Good

100/100

Name: Jason Wayment TA: 11/11/07

Partner(s):

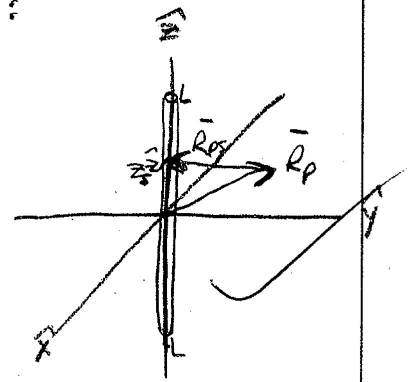
Lab 6 Biot-Savart	Pts	Grd
Prelab		
Sketch and Define the System	10	10
Write and sketch the vectors Rs, Rp, R	10	10
Define the source	5	5
Write the integral to find H	15	15
Integrate and Fill in Chart	15	15
Write a program to find H and include with lab	20	20
Plot the magnetic field along y axis	15	15
Conclusion	10	10
Total	100	100

How much time was spent on this lab?

Comments:

Prelab # 5	ECE 3300 Thurs Morning Lab	Jason Wayment

Given a wire (thin) antenna oriented along the z-axis from $z_s = -L$ to L and a current distribution:



$$\bar{R}_s = x_s\hat{x} + y_s\hat{y} + z_s\hat{z}$$

$$= z_s\hat{z} \quad \text{for thin (assume } r=0\text{) wire}$$

$$\bar{R}_p = x_p\hat{x} + y_p\hat{y} + z_p\hat{z}$$

$$\bar{R}_{ps} = x_p\hat{x} + y_p\hat{y} + (z_p - z_s)\hat{z}$$

$$\hat{R}_{ps} = \frac{\bar{R}_{ps}}{\sqrt{x_p^2 + y_p^2 + (z_p - z_s)^2}} \qquad |\bar{R}_{ps}| = \sqrt{x_p^2 + y_p^2 + (z_p - z_s)^2}$$

source $= \vec{I}\, dl$

$$\begin{vmatrix} \hat{x} & -\hat{y} & \hat{z} \\ 0 & 0 & I \\ x_p & y_p & z_p - z_s \end{vmatrix} = -Iy_p\hat{x} + Ix_p\hat{y}$$

$$H = \int \frac{d\bar{I} \times \bar{R}}{4\pi R^2} = \int_{-L}^{L} \frac{I x_p\, \hat{y}\, dz_s}{4\pi\left(x_p^2 + y_p^2 + (z_p - z_s)^2\right)^{3/2}} - \int_{-L}^{L} \frac{I y_p\, \hat{x}\, dz_s}{4\pi\left(x_p^2 + y_p^2 + (z_p - z_s)^2\right)^{3/2}}$$

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Total	100	

How much time was spent on this lab? 3 hours

Comments:

Lab 5 Biot-Savart

$n = \frac{b-a}{2h} + 2$

$\int_a^b f(x) = h\left[\frac{f(a)}{2} + \frac{f(b)}{2} + \sum_{j=1}^{n-1} f(a+jh)\right] + error \cdot (h_3 f'')$

$A = \int_1^5 F(z)\,dz$ where $F(z) = z, z^2, z^3$

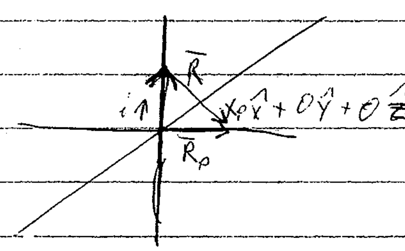
F(z)	Matlab	Real	Error
z	12	12	0
z^2	41.334	124/3 = 41.33	-6.666E-5
z^3	156.06	625/4 = 156.25	0.19

F(z)	h size	Matlab	Error
z^3	1	162	5.75
z^3	0.01	156.0002	-0.2495
z^3	0.0001	156.0000	-0.25

$I = \cos(z)\,\hat{z}$

$R_s = z_s\,\hat{z}$

$R_p = x_p\hat{x} + y_p\hat{y} + z_p\hat{z}$

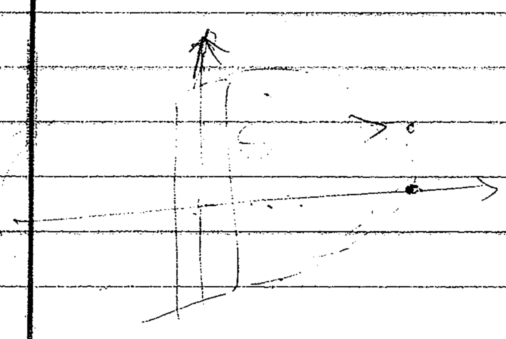


$\bar{R}_{ps} = x_p\hat{x} + y_p\hat{y} + (z_p - z_s)\hat{z}$

$\int_{-L}^{L} \frac{x_p \cos(z)\hat{y} - y_p \cos(z)\hat{x}}{4\pi\left((x_p^2 + y_p^2 + (z_p - z_s)^2\right)^{3/2}}\,dz_s$

$\hat{x}$	$-\hat{y}$	$\hat{z}$
0	0	$\cos(z)$
x_p	y_p	$z_p - z_s$

$= y_p \cos(z)\hat{y} - x_p \cos(z)\hat{x}$



F(z)	$A_{analytical}$	$A_{numerical}$	Error = ($A_{analyt} - A_{num}$) w/ h = 0.1
z	12	12	0
z^2	41.3334	41.33333333	-6.66667E-05
z^3	156.06	156.25	0.19

