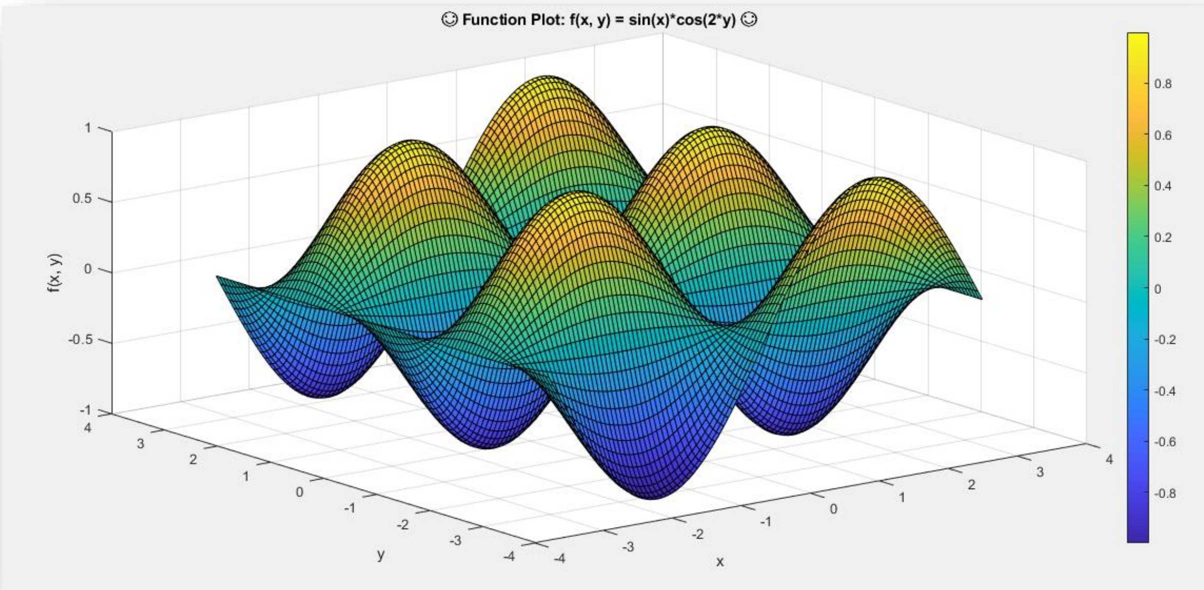
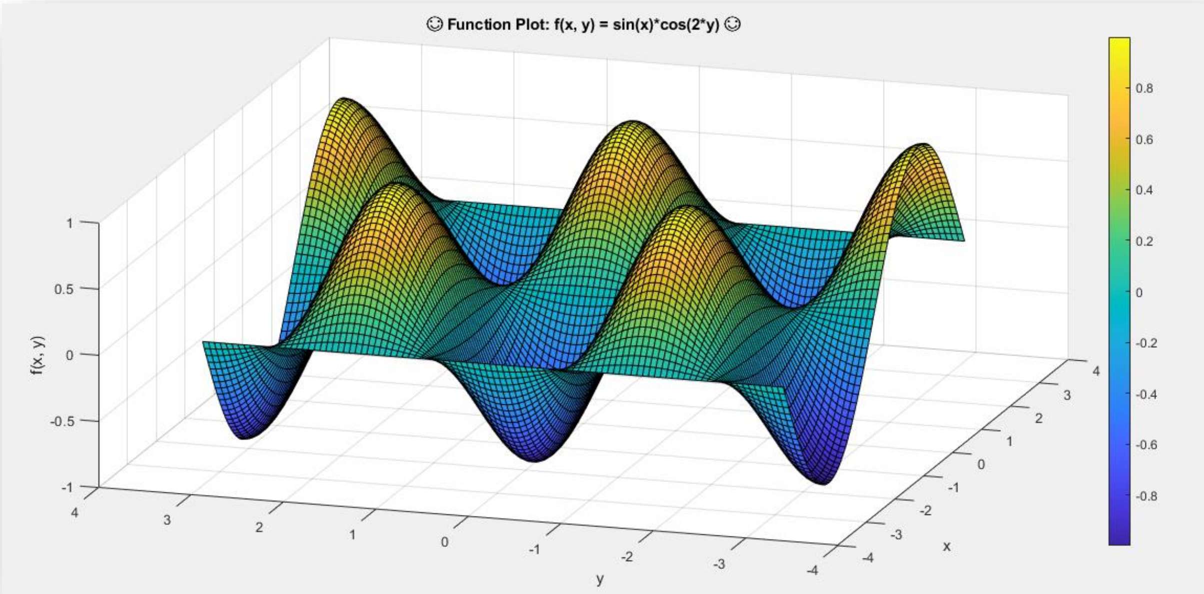
Q:

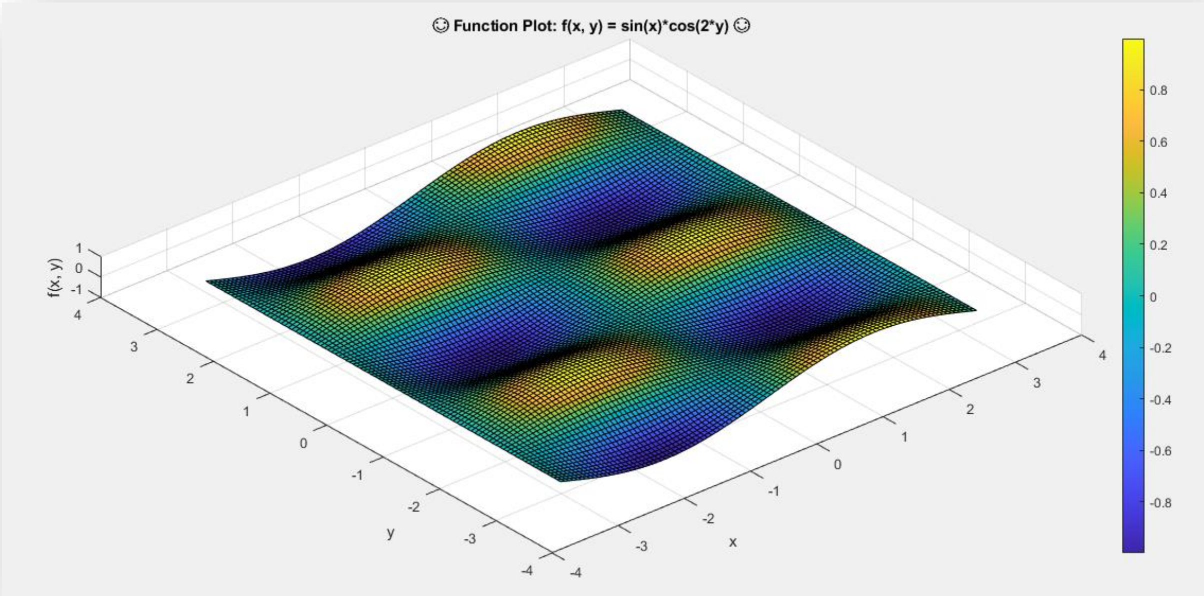
1) Draw the following function with MATLAB software.

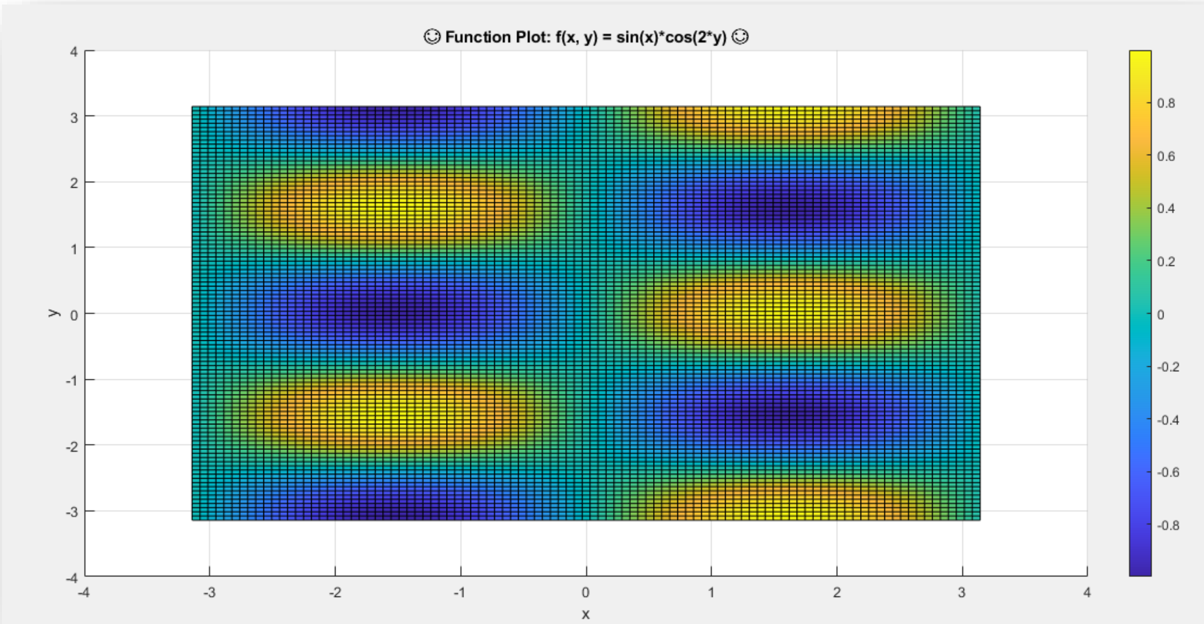
$$f(x, y) = \sin(x) * \cos(2 * y)$$

Sol:

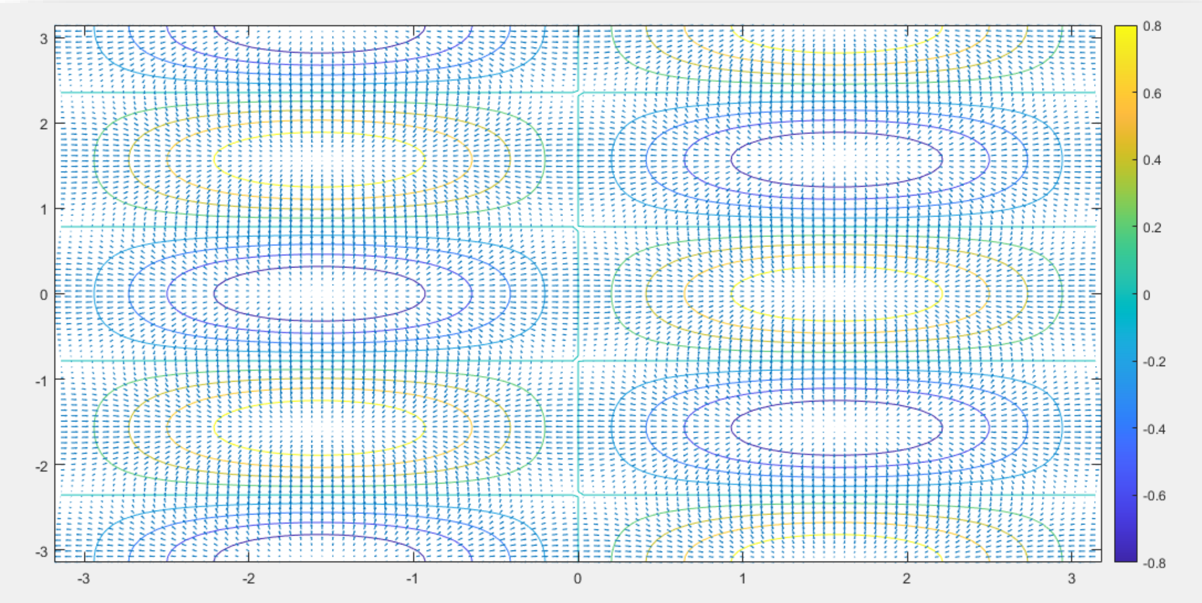


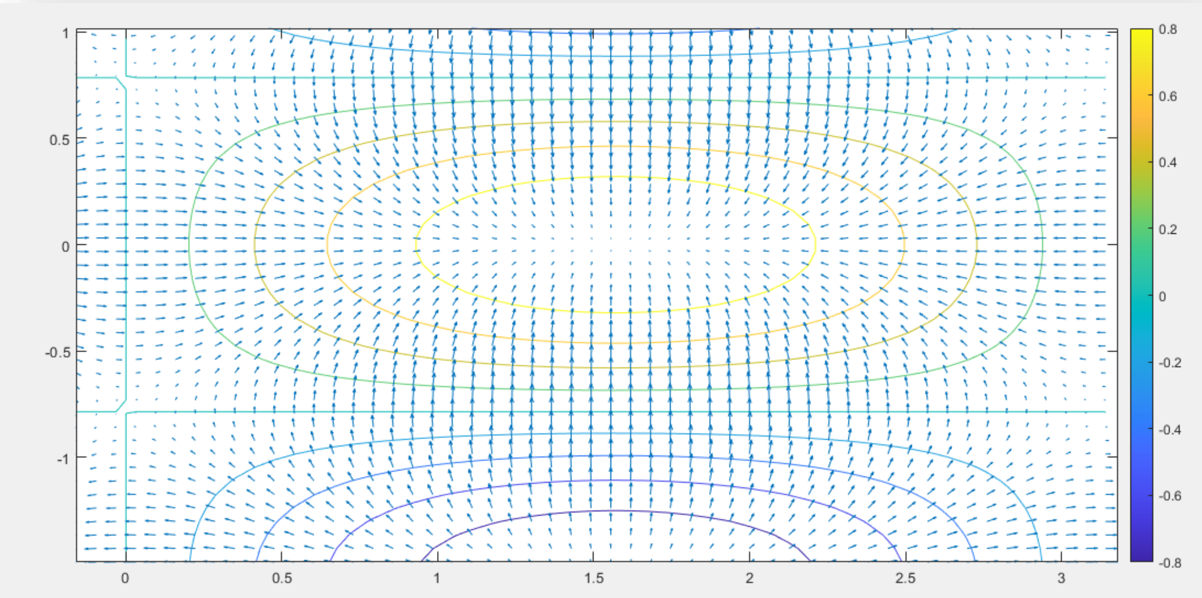


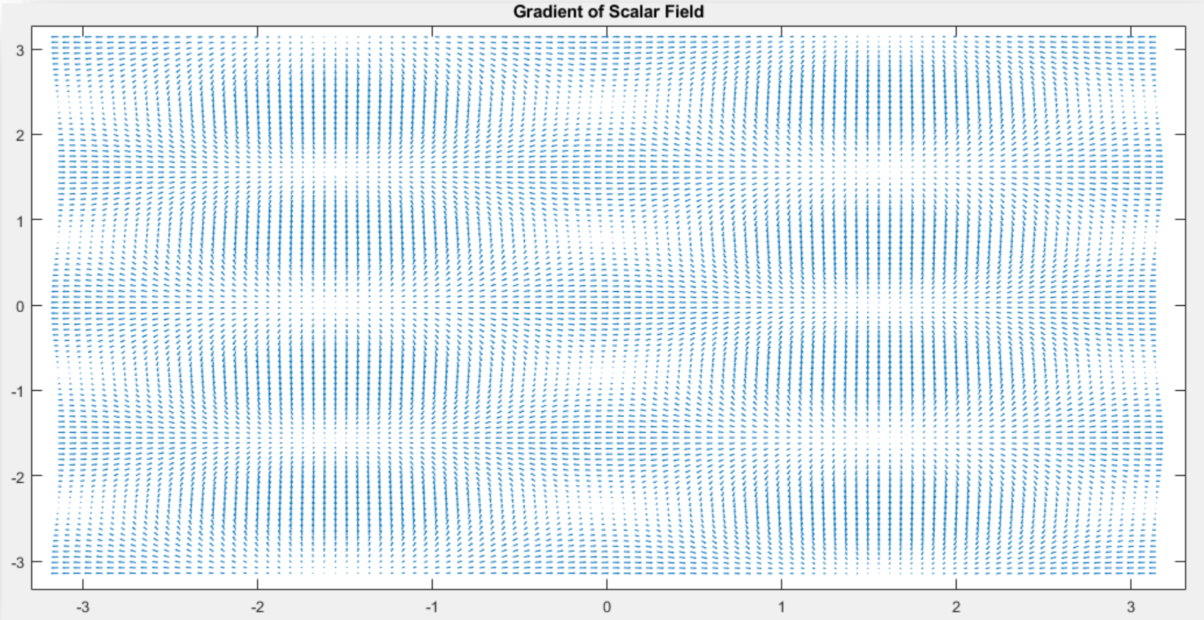

☺ Function Plot: f(x, y) = sin(x)*cos(2*y) ☺
f(x, y)
y
x


