Designing and Analysing Aesthetic Magnetic Exosuit

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Abstract
This paper documents an aesthetically appealing exosuit design concept which uses magnetic fields for keeping itself in place.

Keywords
Exosuit, Magnetism, Aesthetic, Exoskeleton, COMSOL.

Introduction
Deriving inspiration from the paper titled, "Ratchet-Pawl Integration in Full Body Mechanical Rigid Wearable Exoskeleton"[1], the author has designed a concept for aesthetically appealing exosuit using magnetism and have analysed the mentioned in COMSOL MULTIPHYSICS using Magnetic Fields, No Currents module (mfnc) and stationary study because of the softwares credible analyses as shown in paper titled, "Interpretation of Measurements with Novel Thermal Conductivity Sensors Suitable for Space Applications"[2].

Analysis
The analysis of scalar potential, flux density and force across the solid have been presented below to further solidify the concept's feasibility.

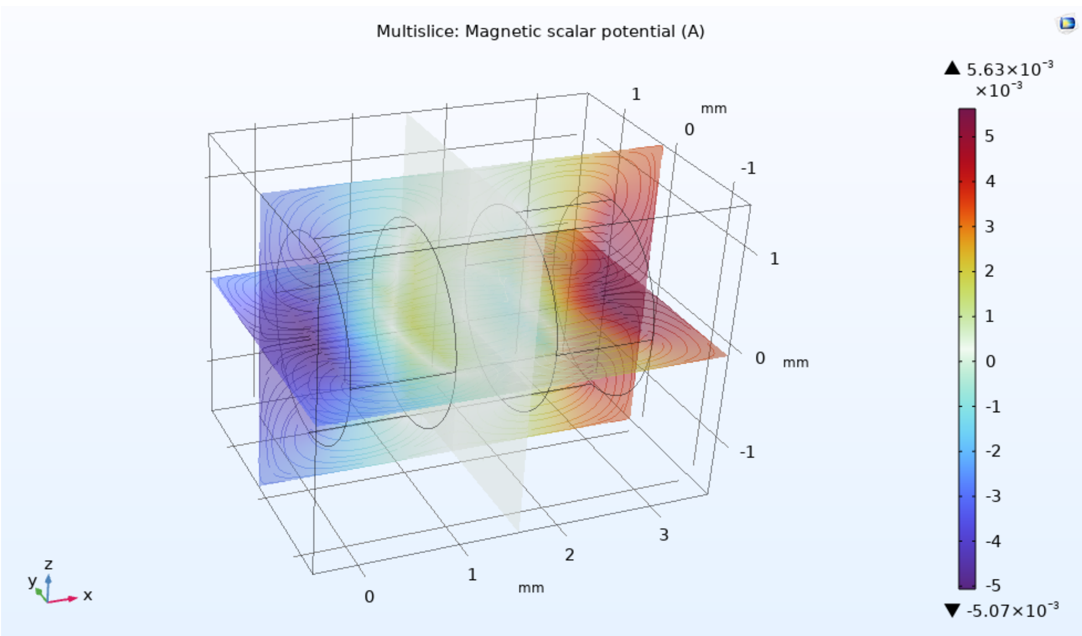

Figure 1

Figure 1 shows magnetic scalar potential on three planes of two N52 (Sintered NdFeB) cylinders with radius and height both of 1 mm having magnetisation of 10 A/m along x axis.