- expected since no change in slope

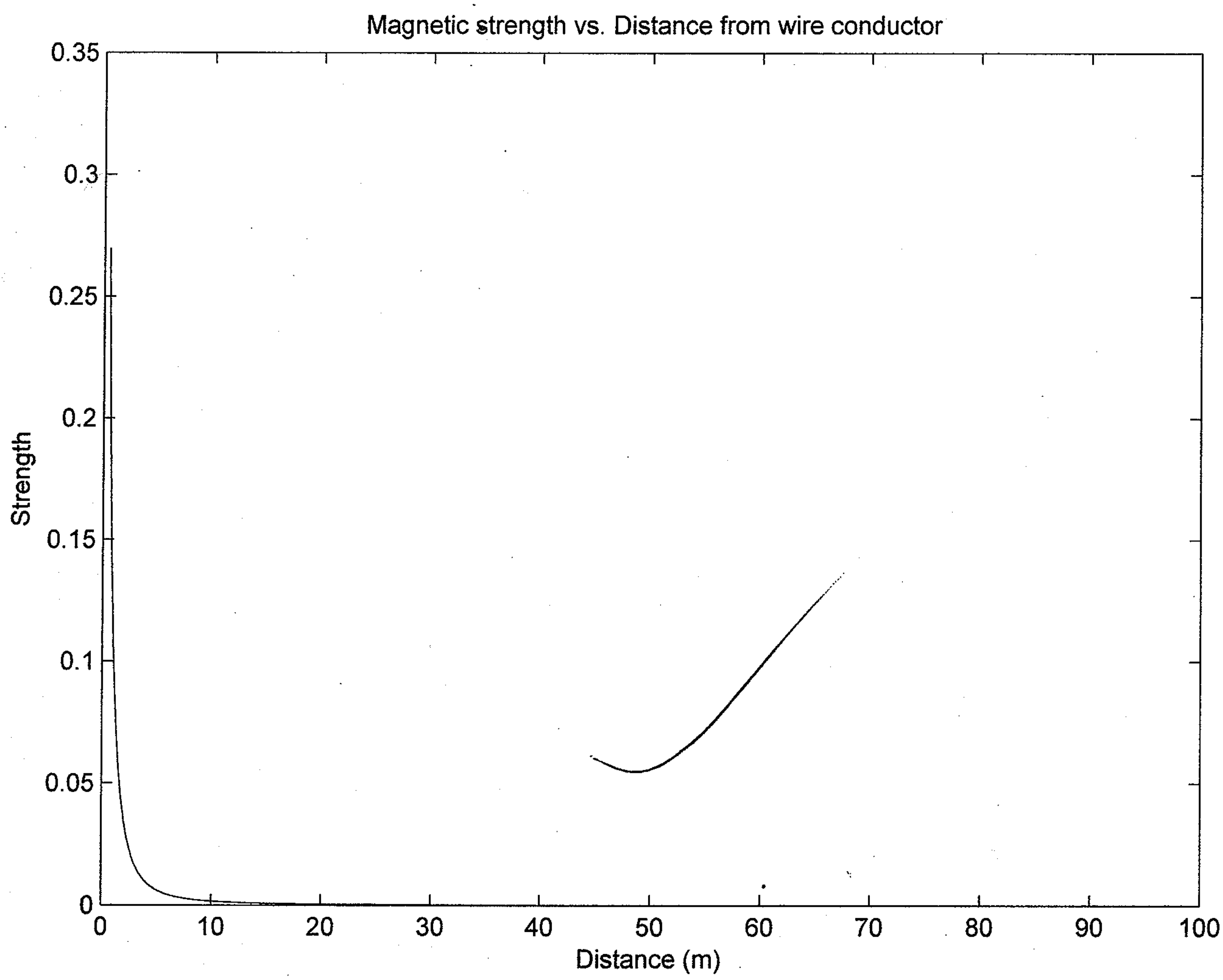
F(z)	h size	$A_{analytical}$	Error =
z^3	1	**162**	5.75
z^3	0.01	156.0006	-0.2494
z^3	0.0001	156	-0.25

Conclusion:

This was a useful lab because I got some much needed practice using Biot-Savart and learned a slick integration trick for Matlab which is now programmed for use w/ other problems.

I got the expected results both from my integration function table (above) and the plot of the $\vec{H}$ field strength vs. distance.

```
function [] = plotforbiot

% This function will plot the H vs distance along the y axis
% using the function BiotSavart
y = 0.5:0.1:100;
for n = 1:length(y)
    Hy(n) = biotsavart1 (-pi/2, pi/2, 0.1 , 0, y(n), 0);
end

plot(y,Hy);

function [Hx] = biotsavart1(a,b,h,xp,yp,zp)
%
% This program will evaluate Biot-Savart analytically
% using the Trapezoidal method
% This program assumes a current on a thin wire oriented along the Z-axis
% from Lower Limit to Upper Limit

% Create a loop which will find X axis component
%%%%%% Not needed for X axis %%%%%%%%%%%
% Because of cross product math, Xbar is negative
% increase = 0;
% for i = a:h:b-h
%     increase = increase - h*xp*(functt (i,xp,yp,zp)+functt(i+h,xp,yp,zp))/2;
% end
% % Print to screen the value
% Hy = increase;

% Create a loop which will find Y axis component
increase = 0;
for i = a:h:b-h
    increase = increase + h*yp*(functt (i,xp,yp,zp)+functt(i+h,xp,yp,zp))/2;
end
Hx = increase;

% Define the function to be integrated

function[dH] = functt(zs,xp,yp,zp)
I = cos(zs);
dH= I/(4*pi*(xp^2 + yp^2+abs((zp-zs)).^2).^(3/2));
```



Student Version of MATLAB