MATLAB-EXPERIMENT 5A

Divergence, Curl and Gradient and visualization of vector field

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MAT 1011 – Calculus for Engineers (MATLAB)

Experiment 5-A

Divergence, Curl and Gradient and visualization of vector field

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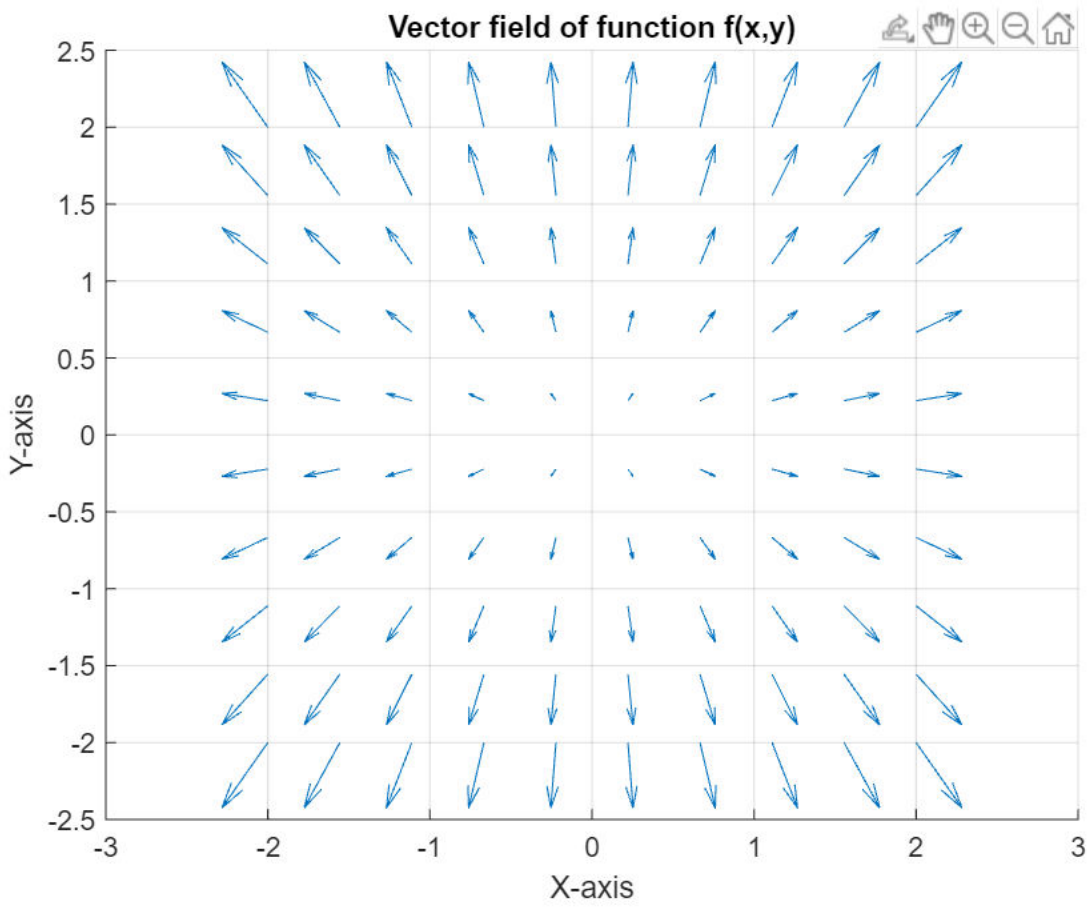
1. Draw the two dimensional vector field for the vector 2xi + 3yj

CODE:

```
% Draw the two dimensional vector field for the
vector 2x i + 3y j.

close all ;
clear;
clc;
syms x y z;

%given function
func = [2*x,3*y];

% div = curl(func, [x, y])
```

```
fx(x, y) = func(1);
fy(x, y) = func(2);
[xcord, ycord] = meshgrid(linspace(-2,2,10));
u = fx(xcord, ycord);
v = fy(xcord, ycord);
figure(1);
% pcolor(xcords, ycords, div(xcords, ycords));
hold on;
grid on;
quiver(xcord, ycord, u, v);

xlabel("X-axis");
ylabel("Y-axis");
title("Vector field of function f(x,y)");
hold off;
```

```
% Draw the two dimensional vector field for the vector 2x i + 3y j.

close all ;
clear;
clc;
syms x y z;

%given function
func = [2*x,3*y];

% div = curl(func, [x, y])
fx(x, y) = func(1);
fy(x, y) = func(2);
[xcord, ycord] = meshgrid(linspace(-2,2,10));
u = fx(xcord, ycord);
v = fy(xcord, ycord);
figure(1);
% pcolor(xcords, ycords, div(xcords, ycords));
hold on;
grid on;
quiver(xcord, ycord, u, v);

xlabel("X-axis");
ylabel("Y-axis");
title("Vector field of function f(x,y)");
hold off;
```