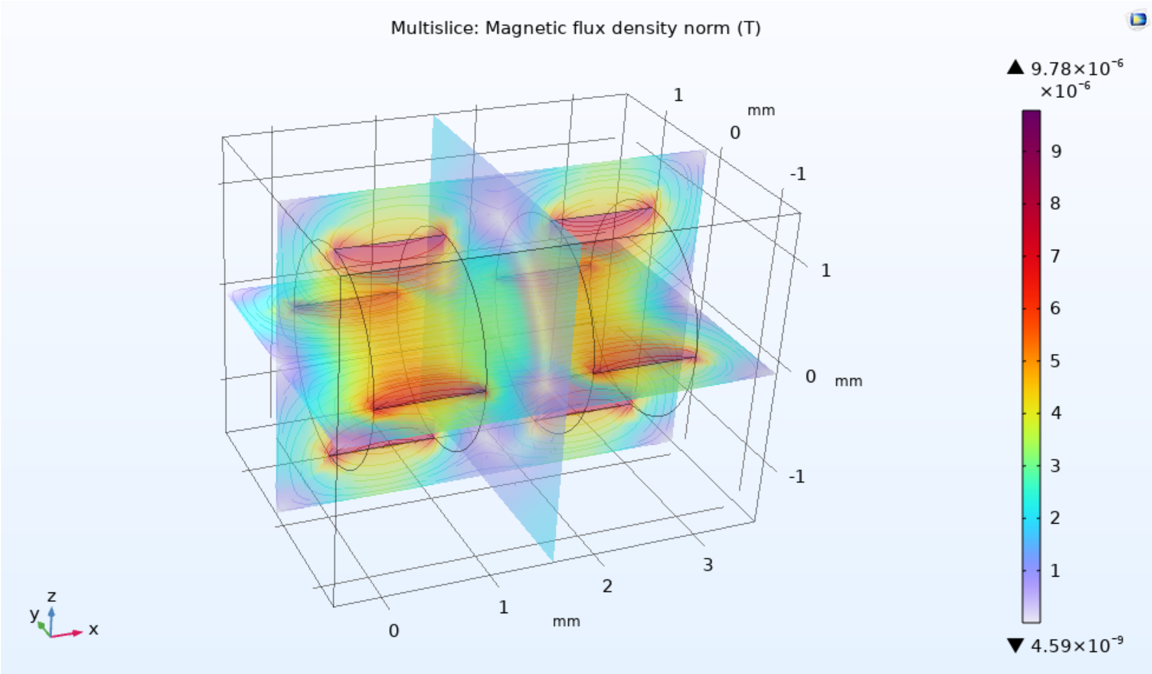

Figure 2

Figure 2 depicts magnetic flux density along three planes.

Both figures above will be necessary to understand the analyses done on the model below.

Design (figures 3, 4)

