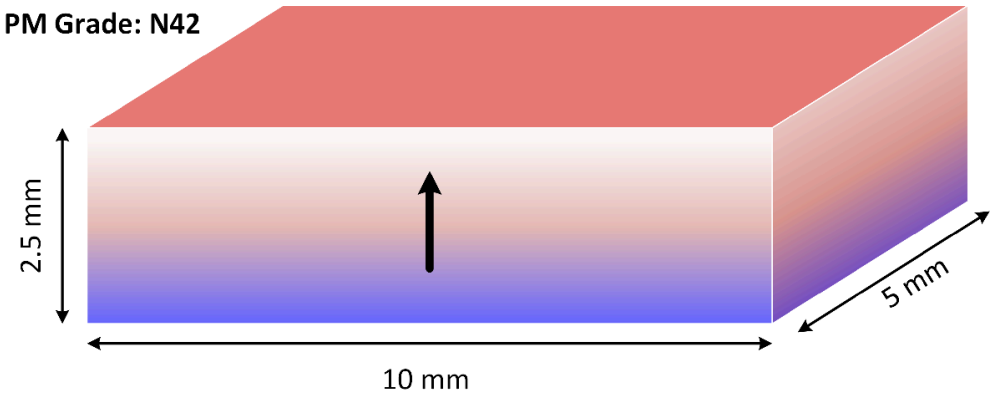
Tutorial - 1: Modeling a Permanent Magnet in FEMM

ELL851 - Computer Aided Design of Electrical Machines

Problem Description:

A permanent magnet of a certain grade (N42) is modeled in FEMM, and its fields and magnitude are plotted. Dimensions and magnetization are specified below.

What'll you understand: *Assigning materials (magnet, air), magnetization assignment*



Define Initial Design Parameters (Known)

```
clc; clear all;
freq  = 0; %frequency of the problem
% Magnet dimensions
MagW = 10; % Magnet Width, units: mm
MagH = 2.5; % Magnet Height
MagD = 10; % Magnet Depth

% Boundary Properties
boundary_rad = 20; % boundary radius, 20 mm
```

Open FEMM and Define Initial Settings

```
openfemm();
newdocument(0); % for Magnetostatic problems
messagebox('Tutorial-I, Permanent Magnet'); %display name of tutorial
mi_probdef(0,'millimeters','planar',1.e-8,5,30); %problem definition
```

Geometry Definition

```
mi_drawrectangle ([-MagW/2 0; MagW/2 MagH])
mi_drawarc(boundary_rad, MagH/2, -boundary_rad, MagH/2, 180, 5) %boundary arc 1
mi_drawarc(-boundary_rad, MagH/2, boundary_rad, MagH/2, 180, 5) %boundary arc 2
mi_zoomnatural
```

Boundary Assignment

```
mi_addboundprop('Air',0,0,0,0,0,0,0,0,0)
mi_selectarcsegment(0,boundary_rad); mi_selectarcsegment(0,-boundary_rad);
%Select the outer boundary
mi_setarcsegmentprop(5, 'Air', 0, 1); %group 1
mi_clearselected
```

Material Assignment

```
% Get materials
mi_getmaterial('Air');
mi_getmaterial('N42');

% Set materials to labels
mi_addblocklabel(0,boundary_rad/2); mi_selectlabel(0,boundary_rad/2);
mi_setblockprop('Air',1,0,'None',0,3,0); %Air, group 3
mi_clearselected();

mi_addblocklabel(0,MagH/2); mi_selectlabel(0,MagH/2);
mi_setblockprop('N42',1,0,'None',90,2,0); %N42, group 2
mi_clearselected();
```

Analysis and Solution

```
%Save before analyzing
mi_saveas('Assignment1.FEM');
mi_createmesh; mi_analyze;
mi_loadsolution; mi_zoomnatural;

mo_showdensityplot(1,0,1,0.0,'bmag');
%outputs flux density in
mo_setgrid(0.5, 'cart');
```

Assignment 1 - Questions:

1. Model the above permanent magnet with dimensions: **10mm x 2.5mm x 10mm and magnetization vector = 0deg (right)** using FEMM and MATLAB. Only '.mlx' files accepted.
2. What does the material grade 'N42' nomenclature signify?
3. List the names of different grades of similar PMs.
4. What is the thermal limit for demagnetization in this particular grade of magnet?
5. Plot the variation of flux density along the x and y axes at 0.1 mm gap from the surface of the PM in the below window.

Post Processing

Plot the flux density along x and y axis at 0.1 mm air-gap from PM

```
% Insert solution here
```