Vector field of function f(x,y)
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
Y-axis
-3
-2
-1
0
1
2
3
X-axis

2. **Find the Gradient of the function $f = x2y^3 - 4y$.**

CODE:

```
% Find the Gradient of the function f=x^2 y^3-
4y.
close all ;
clear all;
clc;
syms x y z;

func = (x^(2))*(y^(3))- 4*y;
disp("The gradient of the function is ");
grad = gradient(func, [x, y]);
disp(grad);

fx(x, y) = grad(1);
fy(x, y) = grad(2);
[xcord, ycord] = meshgrid(linspace(-4, 4, 10));
u = fx(xcord, ycord);
v = fy(xcord, ycord);

figure(1);
hold on;
grid on;
quiver(xcord, ycord, u, v, 2);

xlabel("X-axis");
```

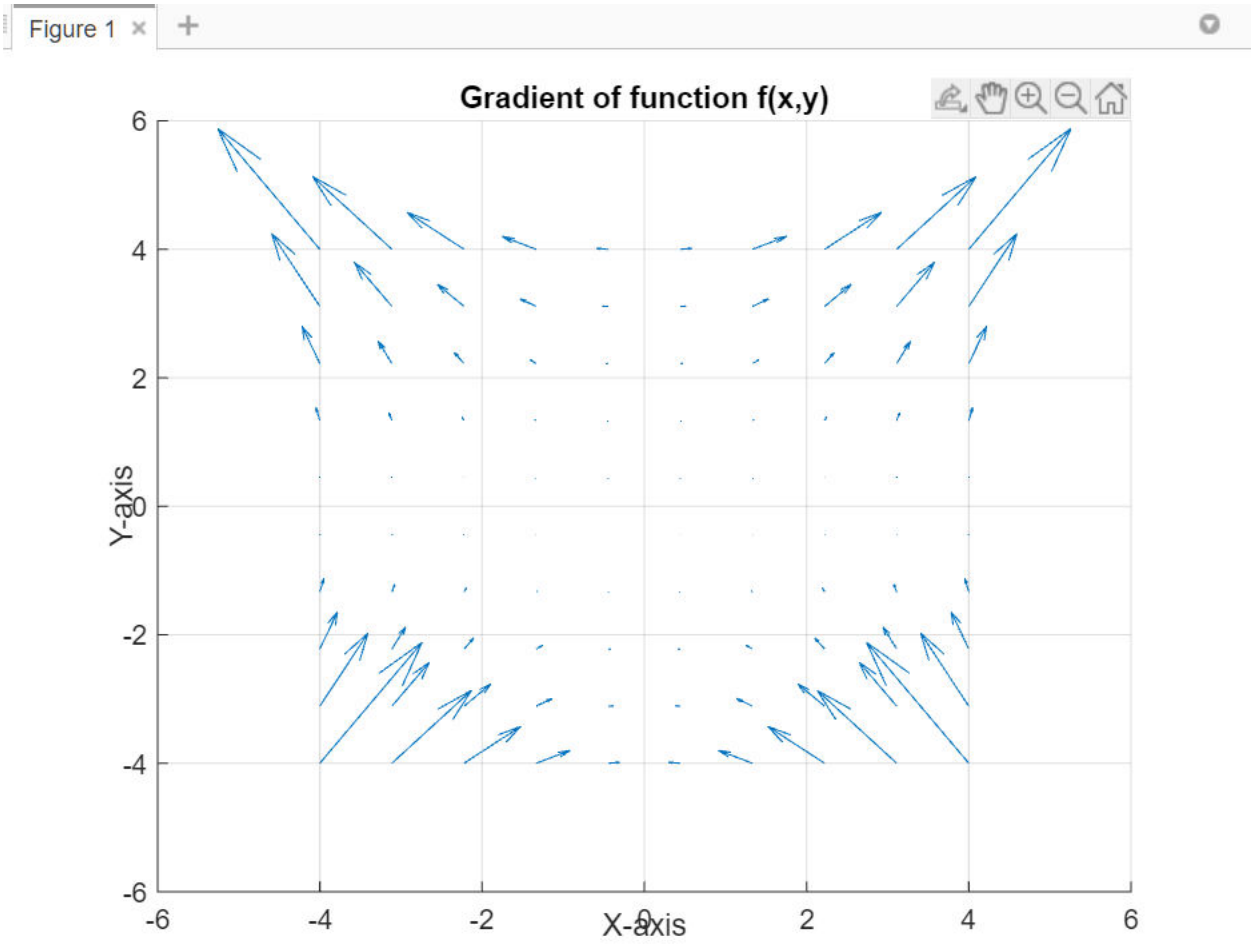
```
ylabel("Y-axis");
title("Gradient of function f(x,y)");
hold off;
```