☺ Function Plot: f(x, y) = sin(x)*cos(2*y) ☺
y
x

Now the gradient of this graph is as follows:





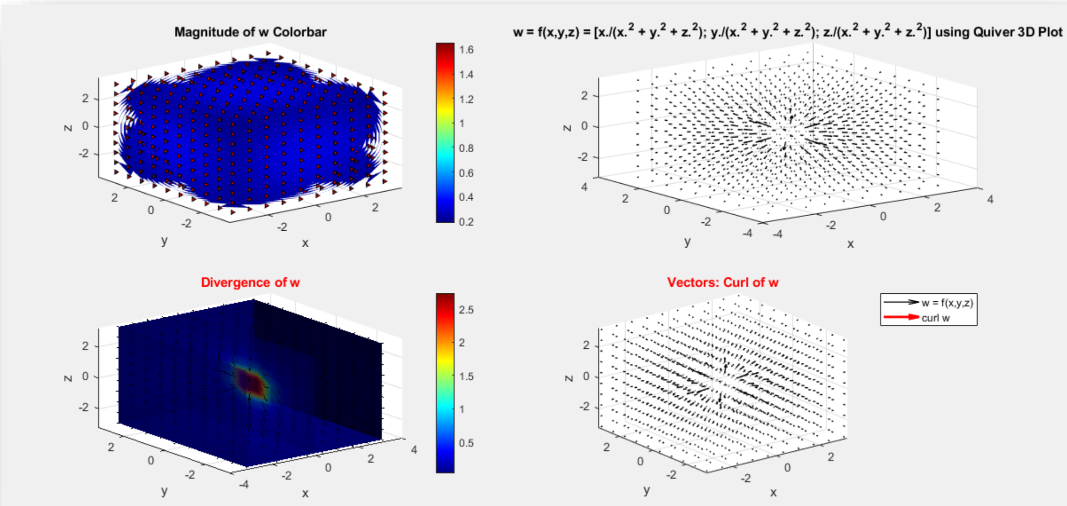


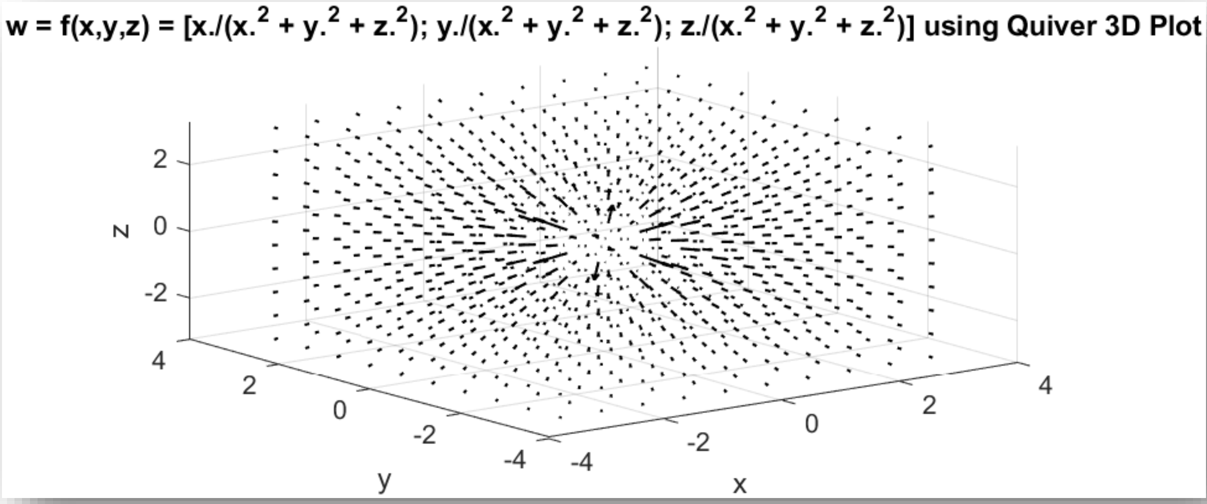
Q:

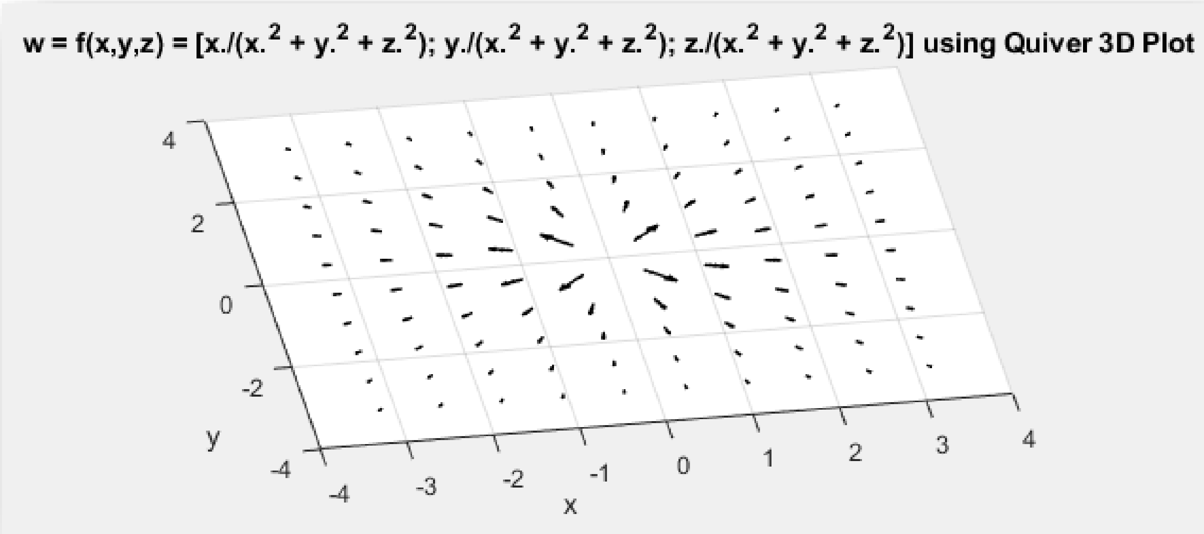
2) Draw the following function with MATLAB software; Display its gradient, divergence and curl as well.

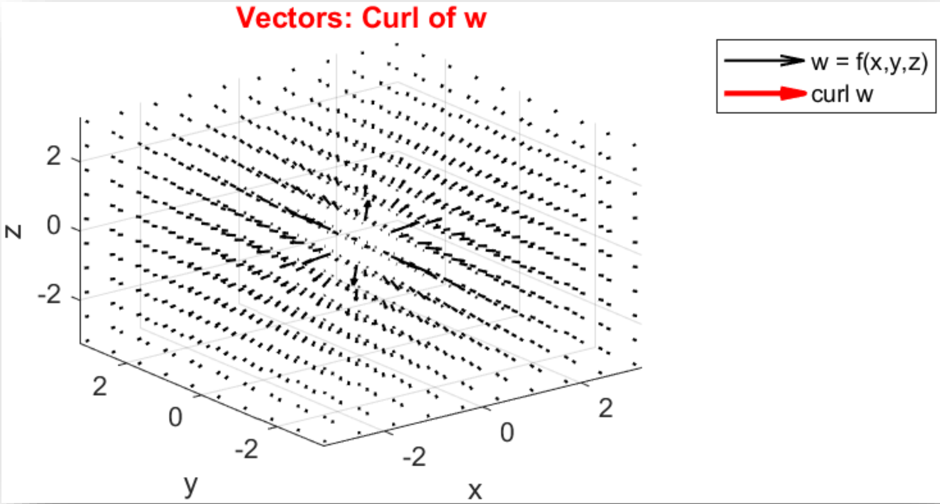
$$\vec{E}(x,y,z) = \frac{x}{x^2+y^2+z^2}\hat{\imath} + \frac{y}{x^2+y^2+z^2}\hat{\jmath} + \frac{z}{x^2+y^2+z^2}\hat{k}$$

