EMAG Tutorial 1: Field Surrounding a Permanent Magnet
Module 1
Electromagnetic Analysis

Objectives:
- Define polarization of a bar permanent magnet
- Apply flux parallel boundary conditions to approximate the far field
- Post processing: scope the field to individual bodies
- Create section plane to better visualize the field
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Start Workbench
The Project Page Loads...

Create standalone system

Hold down LMB to drag Geometry into the Project Schematic
Double Click on Geometry to bring up Design Modeler GUI

Choose “Meter”
Create a block with the dimension shown.
Create a coordinate system using, in order, the 3 points shown. Set “Export Coordinate System?” to “Yes”. This coordinate system will be used to define the direction of polarization. You can rename the coordinate system name in “Details”.

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Create an enclosure – the domain surrounding the PM. It is very important to set “Merge Parts?” to “Yes”.

<table>
<thead>
<tr>
<th>Details of Enclosure1</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Enclosure</td>
<td>Enclosure1</td>
</tr>
<tr>
<td>Shape</td>
<td>Box</td>
</tr>
<tr>
<td>Number of Planes</td>
<td>0</td>
</tr>
<tr>
<td>Cushion</td>
<td>Uniform</td>
</tr>
<tr>
<td>FDI, Cushion (&gt;0)</td>
<td>0.05 m</td>
</tr>
<tr>
<td>Target Bodies</td>
<td>All Bodies</td>
</tr>
<tr>
<td>Merge Parts?</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Now might be a good time to save the project as “PM_in_air”
On the Project Page, drag a Magnetostatic Analysis System onto Geometry.
Double click on Model
When Mechanical GUI appears, create a variable in the variable manager named “ansys 230x”, set its value to 1, and check the “active” box.
Return to the Project Page and open Engineering Data. From Magnetic B-H Curves data source, you can add Neodymium PM to the list of materials to be included in Engineering Data (the material properties that are available in the model).
You can verify that Neodymium PM has been added by choosing Engineering Data and inspecting its contents in the Outline Schematic. If you have not already done so, you should now click “Refresh Project” at the top of the Project Page to load the data into Mechanical.
Return to the Project and double click on Model to bring up the Mechanical GUI
It is often most sensible to use the Wireframe display mode.
Choose the solid which is the PM body and change its material assignment to Neodymium PM and its Coordinate System to “polarization”.

The PM body highlights in green.
Make all external surfaces flux parallel

Use Ctrl-LMB to select multiple surfaces
Solve the model (runs in under 1 minute)

After completion, ask for a plot of the total magnetic flux density
The image will typically be of little use unless you request a vector plot representation.
Bring up vector plot controls to adjust appearance of plot

Solid form

Variable length

Grid aligned

Length adjustment

Density adjustment
“Clean” the results to scope it to the air body alone.
Choose the single body enclosing the PM and re-evaluate the B field.
Insert a section plane, then view down the z axis to create the plane.
Create a section plot

LMB, then drag a line to define the section plane
Adjust location of section plane after returning to contour plot mode.