OUTPUT:

```
The gradient of the function is
      2*x*y^3
3*x^2*y^2 - 4
```

```
% Find the Gradient of the function f=x^2 y^3- 4y.
close all ;
clear all;
clc;
syms x y z;

func = (x^(2))*(y^(3))- 4*y;
disp("The gradient of the function is ");
grad = gradient(func, [x, y]);
disp(grad);

fx(x, y) = grad(1);
fy(x, y) = grad(2);
[xcord, ycord] = meshgrid(linspace(-4, 4, 10));
u = fx(xcord, ycord);
v = fy(xcord, ycord);

figure(1);
hold on;
grid on;
quiver(xcord, ycord, u, v, 2);

xlabel("X-axis");
ylabel("Y-axis");
title("Gradient of function f(x,y)");
hold off;
```

```
The gradient of the function is

      2*x*y^3
3*x^2*y^2 - 4

>>
```



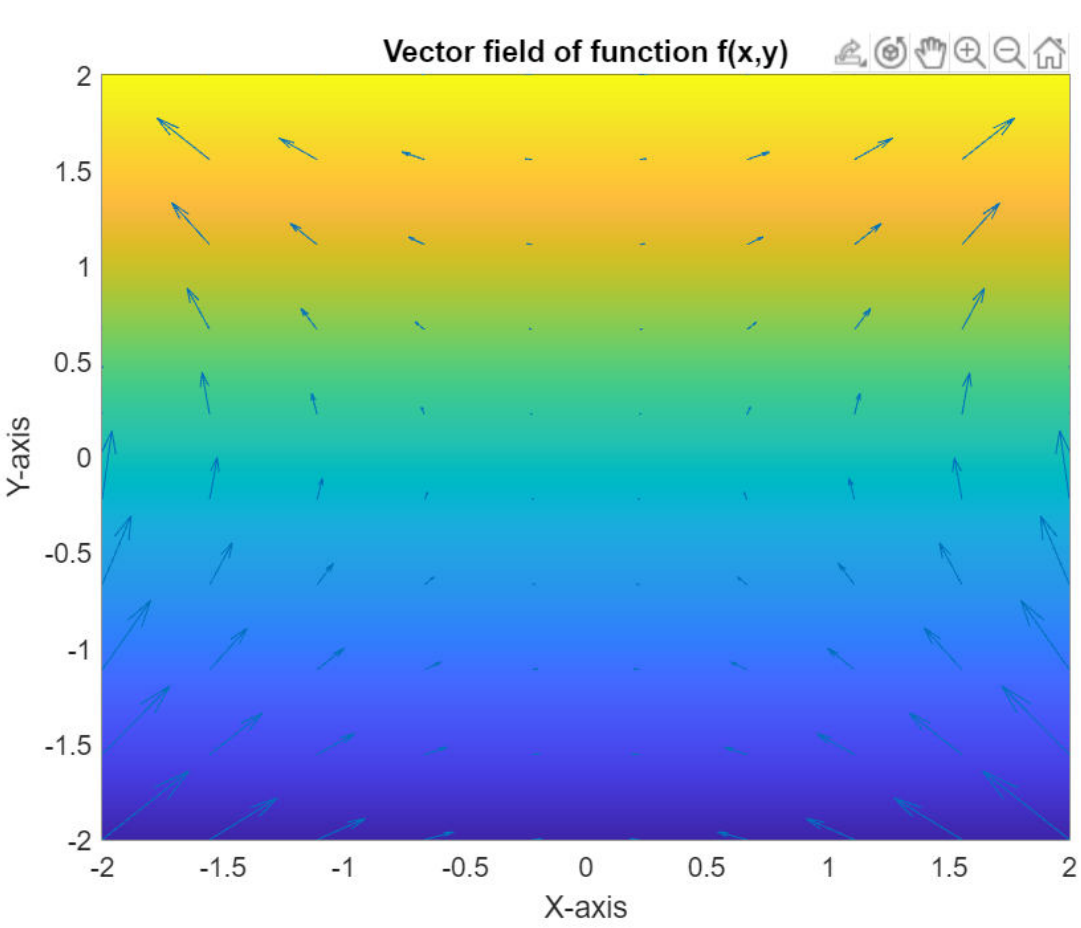
3. Find the divergence of a vector field $f=[xy,x^2]$.

