Assignment correction

22.2MB1

Dr Yvan Petillot

Introduction

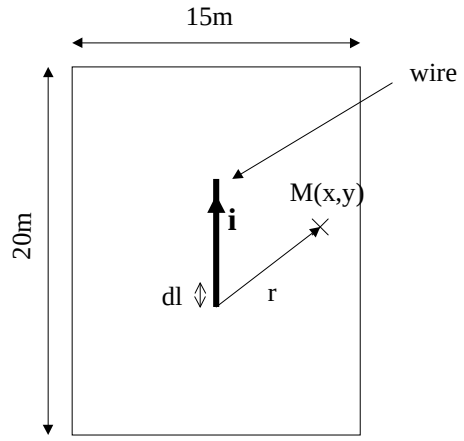
Use MATLAB to determine the distribution of magnetic flux density B(T) in the region of free space surrounding a straight current-carrying conductor of finite length.
Apply the Biot-Savart Law to evaluate B(T).

Assume that the conductor is 5m long and that it carries a direct current of 1A. Compute the magnetic field at grid points over an area of 20m x 15m, with the conductor at the centre of the grid, lying along the 20m direction.

Your report should contain the following detail, as a minimum.

1. A description of the mathematics involved, referring to an appropriate textbook.
2. A printout of your MATLAB code, with descriptive comments beside each line of code.
3. A group of four subplots

Analysis of the problem



$$d\vec{B} = \frac{\mu_0}{4\pi} \frac{i \overrightarrow{dl} \times \vec{r}}{r^3}$$

Problems:
- Which resolution to use?
- How to do that with matlab?

Matlab program

Initiliasation

```
current = 1;        % Fixes the current amplitude to 1 A
mu_0 = 4*pi*1e-7;   % Value of mu_0
step = 0.5;         % Resolution of the grid
nbx = 15/step;      % number of points in x direction
nby = 20/step;      % number of points in y direction
% creates equally spaced points from -7.5 to 7.5
x = linspace(-7.5,7.5,nbx);
% creates equally spaced points from -10 to 10
y = linspace(-10,10,nby);
% Creates a grid of points
[X,Y] = meshgrid(x,y);
% number of elements of current
nb_dl = 10/step;
CurrentLine = linspace(-2.5,2.5,nb_dl); % Line of current

B = zeros(nby,nbx,3);      % Initiliases the B vector field
Btot = zeros(nby,nbx,3);   % Initiliases the total B vector field
```

Matlab program

Calculus

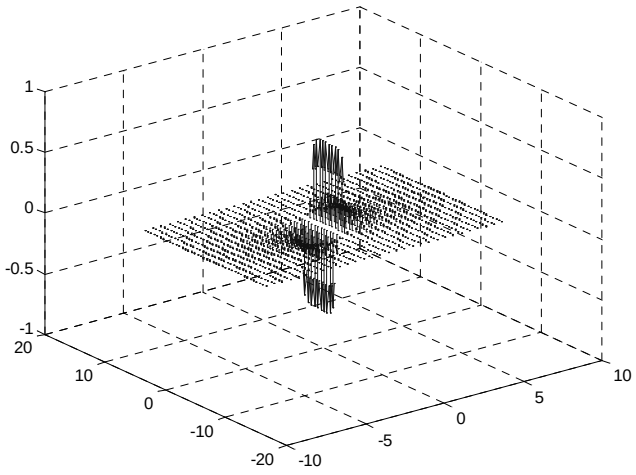
```
for i = 1 : nb_dl     % For each small element of current
   dl = [0;step;0];   % Creates the dl vector
   for k = 1 : nby    % For each y coordinates
      for l = 1 : nbx % For each x coordinates
         %Creates R vector over the grid
         R = [X(k,l) ; Y(k,l)- CurrentLine(i); 0];
         % Caclulates the B value due to dl over the grid
         B(k,l,:) = mu_0/(4*pi)*current*cross(R,dl)/norm(R)^3; %Calc
      end
   end
   % Initialises z Value for the origin of B (always 0)
   z = zeros(nby,nbx);
   figure(1);  % Create a figure
   quiver3(X,Y,z,B(:,:,1),B(:,:,2),B(:,:,3));       %Plots B
   drawnow;    % Ask for a redraw;
   Btot = Btot + B;   % Generated the overall Fields to date
   figure(2);  % Create a figure
   quiver3(X,Y,z,Btot(:,:,1),Btot(:,:,2),Btot(:,:,3)); %Plots Btot
   drawnow;
end
```


Matlab program

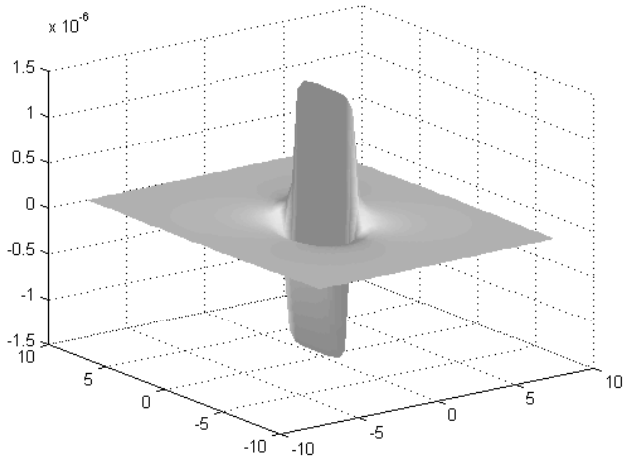
Display

```
% Calculation is now finished
figure(3);
%Plots the z value of B as Bx and By are null
surfl(X,Y,Btot(:,:,3)); shading interp;        % Make it
nicer
colormap(pink);            % idem
figure(4);
contour(X,Y,Btot(:,:,3));  % Now get the contours of B
BzdB = 20*log(abs(Btot(:,:,3))/1e-9); % Get Bz in dB
% Same as for B
figure(5);
surfl(X,Y,BzdB);
shading interp;
colormap(pink);
figure(6);
contour(X,Y,BzdB);
```

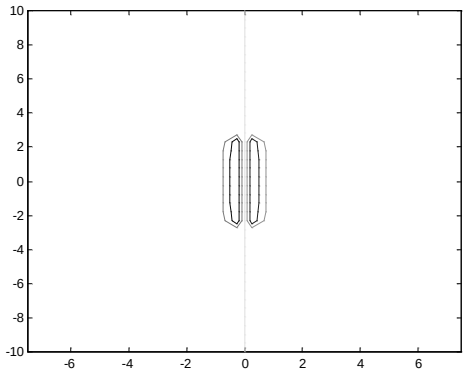
Results



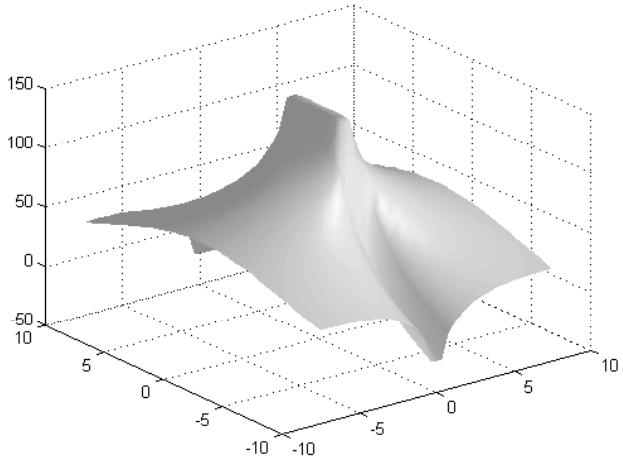
Results



Results



Results



Results