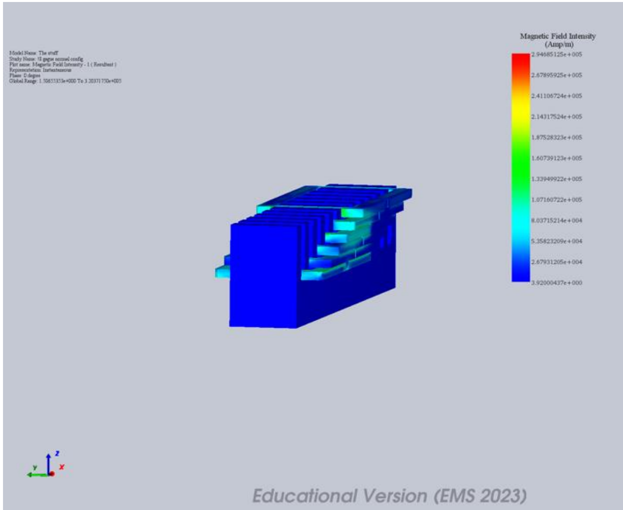
EMWorks Abstract

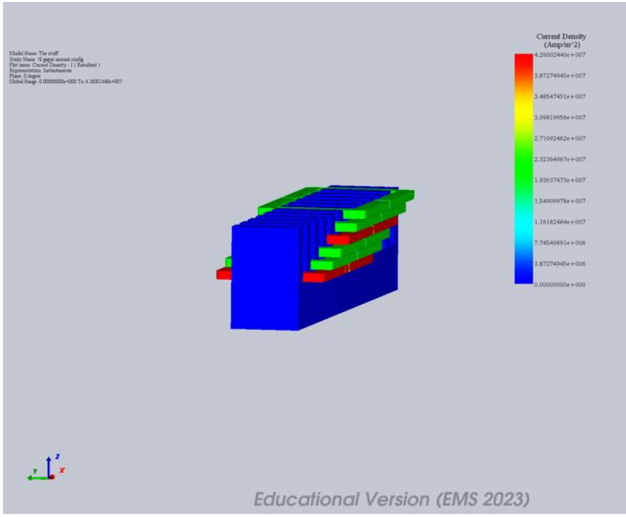
EMWorks has proved to be very crucial and useful simulation software for LoopMIT which has helped us a lot in the propulsion system of the project. We leveraged the advanced simulation capabilities of EMWorks to enhance the design of our LIM (Linear Induction Motor) and do in-depth analysis of the design, technicalities and the variations in the output of the LIM according to different configurations. Utilizing EMWorks, we conducted detailed simulations to optimize the motor's performance parameters, such as thrust force, efficiency, and thermal characteristics.

It eased our way in deciding the thickness of the copper wires to be used for coiling in the LIM which is a very important parameters of motor functioning and power output in terms of magnetic flux density and mechanical force. Along with this, it helped us in optimising the LIM with a balanced configuration of thickness of copper coils and the number of turns possible with that particular gauge of wire. It’s feature of ‘filling factor’ helped us to get an idea of max number of turns possible in the LIM and do further calculations according to it.

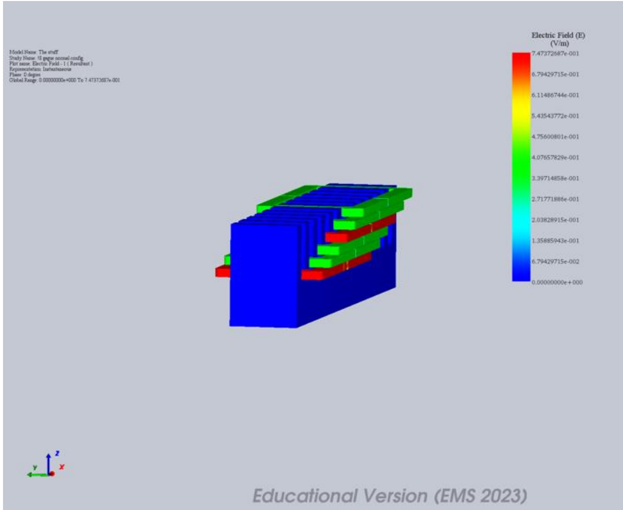
EMWorks has been the most important element in analysing and calculating various para meters as displayed below:

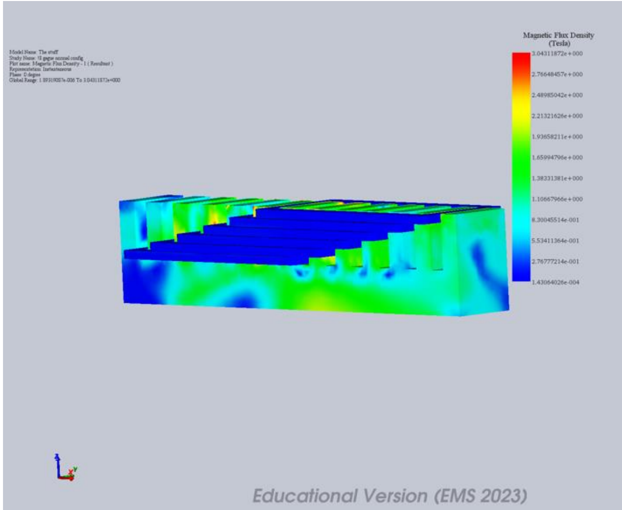


Magnetic Field Intensity



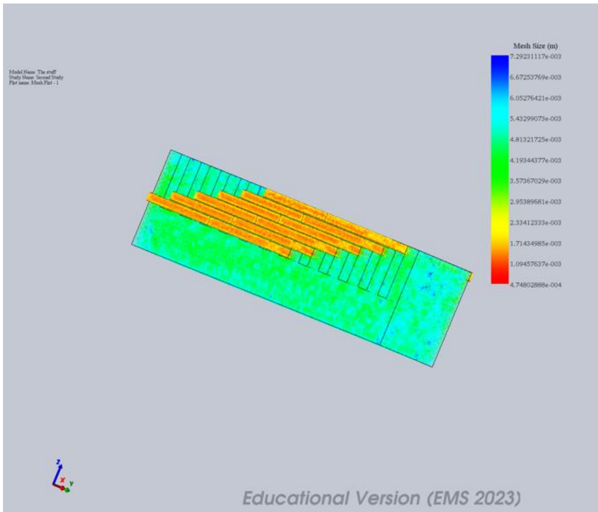
Current Density

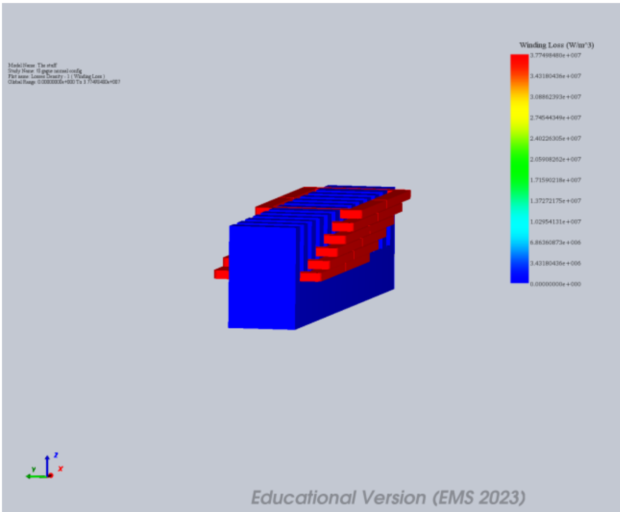




Electric Field Strength

Magnetic Flux Density





Winding Loss

These parameters have proven crucial in the development of the LIM, providing valuable insights into key factors such as electric field strength, magnetic flux density, magnetic field intensity, and winding loss, among others. The software enabled us to understand how these parameters vary with different configurations of the LIM's windings, including the number of turns and coiling patterns.

Analysis of winding losses, which varied according to different coiling patterns allowed for in depth analysis for maximizing magnetic flux output and minimizing the losses in the LIM which increased the efficiency of the LIM.

Meshing analysis helped us to get more accurate results of every parameter and output as much as possible.

The analysis of magnetic field intensity and magnetic flux density provided a detailed understanding of the magnetic flux distribution within the LIM when subjected to a three-phase alternating current. This analysis enabled us to pinpoint areas where the magnetic flux was either concentrated or deficient. By mapping these variations, we could identify regions of the LIM that required design modifications to optimize magnetic flux flow.

By using the ‘animate’ option we were able to properly analyze the change in the LIM over time and phase of current. The option to change the number of frames generated was also extremely useful as we were able to get instantaneous values of flux and magnetic fields generated for more accurate calculations. This insight was crucial for improving the efficiency and performance of the LIM. Specifically, it allowed us to adjust the design of the motor's windings and core structure to ensure a more uniform distribution of magnetic flux. These modifications helped minimize losses and enhance the motor's overall electromagnetic performance.

This capability allowed us to rigorously test various configurations and select the most efficient design, thereby enhancing the speed and accuracy of our decision-making and manufacturing processes. The precise outputs provided by EMWorks, combined with our practical testing of the LIM on the pod, facilitated accurate determination of the motor's ratings. This, in turn, ensured that our battery management system was properly calibrated to the motor's performance specifications.

By integrating EMWorks into our workflow, we achieved a comprehensive understanding of the LIM's electromagnetic properties, leading to an optimized design and streamlined production process.

In addition to the detailed simulation capabilities, EMWorks offered an extensive library of materials with comprehensive property data, which was instrumental in selecting the optimal materials for our linear induction motor (LIM). This extensive material database included various types of conductive and magnetic materials, each with specific properties. By utilizing this resource, we were able to evaluate and compare different materials in terms of their conductivity, permeability, thermal conductivity, and mechanical strength.

The ability to simulate the LIM with different materials allowed us to assess how each material influenced key performance metrics such as efficiency, heat dissipation, and durability. For instance, we could analyze the impact of different core materials on magnetic flux density and hysteresis losses, as well as evaluate various conductor materials for their effect on winding loss and overall electrical efficiency.

By optimizing material selection through EMWorks, we were able to enhance the motor's performance while also reducing costs and improving manufacturability. This informed approach to material selection played a crucial role in achieving an efficient, reliable, and high-performance LIM design.

The integration of EMS software has demonstrated significant improvements in efficiency and accuracy across various applications. Looking ahead, the potential for EMS systems presents exciting possibilities to work on our Levitation system, making use of multiple critical functions in addition to what we are currently using. Simulation results from EMS is crucial for us to move forward to choosing materials or the configuration that we use to achieve levitation. Future research and development in this area will be crucial to unlocking the full potential of levitation technology, paving the way for groundbreaking advancements and further optimization of EMS software functionalities.