CODES:

```
% Draw the two dimensional vector field for the
vector 2x i + 3y j.
close all ;
clear all;
clc;
syms x y z;

func = [x*y,x^2];
div(x,y) = divergence(func, [x, y]);
fx(x, y) = func(1); fy(x, y) = func(2);
[xcords, ycords] = meshgrid(linspace(-2,2,10));
u = fx(xcords, ycords);
v = fy(xcords, ycords);

figure(1);
pcolor(xcords, ycords, div(xcords, ycords));
shading interp;
hold on;
grid on;
quiver(xcords, ycords, u, v);

xlabel("X-axis");
ylabel("Y-axis");
title("Vector field of function f(x,y)");
hold off;
```

OUTPUT:

```
% Draw the two dimensional vector field for the vector 2x i + 3y j.
close all ;
clear all;
clc;
syms x y z;

func = [x*y,x^2];
div(x,y) = divergence(func, [x, y]);
fx(x, y) = func(1); fy(x, y) = func(2);
[xcords, ycords] = meshgrid(linspace(-2,2,10));
u = fx(xcords, ycords);
v = fy(xcords, ycords);

figure(1);
pcolor(xcords, ycords, div(xcords, ycords));
shading interp;
hold on;
grid on;
quiver(xcords, ycords, u, v);

xlabel("X-axis");
ylabel("Y-axis");
title("Vector field of function f(x,y)");
hold off;
```


Vector field of function f(x,y)
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
Y-axis
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
X-axis

4. Visualize the curl of a vector function f =[yz 3, 3zx, z].

CODES:

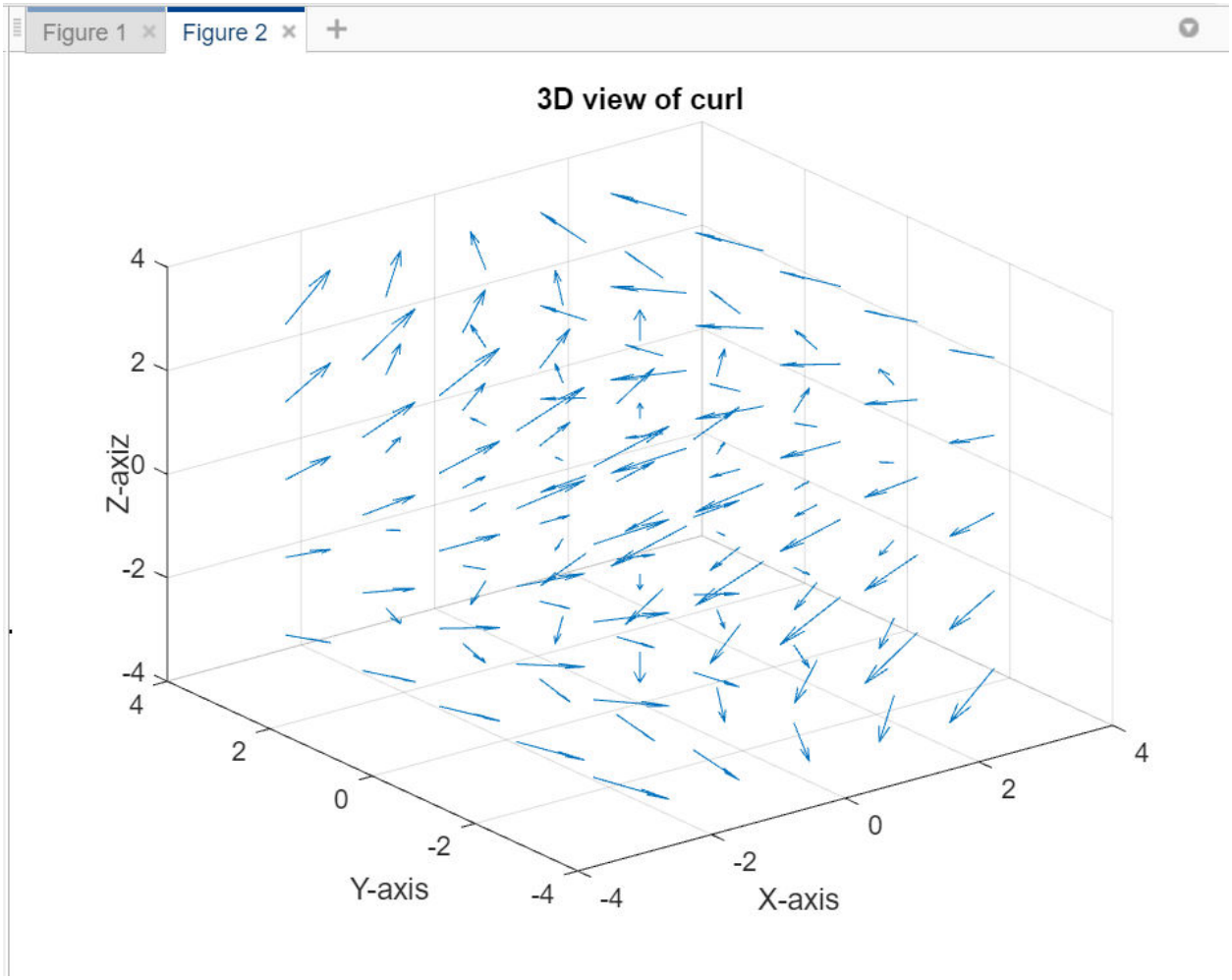
```
% Visualize the curl of a vector function f =
[y*z, 3*z*x, z].
close;
clear all;
clc;
syms x y z;

func = [y*z,3*z*x,z];
disp("The curl of the function is ");
cur = curl(func, [x, y, z]);
disp(cur);
[xcords, ycords, zcords] = meshgrid(linspace(-
3, 3, 5));
fx(x, y, z) = func(1);
fy(x, y, z) = func(2);
fz(x, y, z) = func(3);

u = fx(xcords, ycords, zcords);
v = fy(xcords, ycords, zcords);
w = fz(xcords, ycords, zcords);


figure(1);
quiver3(xcords, ycords, zcords, u, v, w);
hold on;
```