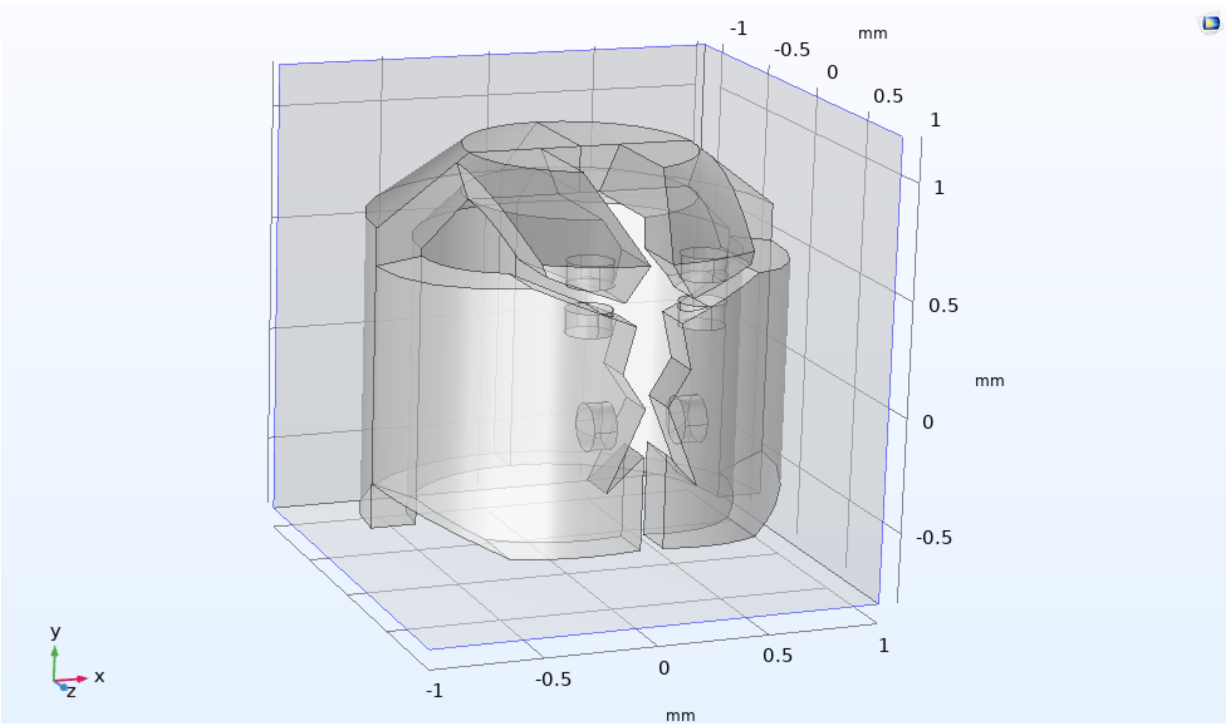

Figure 3

The exosuit (chest) depicted in figure 3 consists of 5 parts, back, front right, front left and two collar parts (left and right). The collars each have one magnet and the front parts each have two magnets. (Both N52 sintered NdFeB)

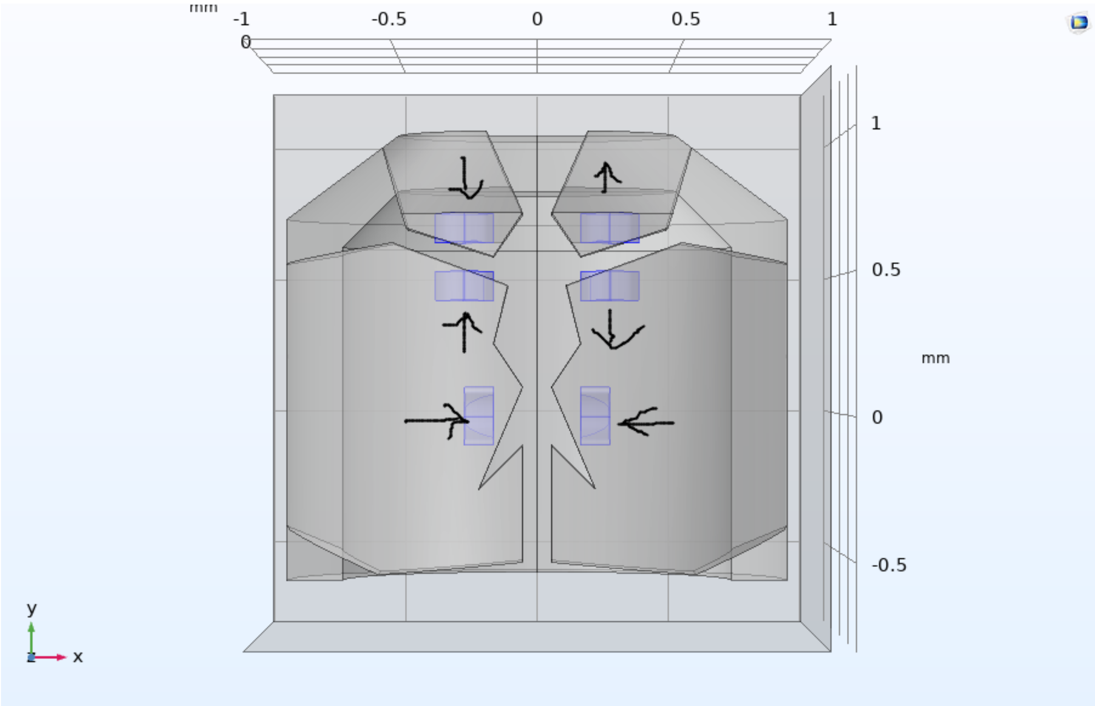

Figure 4

Figure 4, consisting of six magnets embedded into the front and collar parts and close two each other with only air separating them, the magnets have magnetization of 100 A/m.
Top left: -100 A/m along Y axis ; Top right: 100 A/m along Y axis ;
Middle left: 100 A/m along Y axis ; Middle right: -100 A/m along Y axis ;
Lower left: -100 A/m along X axis ; Lower right: -100 A/m along X axis .

