



MATLAB-EXPERIMENT 5A

Divergence, Curl and Gradient and
visualization of vector field



APRIL 9, 2021
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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);

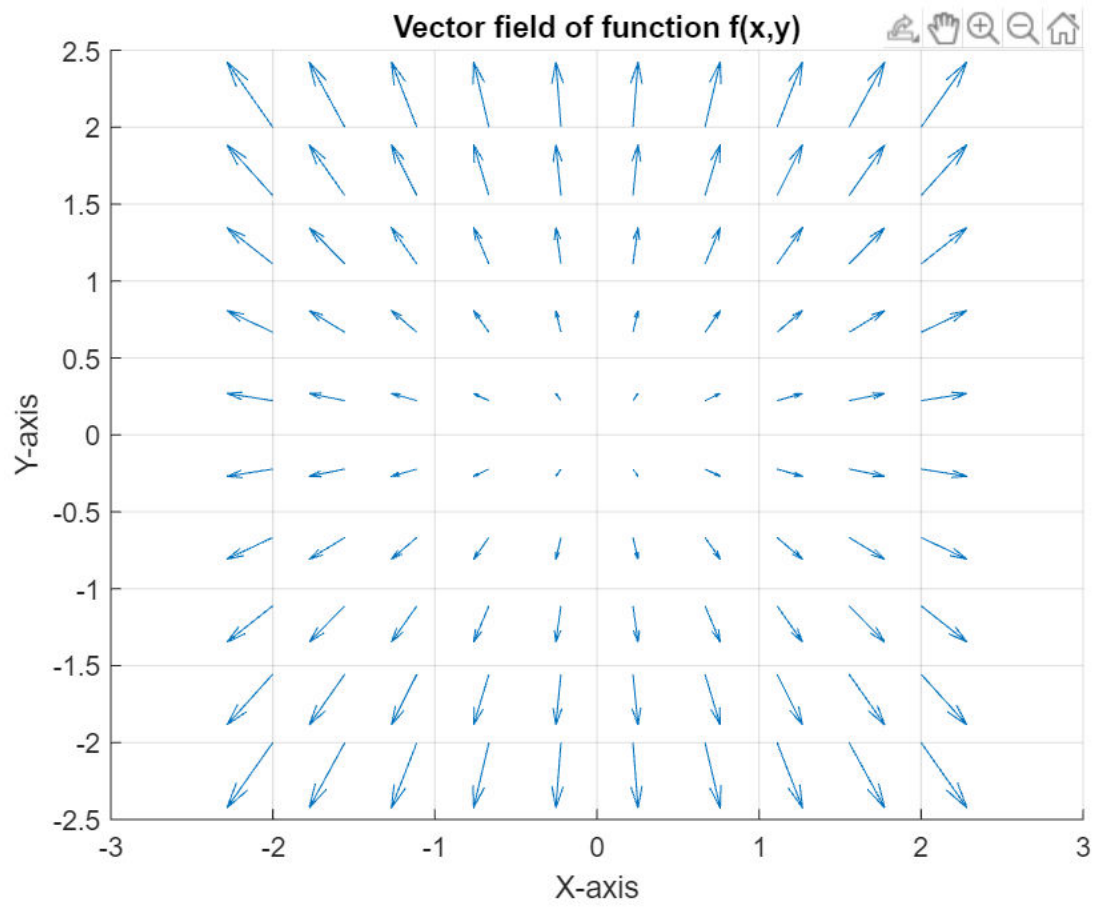
xlabel("X-axis");
ylabel("Y-axis");
title("Vector field of function f(x,y)");
hold off;
```

