Oppgave 2

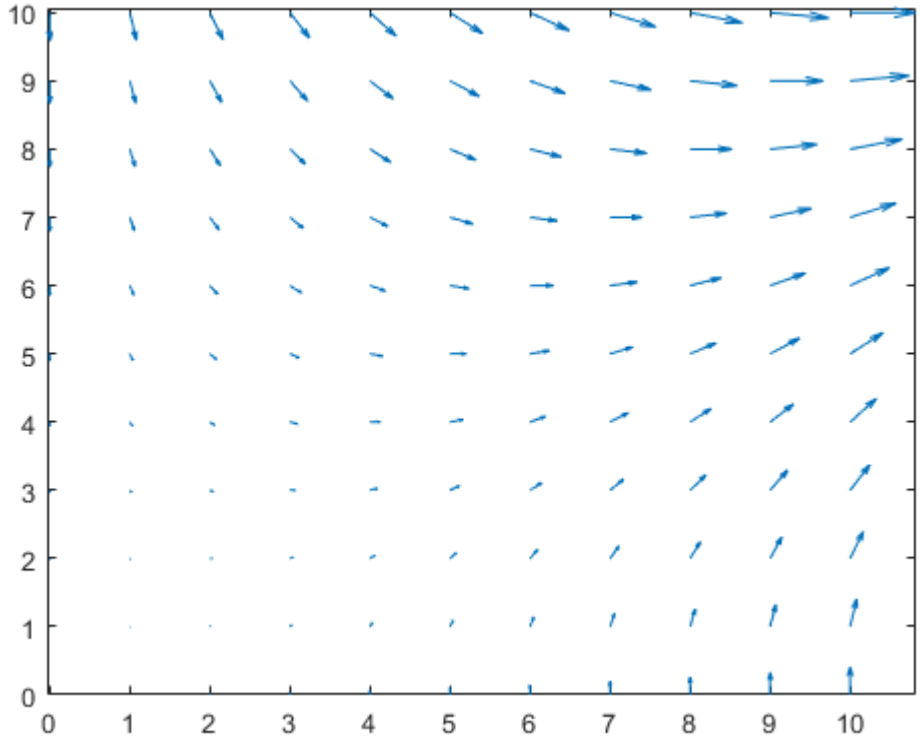
First we define the Vektor field E

```
syms Ex(x,y,z) Ey(x,y,z) Ez(x,y,z) x1 y1 l11(t) l12(t) l13(t)

Ex(x,y,z) = 6*x*y;
Ey(x,y,z) = 3*x^2 - 3*y^2;
Ez(x,y,z) = 0;
```

Plott the vector field for visbility

```
[xx,yy,zz] = meshgrid(0:1:10,0:1:10,0:1:10);
ex = 6.*xx.*yy;
ey = 3.*xx.^2 - 3.*yy.^2;
ez = 0.*xx;
quiver(xx,yy,ex,ey), axis tight
```



The line integral is calculated with this formualr

```
syms W r(s) F(r)

W=int(F(r)*diff(r)*diff(s))
```

W(s) =

$$\int F(r(s))\,\frac{\partial}{\partial s}\,r(s)\mathrm{d}s$$

The parametric equation for straight line is:

(x0,y0,z0) to (x1,y1,z1) -->

x = (1-t)*x0 + t*x1

y = (1-t0)*y0 + t*y1

z = (1-t)*z0 + t*z1

For the calculation t is set to beetween [0 1]

C1

First the movement from origo to (x1,0,0)

```
l11(t) = x1*t;
l12(t) = 0;
l13(t) = 0;

l = [l11; l12; l13];
E = [Ex; Ey; Ez];

Er = E(l11(t), l12(t), l13(t));
dl = diff(l(t), t);

integrand = dot(Er,dl);

work1 = int(integrand, t, [0 1])
```

work1 = 0

C2

Then from (x1,0,0) to (x1,y1,0)

```
syms l21(t) l22(t) l23(t)

l21(t) = (1-t)*x1 + x1*t;
l22(t) = y1*t;
```

```
l23(t) = 0;

l2 = [l21; l22; l23];

Er2 = E(l21(t), l22(t), l23(t));
dl2 = diff(l2(t), t);

integrand2 = dot(Er2, dl2);

work2 = int(integrand2, t, [0 1])
```

work2 = $3\,y_1\,\overline{x_1}^2 - y_1\,\overline{y_1}^2$

C3

Then for the other way, from otigo to (0,y1,0)

```
syms l31(t) l32(t) l33(t)

l31(t) = 0;
l32(t) = y1*t;
l33(t) = 0;

l3 = [l31; l32; l33];

Er3 = E(l31(t), l32(t), l33(t));
dl3 = diff(l3(t), t);

integrand3 = dot(Er3, dl3);

dll = diff(l3(t),t);

work3 = int(integrand3, t, [0 1])
```

work3 = $-y_1\,\overline{y_1}^2$

C4

From (0,y1,0) to (x1,y1,0)

```
syms l41(t) l42(t) l43(t)

l41(t) = x1*t;
l42(t) = (1-t)*y1 + t*y1;
l43(t) = 0;

l4 = [l41; l42; l43];
```

```
Er4 = E(l41(t), l42(t), l43(t));
dl4 = diff(l4(t), t);

integrand4 = dot(Er4, dl4);

work4 = int(integrand4, t, [0 1])
```

work4 = $3\,|x_1|^2\,\overline{y_1}$

C1+C2 and C3+C4

Add the found work for comparison

```
workWay1 = work1 + work2
```

workWay1 = $3\,y_1\,\overline{x_1}^2 - y_1\,\overline{y_1}^2$

```
workWay2 = work3 + work4
```

workWay2 = $3\,|x_1|^2\,\overline{y_1} - y_1\,\overline{y_1}^2$

```
differance = workWay1 - workWay2
```

differance = $3\,y_1\,\overline{x_1}^2 - 3\,|x_1|^2\,\overline{y_1}$

```
diffNum = subs(differance,{x1 y1},{1 -1})
```

diffNum = 0

The difference is not equal to zero because MATLAB tells s that one of the x1 have to be absolutt. Since the x value is squared this may be neglected anyway and the difference would be zero. As numericaly shown in the diff num for [-1 1]. It is check for multiple values. The E indeed represent a electrostatic field.

C5

```
syms l15(t) l52(t) l53(t)

l51(t) = x1*t;
l52(t) = y1*t;
l53(t) = 0;

l5 = [l51; l52; l53];
```

```
Er5 = E(l51(t), l52(t), l53(t));
d15 = diff(l5(t), t);

integrand5 = dot(Er5, d15)
```

integrand5 =

$$y_1 \left(3\,\overline{t}^2\,\overline{x_1}^2 - 3\,\overline{t}^2\,\overline{y_1}^2\right) + 6\,x_1\,\overline{t}^2\,\overline{x_1}\,\overline{y_1}$$

```
work5 = int(integrand5, t, [0 1])
```

work5 =

$$\frac{y_1\left(3\,\overline{x_1}^2 - 3\,\overline{y_1}^2\right)}{3} + 2\,x_1\,\overline{x_1}\,\overline{y_1}$$

```
syms Ed(x,y,z)

dx = diff(x);
dy = diff(y);

Ed(x,y,z) = 6*x*y*dx + (3*x^2 - 3*y^2)*dy == 0;

%ySolve(t) = dsolve(Ed, )
```