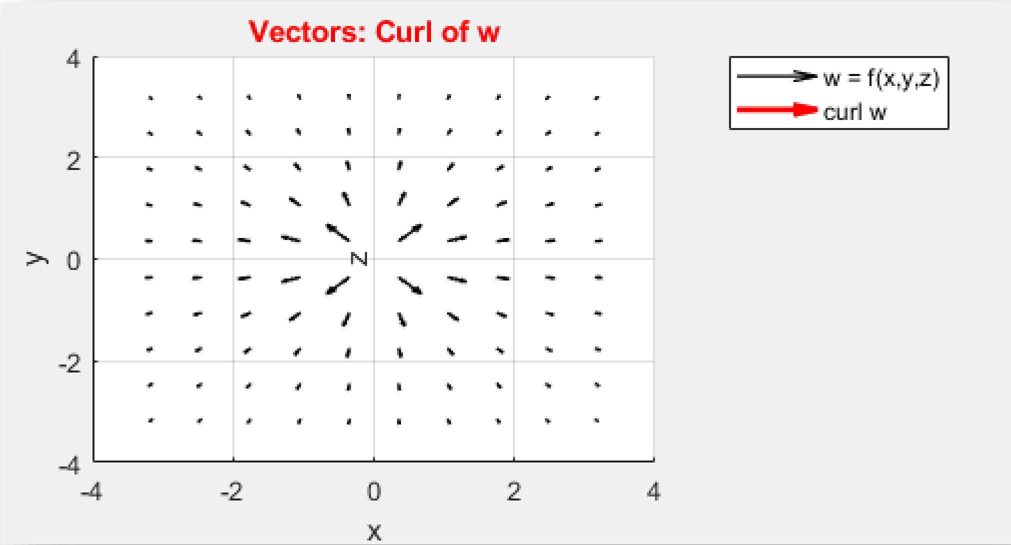
Sol:




w = f(x,y,z) = [x./(x.^2 + y.^2 + z.^2); y./(x.^2 + y.^2 + z.^2); z./(x.^2 + y.^2 + z.^2)] using Quiver 3D Plot
z
2
0
-2
4
2
0
-2
-4
y
-4
-2
0
2
4
x


w = f(x,y,z) = [x./(x.^2 + y.^2 + z.^2); y./(x.^2 + y.^2 + z.^2); z./(x.^2 + y.^2 + z.^2)] using Quiver 3D Plot
4
2
0
-2
y
-4
-4
-3
-2
-1
0
1
2
3
4
x





As it turns out, its curl graph doesn't exist because:

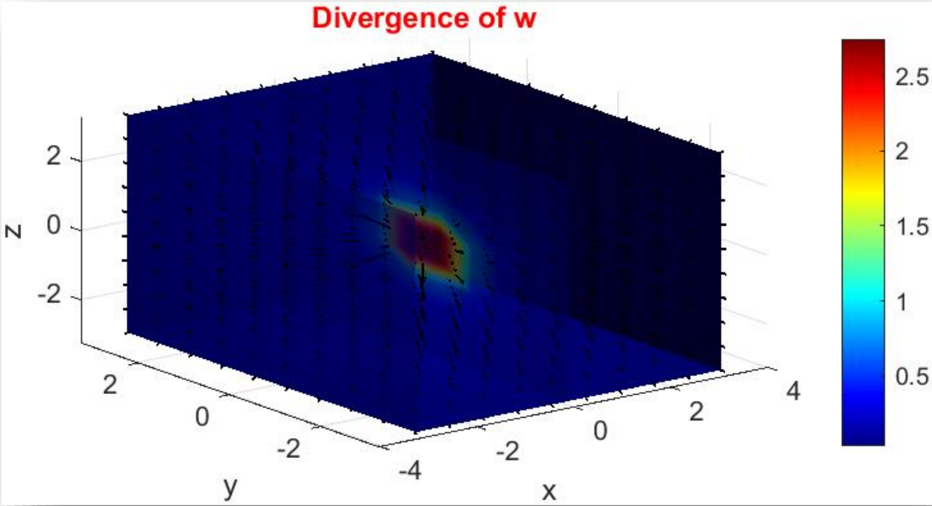
$$\nabla \times E = \begin{vmatrix} \hat{x} & \hat{y} & \hat{z} \\ \partial/\partial x & \partial/\partial y & \partial/\partial z \\ E_x & E_y & E_z \end{vmatrix} = \hat{x}\left(\frac{\partial E_z}{\partial y} - \frac{\partial E_y}{\partial z}\right) + \hat{y}\left(\frac{\partial E_x}{\partial z} - \frac{\partial E_z}{\partial x}\right) + \hat{z}\left(\frac{\partial E_y}{\partial x} - \frac{\partial E_x}{\partial y}\right)$$

$$= \hat{x}\left(-\frac{2yz}{(x^2+y^2+z^2)^2} - (-\frac{2yz}{(x^2+y^2+z^2)^2})\right)$$

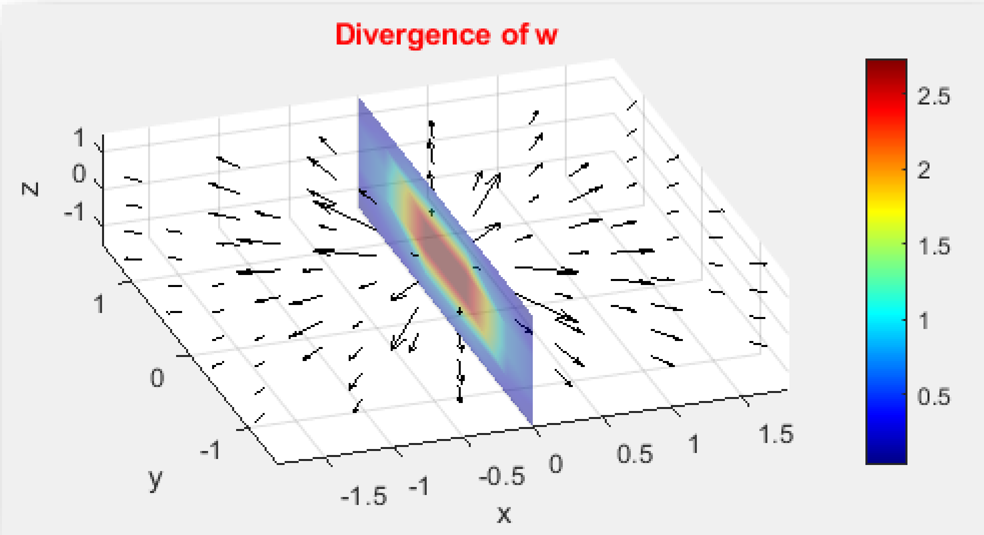
$$+ \hat{y}\left(-\frac{2xz}{(x^2+y^2+z^2)^2} - (-\frac{2xz}{(x^2+y^2+z^2)^2})\right)$$

