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```
close all
clear
clc
```

## The B0 Field

---

```
z = linspace(-2.5, 2.5, 100);
Rect = [-1, -0.25, 2, 0.5];

Bz = 0;
u = pi*4e-7;
N = 64;

i = N.*[49, 64, 49];
Z = 1.5*[-sqrt(3/7), 0, sqrt(3/7)];
a = 1.5*[ sqrt(4/7) , 1, sqrt(4/7)];

for o = 1 : length(i)
    Bz = Bz + ((u*i(o).*a(o).^2)*N)./(2*(a(o).^2 + (z - Z(o)).^2)).^(3/2);
end

figure
plot(z, Bz/.14)
hold on

for x = [-1, 0, 1]
    xline(x, '--r')
end

xlim([-2.5, 2.5])
xlabel('z, m')

ylim([0,1.2])
ylabel('B_0, T')
title('B_0 Field of Maxwell Coil')
hold off

% Maxwell coils
x = linspace(-1.8, 1.8, 50);
z = linspace(-1.8, 1.8, 50);
[X,Z] = meshgrid(x,z);

z0 = 0;
z1 = sqrt(3/7)*1.5;
z2 = -sqrt(3/7)*1.5;

a = 1.5;
a1 = sqrt(4/7)*1.5;
a2 = sqrt(4/7)*1.5;

i = 49*N;
```

```

i1 = 64*N;
i2 = i;

figure
hold on
[BX,BZ] = loopBField(X, Z, a , z0, i );
[BX1,BZ1] = loopBField(X, Z, a1, z1, i1);
[BX2,BZ2] = loopBField(X, Z, a2, z2, i2);

pcolor(Z, X, (3500/11)*(sqrt(BZ.^2 + BX.^2) + sqrt(BZ1.^2 + BX1.^2) + sqrt(BZ2.^2 + BX2.^2) ))
quiver(Z, X, (3500/11)*(BZ + BZ1 + BZ2), (3500/11)*(BX + BX1 + BX2), 3, 'm');

