2.000000	350.493769

Application to Capstone Project

With this understanding of Ansys, I believe Ansys Maxwell 3D will be a powerful tool for designing and refining our generator. By utilizing its modeling and simulation capabilities, I can contribute to our team’s efforts in creating an accurate virtual prototype before physical testing. This will enable us to predict performance characteristics, identify inefficiencies, and make necessary modifications early in the design process.

One of the most significant benefits of this learning experience is the ability to optimize design parameters through iterative simulations. By adjusting input parameters such as coil configurations, core materials, and excitation levels, we can determine the most efficient setup for our generator. Additionally, Maxwell 3D’s ability to analyze electromagnetic behavior will help us understand how different design choices impact power output, energy losses, and overall efficiency.

References

[1] Ansys Electronics Desktop Student Version | Free Software Download,
<https://www.ansys.com/academic/students/ansys-electronics-desktop-student> (accessed Feb. 28, 2025).

[2] “ANSYS Tutorial - 1 (Maxwell 3D, coils, magnetostatics),” YouTube,
https://www.youtube.com/watch?v=T4BJ4hkwS_0 (accessed Feb. 28, 2025).