```

1      % Draw the two dimensional vector field for the vector  $2x \mathbf{i} + 3y \mathbf{j}$ .
2
3      close all ;
4      clear;
5      clc;
6      syms x y z;
7
8      %given function
9      func = [2*x,3*y];
10
11     % div = curl(func, [x, y])
12     fx(x, y) = func(1);
13     fy(x, y) = func(2);
14     [xcord, ycord] = meshgrid(linspace(-2,2,10));
15     u = fx(xcord, ycord);
16     v = fy(xcord, ycord);
17     figure(1);
18     % pcolor(xcords, ycords, div(xcords, ycords));
19     hold on;
20     grid on;
21     quiver(xcord, ycord, u, v);
22
23     xlabel("X-axis");
24     ylabel("Y-axis");
25     title("Vector field of function f(x,y)");
26     hold off;

```





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

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

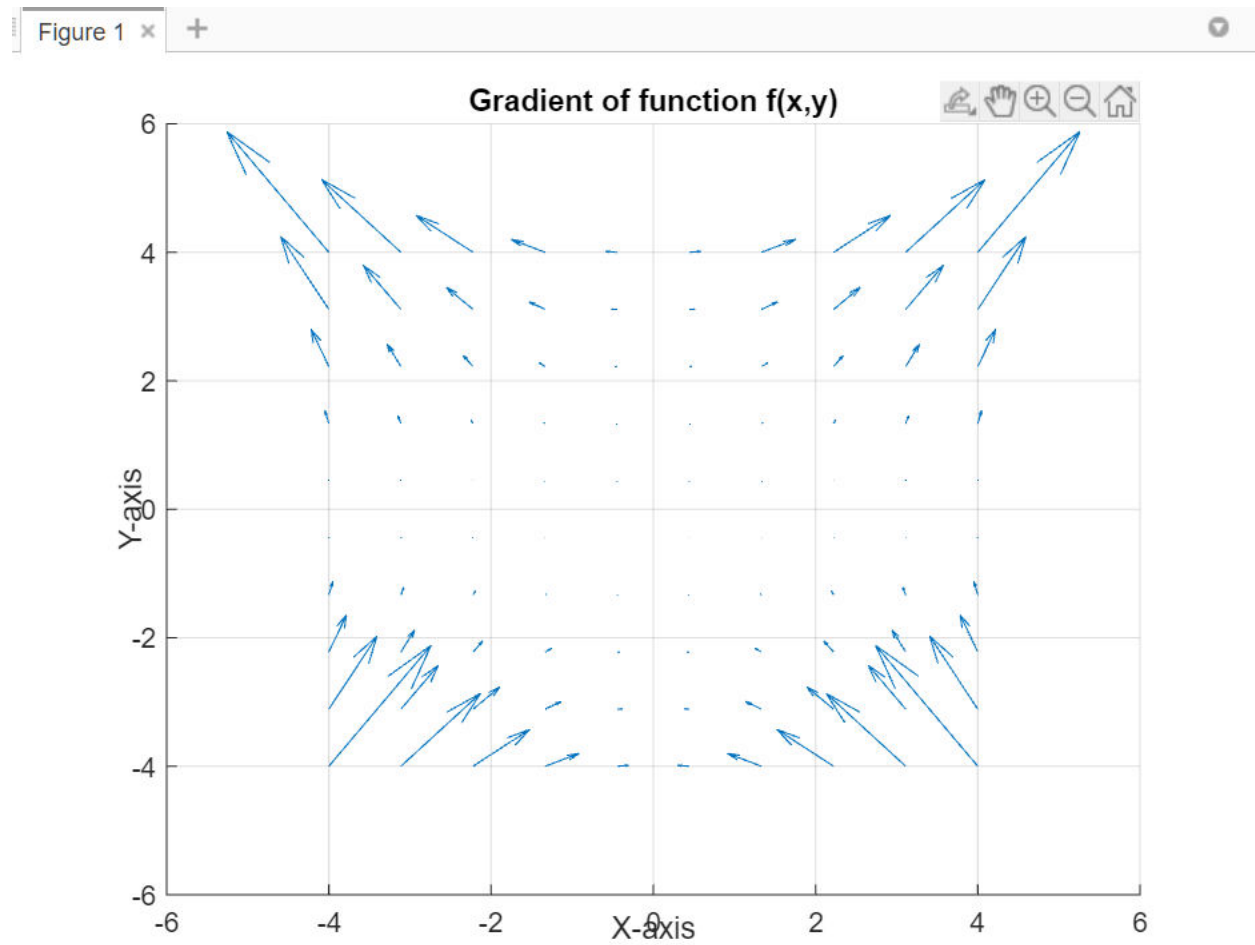
$$\begin{matrix} 2*x*y^3 \\ 3*x^2*y^2 - 4 \end{matrix}$$