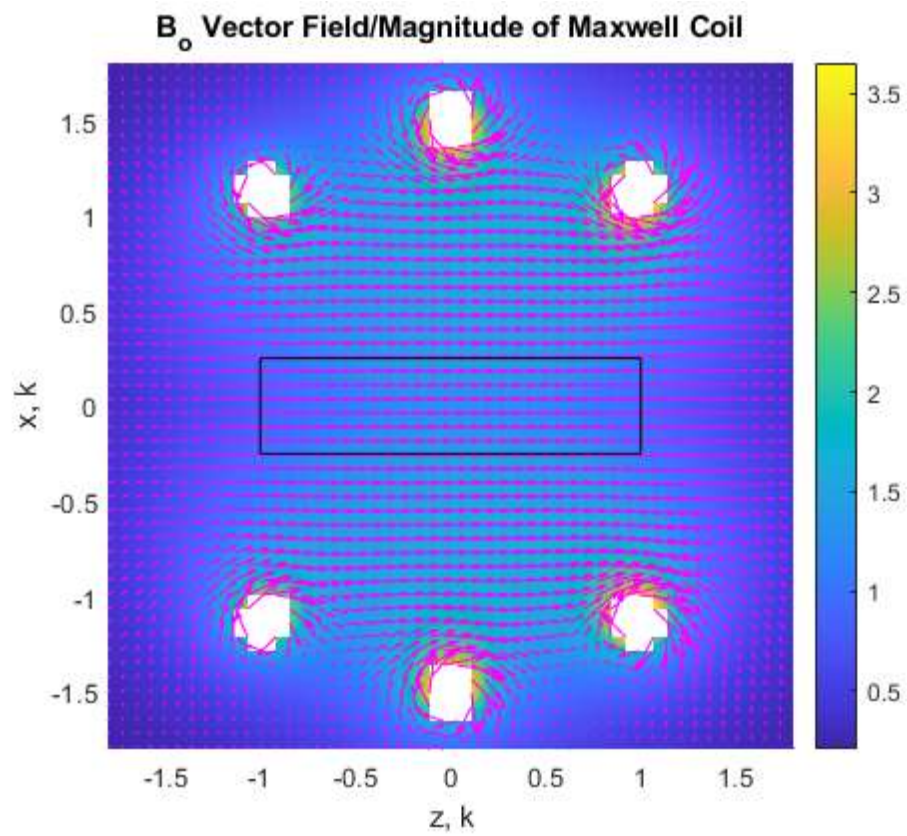
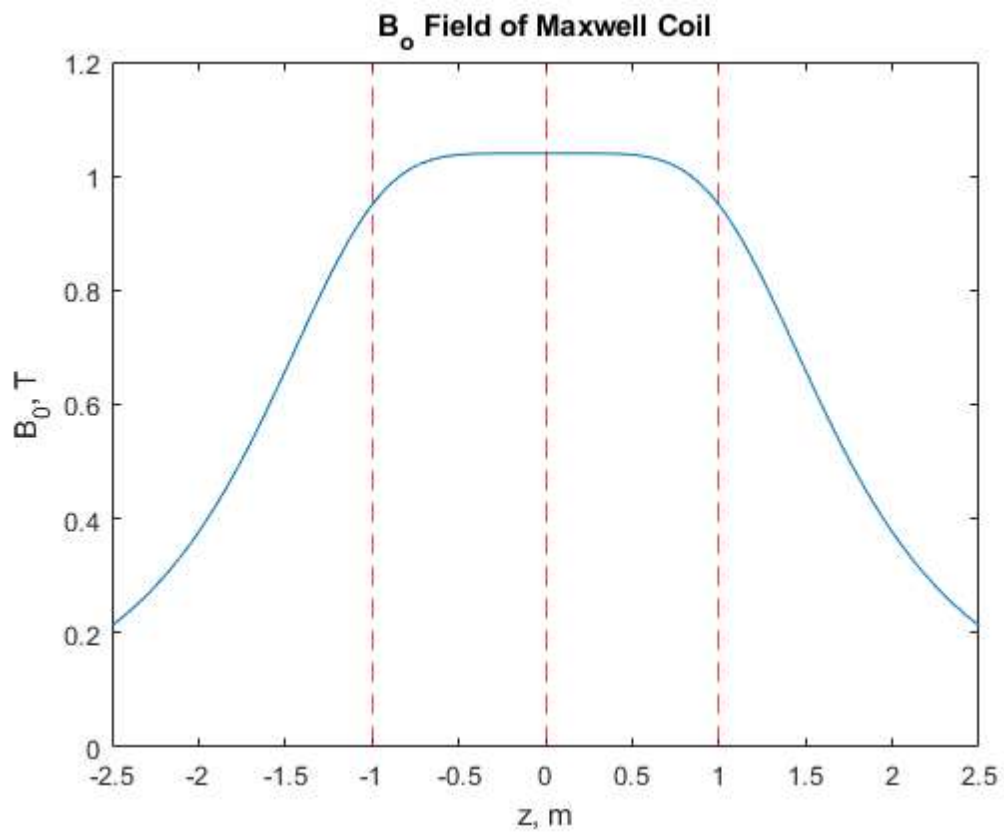
rectangle ('Position', Rect)
shading interp;
colorbar;
axis square;

xlim([min(x),max(x)]);
xlabel('z, k');

ylim([min(z),max(z)]);
ylabel('x, k');
title('B_o Vector Field/Magnitude of Maxwell Coil')
hold off

```

---



## Gradient Fields

```
z = linspace(-2.5, 2.5, 50);
```

```
R = 0.75;
```

```

d = 1.5;
I = 2000;