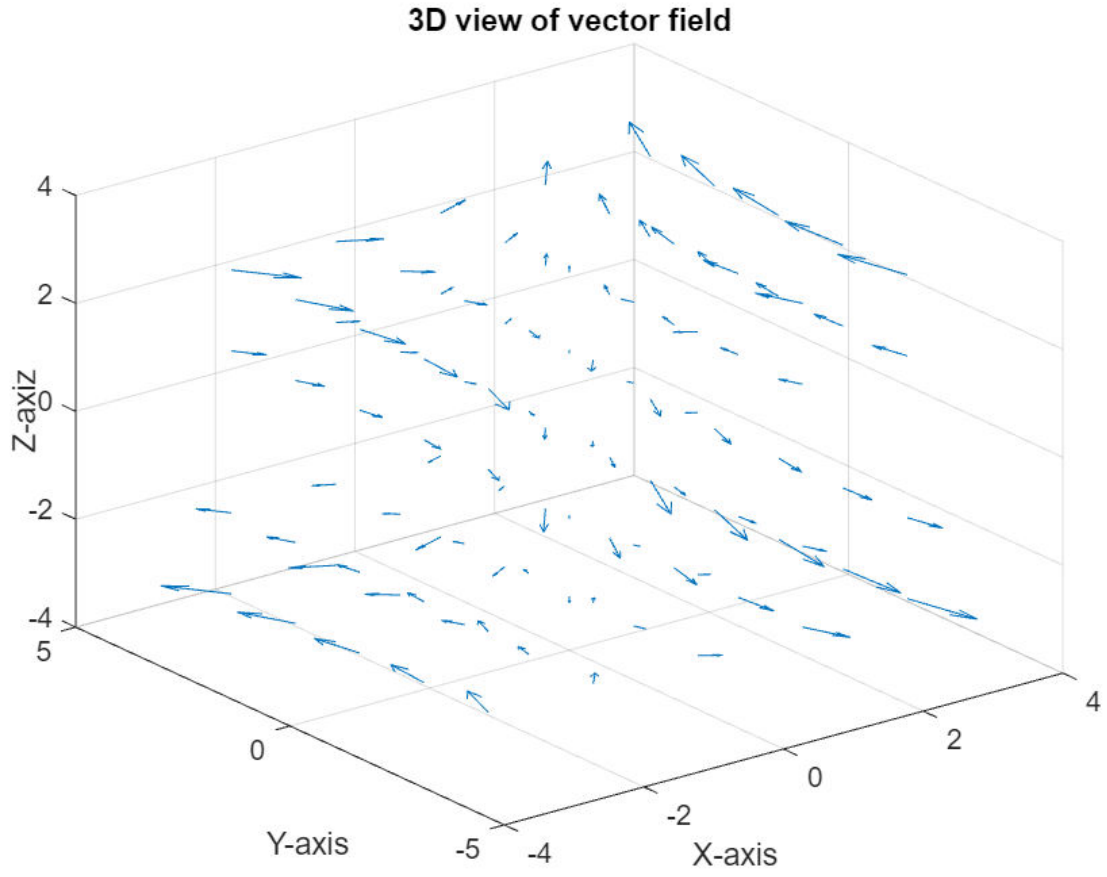
```
grid on;
xlabel("X-axis");
ylabel("Y-axis");
zlabel("Z-axiz");
title("3D view of vector field");
hold off;

figure(2)
% curl view
curlx(x, y, z) = cur(1);
curly(x, y, z) = cur(2);
curlz(x, y, z) = cur(3);
curl1 = curlx(xcords, ycords, zcords);
curl2 = curly(xcords, ycords, zcords);
curl3 = curlz(xcords, ycords, zcords);
quiver3(xcords, ycords, zcords, curl1, curl2,
curl3);
hold on;
grid on;
xlabel("X-axis");
ylabel("Y-axis");
zlabel("Z-axiz");
title("3D view of curl");
hold off;
```

```
% Visualize the curl of a vector function f = [y*z, 3*z*x, z].
close;
clear all;
clc;
syms x y z;

func = [y*z,3*z*x,z];
disp("The curl of the function is ");
cur = curl(func, [x, y, z]);
disp(cur);
[xcords, ycords, zcords] = meshgrid(linspace(-3, 3, 5));
fx(x, y, z) = func(1);
fy(x, y, z) = func(2);
fz(x, y, z) = func(3);

u = fx(xcords, ycords, zcords);
v = fy(xcords, ycords, zcords);
w = fz(xcords, ycords, zcords);


figure(1);
quiver3(xcords, ycords, zcords, u, v, w);
hold on;
grid on;
xlabel("X-axis");
ylabel("Y-axis");
zlabel("Z-axiz");
title("3D view of vector field");
hold off;

figure(2)
% curl view
curlx(x, y, z) = cur(1);
curly(x, y, z) = cur(2);
curlz(x, y, z) = cur(3);
curl1 = curlx(xcords, ycords, zcords);
curl2 = curly(xcords, ycords, zcords);
curl3 = curlz(xcords, ycords, zcords);
quiver3(xcords, ycords, zcords, curl1, curl2, curl3);
hold on;
grid on;
xlabel("X-axis");
ylabel("Y-axis");
zlabel("Z-axiz");
title("3D view of curl");
hold off;
```

Command Window

```
The curl of the function is

-3*x
   y
 2*z

>>
```




3D view of vector field
Z-axiz
4
2
0
-2
-4
5
0
-5
Y-axis
-4
-2
0
2
4
X-axis