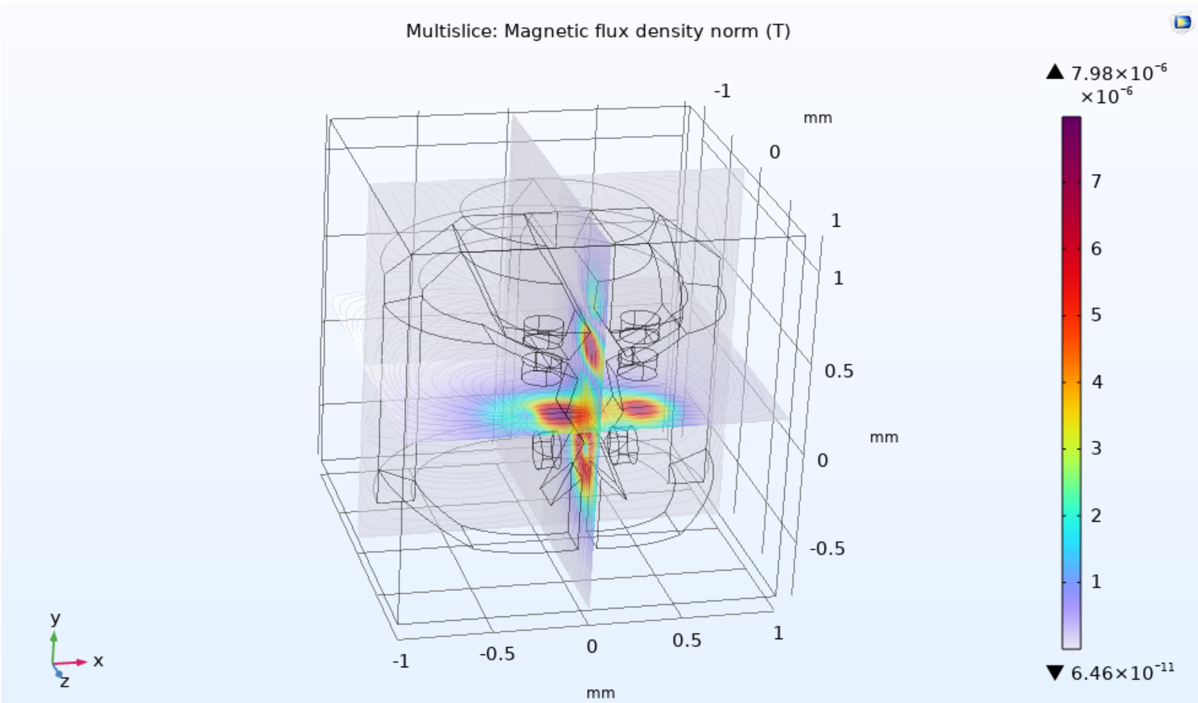

Figure 5

Figure 5 illustrates magnetic flux density along all three planes and the relative lack of flux on the XY plane intersecting the assembly in the middle.