BZ1 = (u/4*pi)*((2*pi*R^2*I)./(((z+(d/2)).^2+R^2).^(3/2)));
BZ2 = (u/4*pi)*((2*pi*R^2*I)./(((z-(d/2)).^2+R^2).^(3/2)));

figure
plot(z, BZ1- BZ2);
hold on

for o = [0.75, -0.75]
    xline(o, '--r')
end

xlim([-2.5, 2.5])
xlabel('z, m')

ylim([-0.02, 0.02])
ylabel('B_{z-gradient}, T')

title('B Field of z-Gradient Coil')
hold off

x = linspace(-1.8, 1.8, 50);
z = linspace(-1.8, 1.8, 50);
[X,Z] = meshgrid(x,z);

a = 0.75;
a1 = a;

z0 = 0.75;
z1 = -z0;

i = 49*N;
i1 = 64*N;

[BX ,BZ ] = loopBField(X, Z, a , z0, i );
[BX1,BZ1] = loopBField(X, Z, a1, z1, i1);

figure
pcolor(Z, X, (40/9)*(sqrt(BZ.^2 + BX.^2) + sqrt(BZ1.^2 + BX1.^2)))
hold on

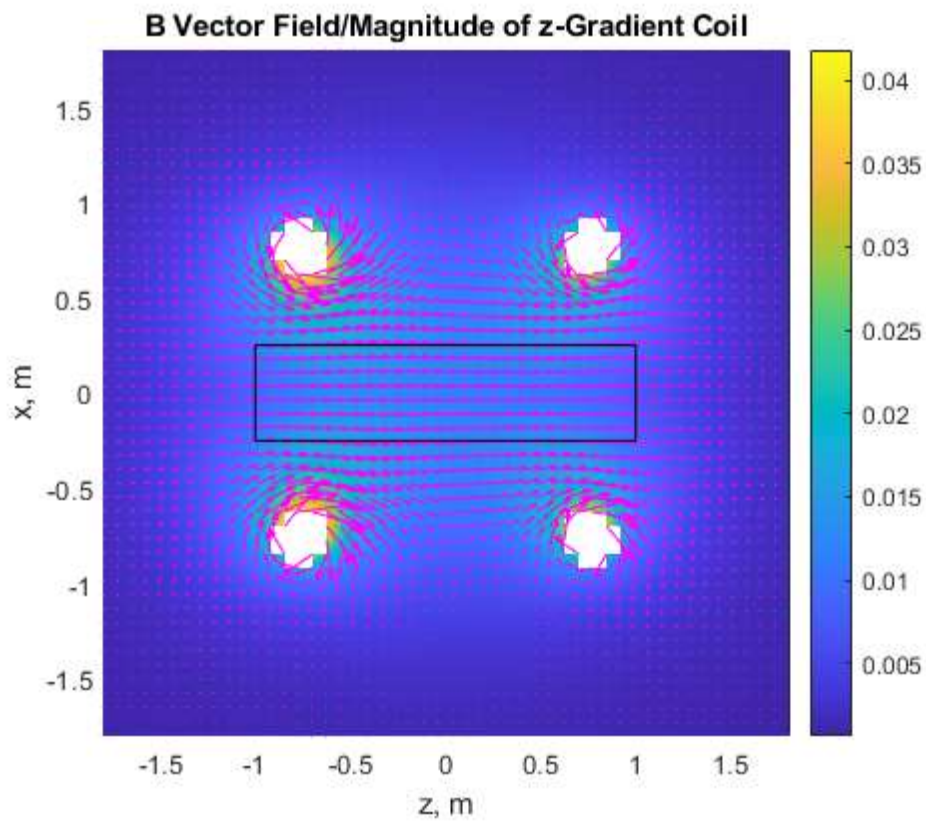
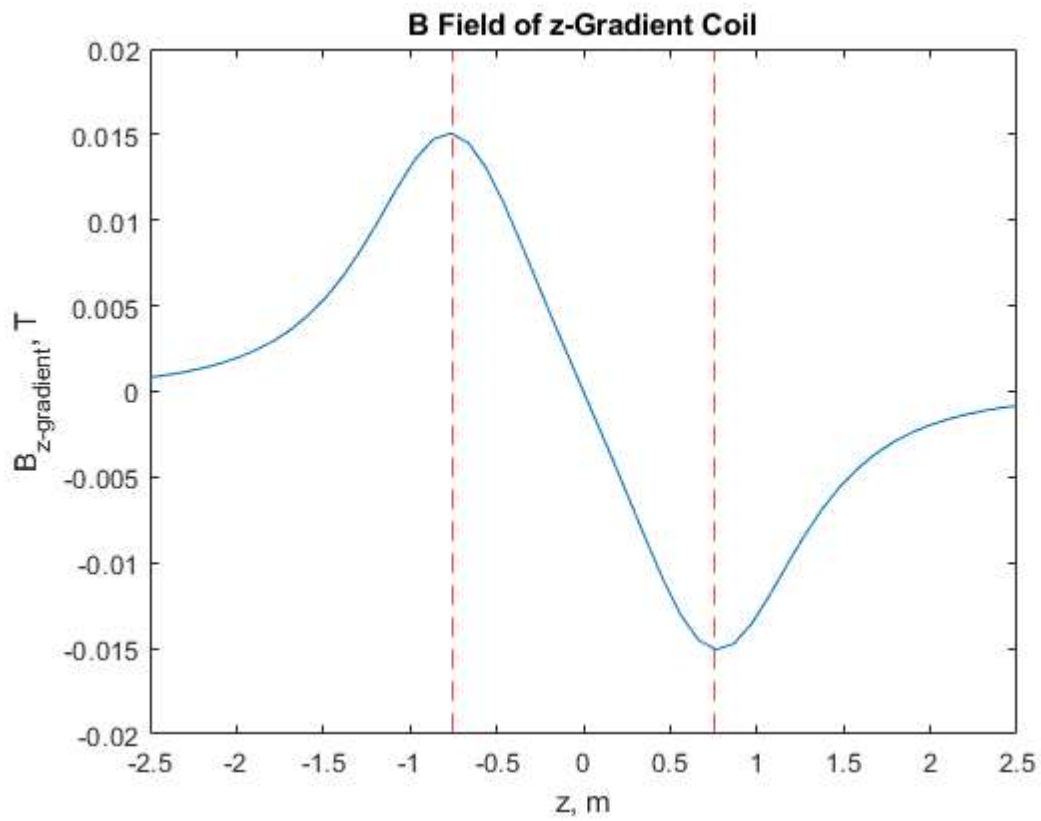
quiver( Z, X, (40/9)*(BZ + BZ1), (40/9)*(BX + BX1), 3, 'm')
rectangle ('Position', Rect)