$$+ \hat{z}\left(-\frac{2yx}{(x^2+y^2+z^2)^2} - (-\frac{2yx}{(x^2+y^2+z^2)^2})\right) = 0$$

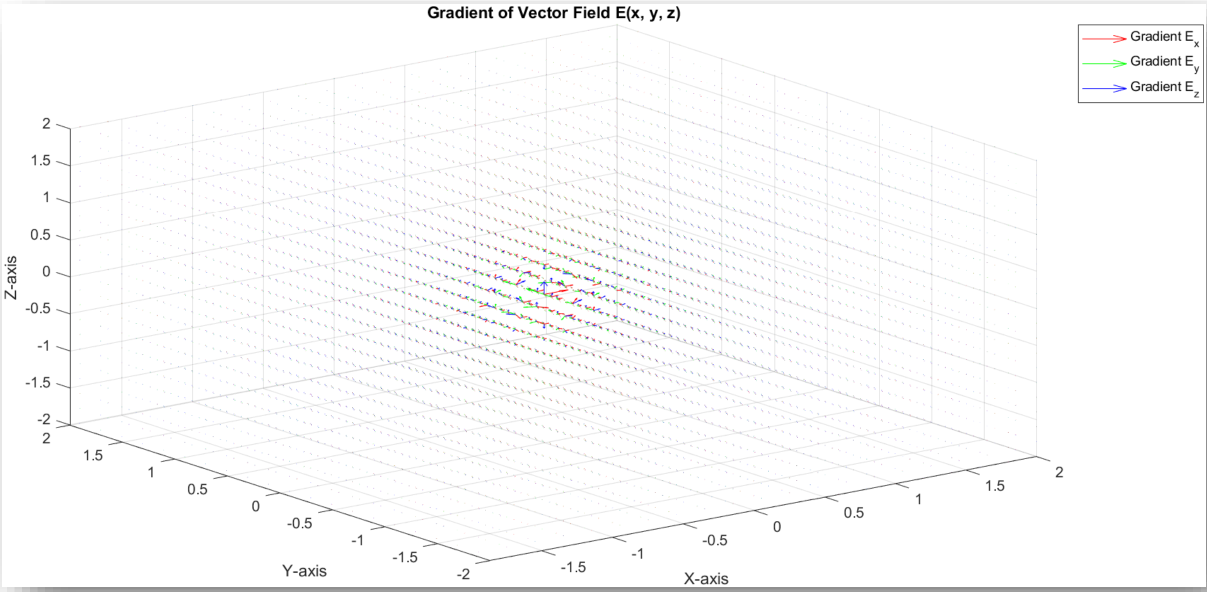
😊

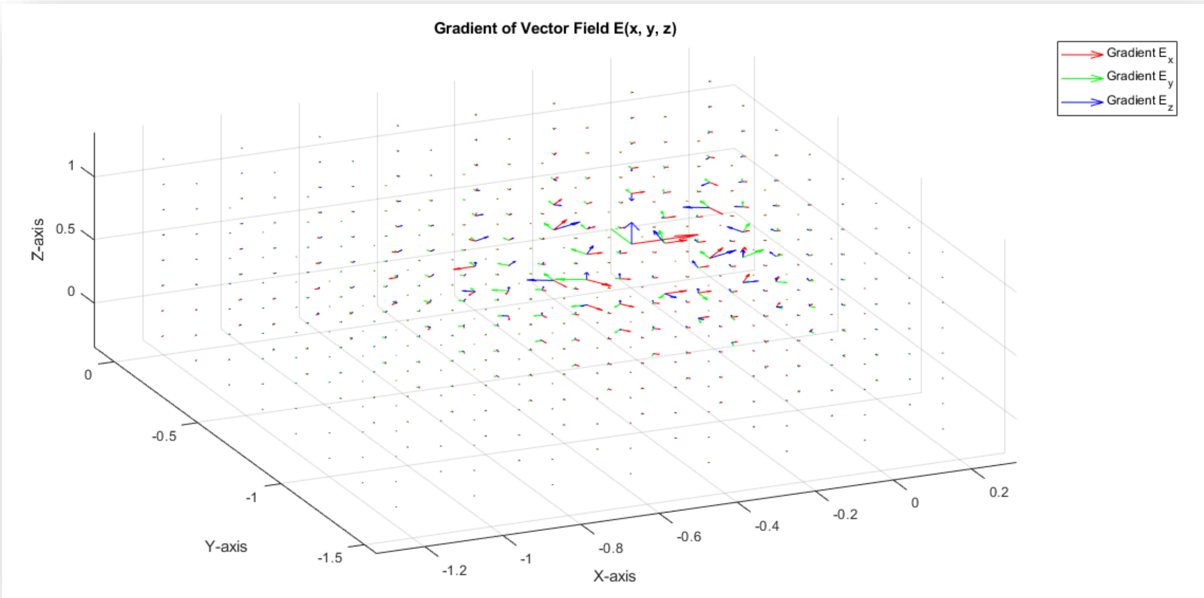


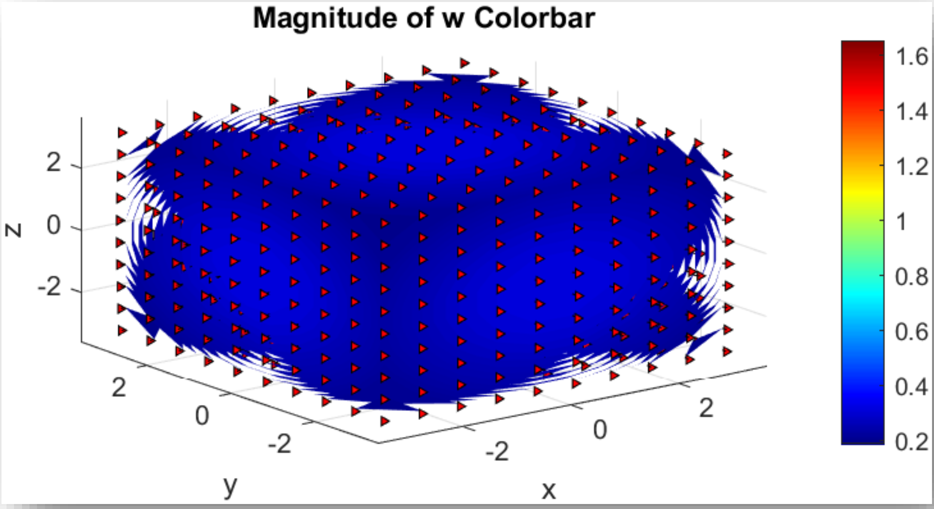
Divergence of w
z
y
x
2.5
2
1.5
1
0.5

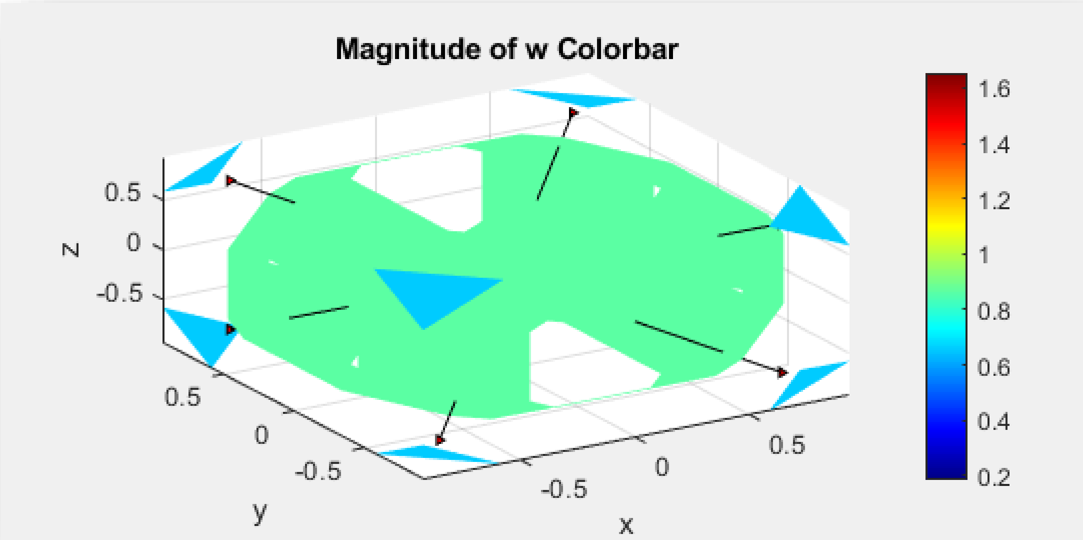


Divergence of w
z
y
x
2.5
2
1.5
1
0.5


Gradient of Vector Field E(x, y, z)
Gradient E_x
Gradient E_y
Gradient E_z
Z-axis
Y-axis
X-axis
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2


Gradient of Vector Field E(x, y, z)
Gradient E_x
Gradient E_y
Gradient E_z
Z-axis
Y-axis
X-axis
1
0.5
0
-0.5
-1
-1.5
-1.2
-0.8
-0.6
-0.4
-0.2
0.2


Magnitude of w Colorbar
z
2
0
-2
y
2
0
-2
x
-2
0
2
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2


Magnitude of w Colorbar
z
0.5
0
-0.5
y
0.5
0
-0.5
x
-0.5
0
0.5
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2