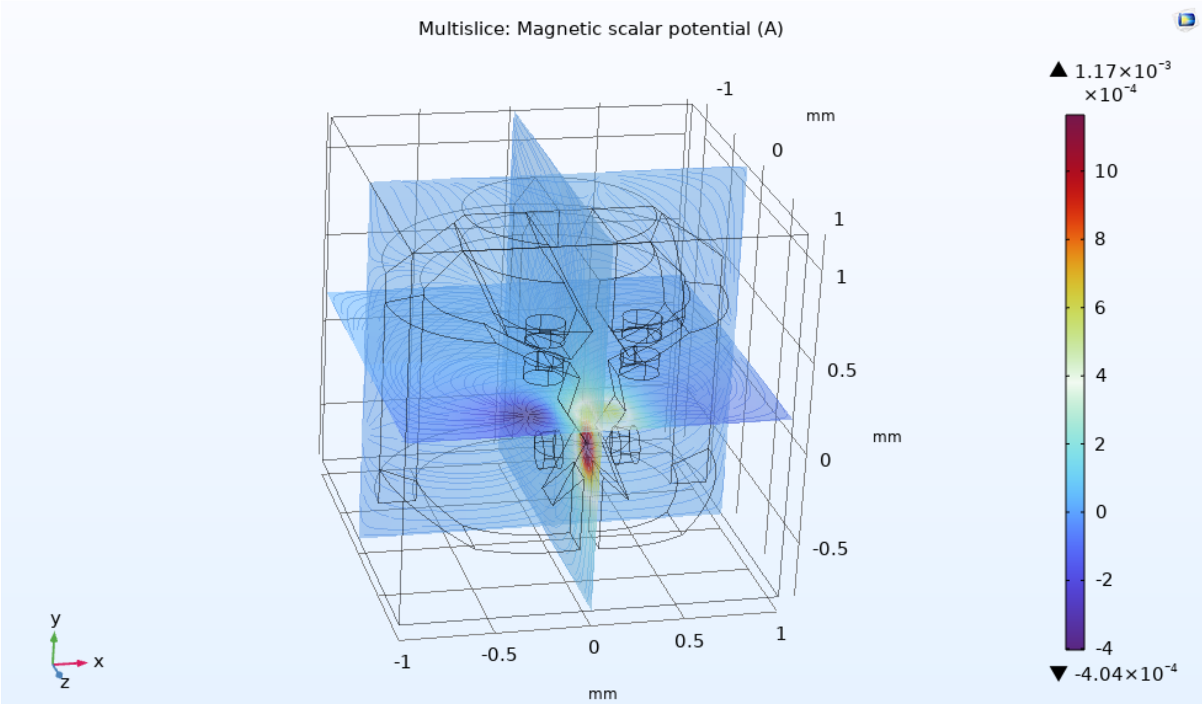

FIgure 6

Figure 6 shows the scalar potential.