```
1 % Find the Gradient of the function f=x^2 y^3- 4y.  
2 close all ;  
3 clear all;  
4 clc;  
5 syms x y z;  
6  
7 func = (x^(2))*(y^(3))- 4*y;  
8 disp("The gradient of the function is ");  
9 grad = gradient(func, [x, y]);  
10 disp(grad);  
11  
12 fx(x, y) = grad(1);  
13 fy(x, y) = grad(2);  
14 [xcord, ycord] = meshgrid(linspace(-4, 4, 10));  
15 u = fx(xcord, ycord);  
16 v = fy(xcord, ycord);  
17  
18 figure(1);  
19 hold on;  
20 grid on;  
21 quiver(xcord, ycord, u, v, 2);  
22  
23 xlabel("X-axis");  
24 ylabel("Y-axis");  
25 title("Gradient of function f(x,y)");  
26 hold off;
```

The gradient of the function is

$$\begin{aligned} &2xy^3 \\ &3x^2y^2 - 4 \end{aligned}$$

>> |



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");
```

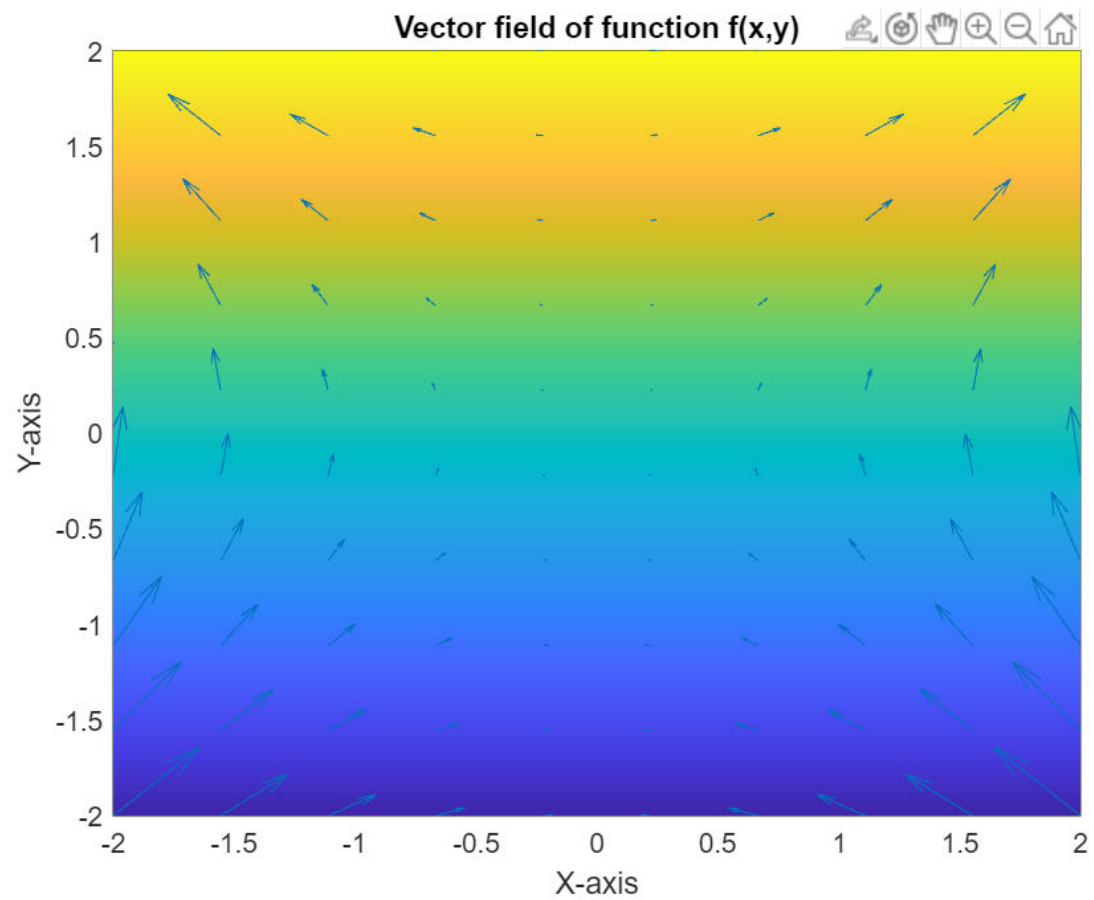
```
ylabel("Y-axis");
```

```
title("Vector field of function f(x,y)");
```

```
hold off;
```