shading interp
colorbar
axis square

xlim([min(x),max(x)])
xlabel('z, m')

ylabel('x, m')
ylim([min(z),max(z)])
title('B Vector Field/Magnitude of z-Gradient Coil')
hold on

```



## Birdcage Coils

```
x = linspace(-0.5, 0.5, 50);
y = linspace(-0.5, 0.5, 50);
[X,Y] = meshgrid(x,y);
```

```

N = [6, 10, 14];

Bz = 0;
th = 0;
a = 0.3;

titles = ["6 Coils" ; "10 Coils" ; "14 Coils"];

for g = 1:length(N)
    figure
    Bx = 0;
    By = 0;
    for c = 1 : N(g)
        th = (2*pi./N(g)).*c;

        x_0 = a.*cos(th);
        y_0 = a.*sin(th);

        i = sin(th+(pi./2));

        [BX,BY] = lineBField(X, Y, x_0, y_0, i);

        Bx = Bx + BX;
        By = By + BY;

    end
    mag = sqrt(Bx.^2+ By.^2);
    pcolor(X,Y,mag);

    hold on

    quiver(X,Y,Bx,By, 3, 'm')
    rectangle ('Position', Rect)
    shading interp
    colorbar
    axis square

    xlim([min(x),max(x)])
    xlabel('x, m')

    ylim([min(y),max(y)])
    ylabel('y, m')
    title(titles(g))
    hold off
end

```