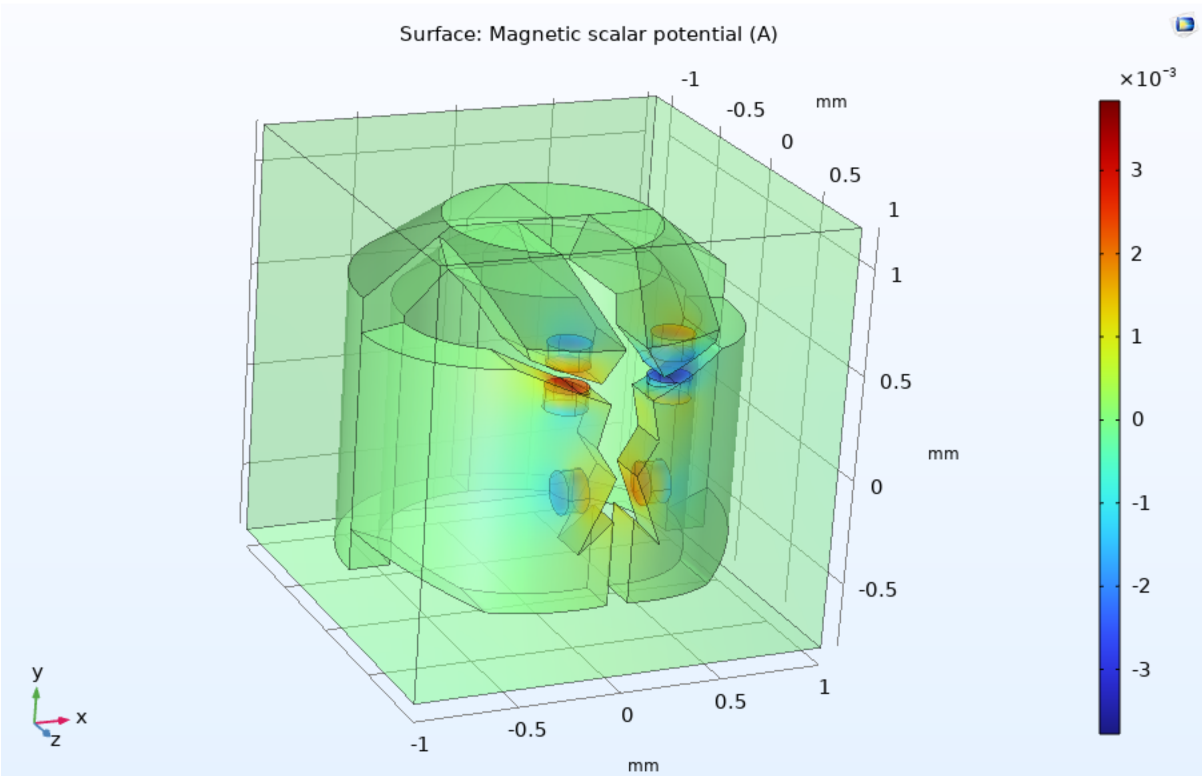

Figure 7

Figure 7 above shows the magnetic scalar potential in 3d and the poles are shown properly.

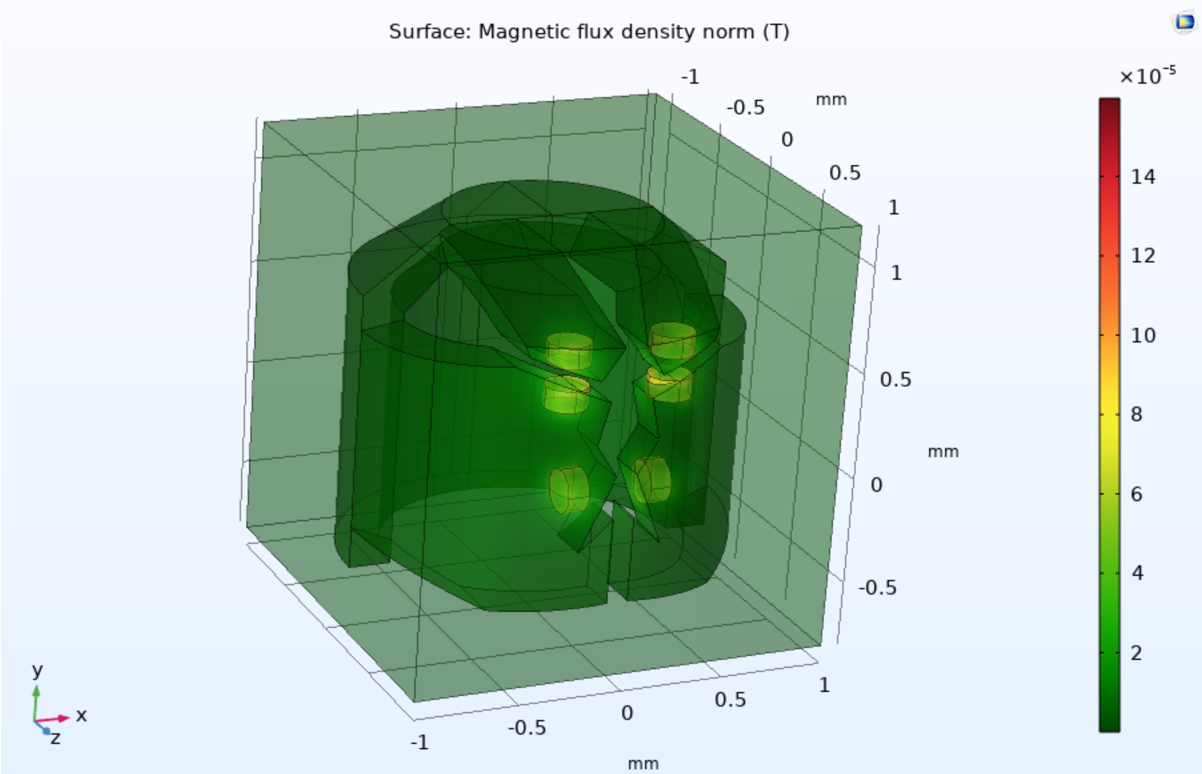

Figure 8

Figure 8 on the other hand shows magnetic flux density across the domains and it is worth noting at this point that the medium is a blank material with relative permeability of 1.