OUTPUT:

```
1 % Draw the two dimensional vector field for the vector  $2x \mathbf{i} + 3y \mathbf{j}$ .
2 close all ;
3 clear all;
4 clc;
5 syms x y z;
6
7 func = [x*y,x^2];
8 div(x,y) = divergence(func, [x, y]);
9 fx(x, y) = func(1); fy(x, y) = func(2);
10 [xcords, ycords] = meshgrid(linspace(-2,2,10));
11 u = fx(xcords, ycords);
12 v = fy(xcords, ycords);
13
14 figure(1);
15 pcolor(xcords, ycords, div(xcords, ycords));
16 shading interp;
17 hold on;
18 grid on;
19 quiver(xcords, ycords, u, v);
20
21 xlabel("X-axis"); |
22 ylabel("Y-axis");
23 title("Vector field of function f(x,y)");
24 hold off;
```



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-axis");  
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-axis");  
title("3D view of curl");  
hold off;
```

```

1 % Visualize the curl of a vector function f = [y*z, 3*z*x, z].
2 close;
3 clear all;
4 clc;
5 syms x y z;
6
7 func = [y*z, 3*z*x, z];
8 disp("The curl of the function is ");
9 cur = curl(func, [x, y, z]);
10 disp(cur);
11 [xcords, ycords, zcords] = meshgrid(linspace(-3, 3, 5));
12 fx(x, y, z) = func(1);
13 fy(x, y, z) = func(2);
14 fz(x, y, z) = func(3);
15
16 u = fx(xcords, ycords, zcords);
17 v = fy(xcords, ycords, zcords);
18 w = fz(xcords, ycords, zcords);
19
20
21 figure(1);
22 quiver3(xcords, ycords, zcords, u, v, w);
23 hold on;
24 grid on;
25 xlabel("X-axis");
26 ylabel("Y-axis");
27 zlabel("Z-axis");
28 title("3D view of vector field");
29 hold off;
30
31 figure(2)
32 % curl view
33 curlx(x, y, z) = cur(1);
34 curly(x, y, z) = cur(2);
35 curlz(x, y, z) = cur(3);
36 curl1 = curlx(xcords, ycords, zcords);
37 curl2 = curly(xcords, ycords, zcords);
38 curl3 = curlz(xcords, ycords, zcords);
39 quiver3(xcords, ycords, zcords, curl1, curl2, curl3);
40 hold on;
41 grid on;
42 xlabel("X-axis");
43 ylabel("Y-axis");
44 zlabel("Z-axis");
45 title("3D view of curl");
46 hold off;

```

Command Window

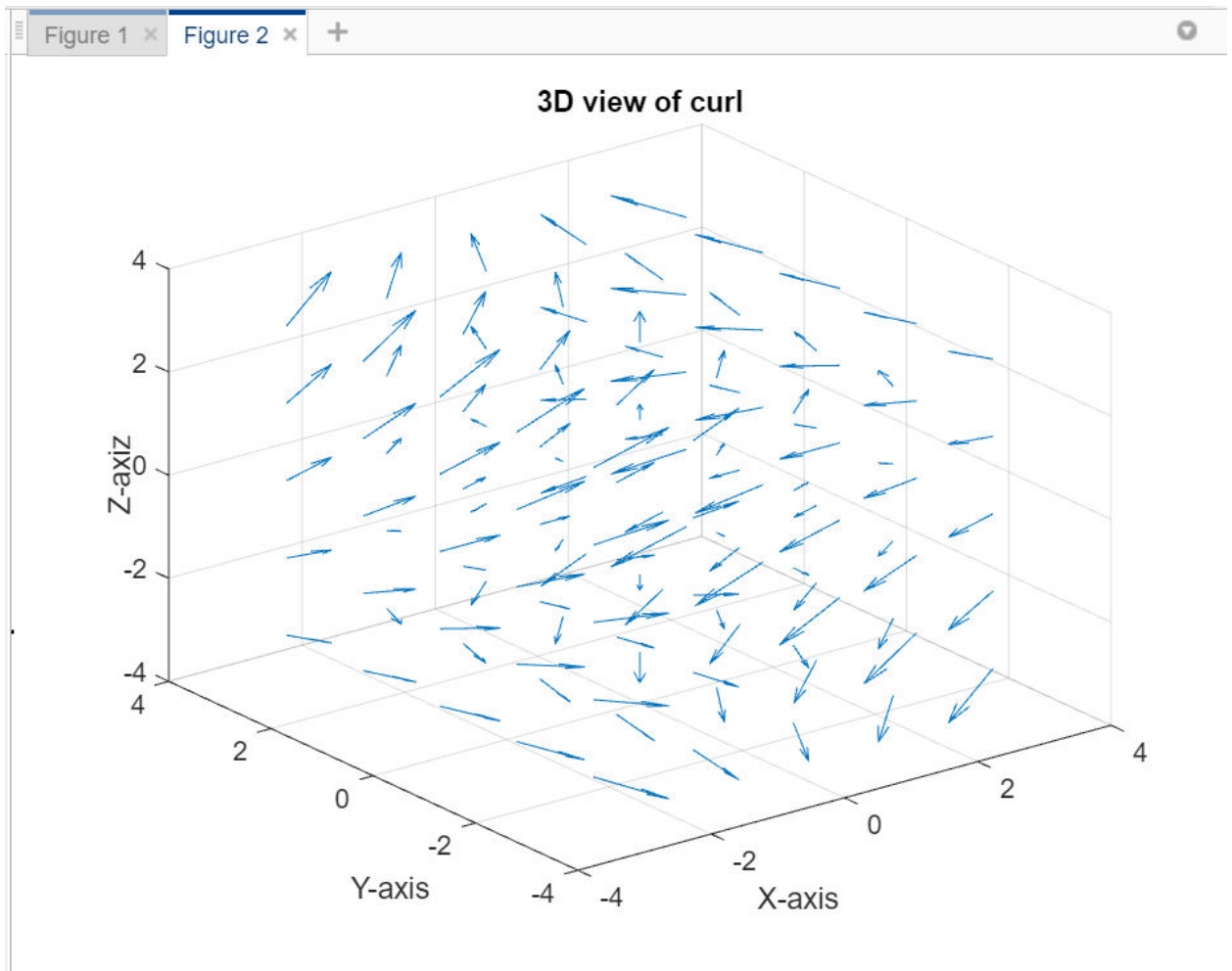
The curl of the function is

```
-3*x
```

```
y
```

```
2*z
```

```
>>
```



3D view of vector field