Conclusion/Remarks:

The analysis has been added to reiterate the feasibility of the concept of having an exosuit that can close itself around if the wearer pushes itself into it while such an exosuit is in its idle position.

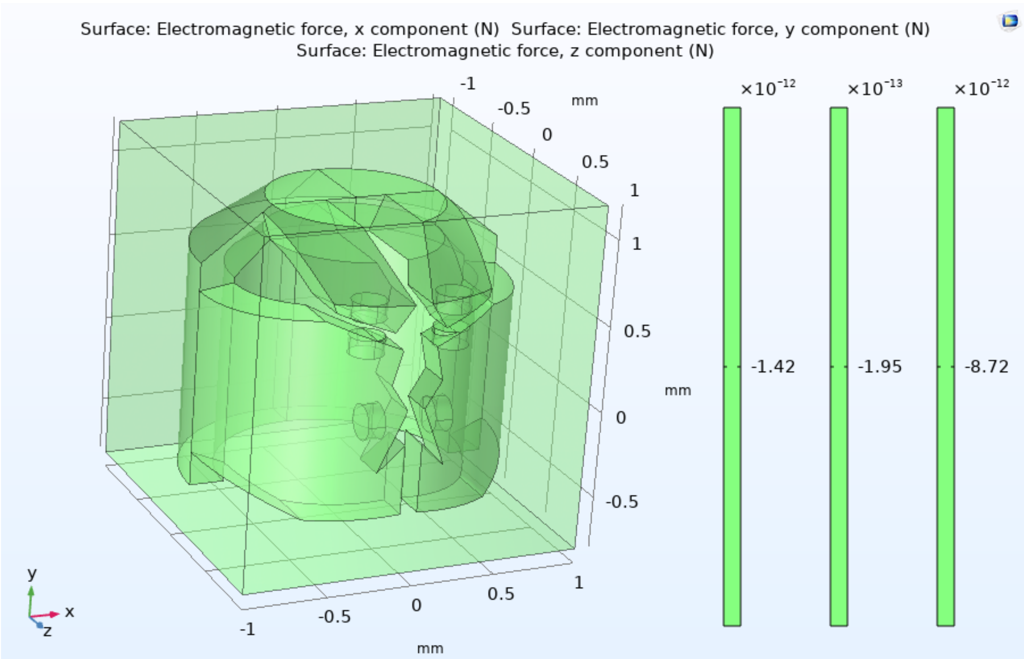

Figure 9

Figure 9 shows the failure of the author to plot the three components of Electromagnetic force into a three dimensional matrix and only consists of the global average drawn over the whole domain. When compared with figures 5,6,7,8, a conclusion can be drawn that the lack of electromagnetic force is there behind xy parallel plane that intersects the domains in half and that F > Electromagnetic force (global) exists to pull opposite polarity magnets embedded in the parts.
Figure 9 does solve the x, y, z components of the electromagnetic force.

References

[1] Shukla, Deepanker, Aryan Verma, Sarthak Yadav, and Basetti Thejeswar. "Ratchet-Pawl Integration in Full Body Mechanical Rigid Wearable Exoskeleton."
Published in 2022

[2] “Interpretation of Measurements with Novel Thermal Conductivity Sensors Suitable for Space Applications” N. I. Kömle, G. Kargl, E. Kaufmann, J. Knollenberg, and W. Macher. Space Research Institute, Austrian Academy of Sciences, Graz, Austria. DLR Institut für Planetenforschung, Berlin, Germany
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