Q2&Q3_Parallel_Jacobian

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In [15]:
```
from sympy import *
l_1 = Symbol('l_1')
l_2 = Symbol('l_2')
theta_1 = Symbol('theta_1')
theta_2 = Symbol('theta_2')
x = Symbol('x')
y = Symbol('y')
dxdtheta_1 = Symbol('dxdtheta_1')
dxdtheta_2 = Symbol('dxdtheta_2')
dydtheta_1 = Symbol('dydtheta_1')
dydtheta_2 = Symbol('dydtheta_2')
```

In [16]:
```
x = ( l_1*cos((theta_2-theta_1)/2) + l_2*sin(acos(l_1/l_2*sin(theta_2/2-theta_1/2))) )
y = ( l_1*cos((theta_2-theta_1)/2) + l_2*sin(acos(l_1/l_2*sin(theta_2/2-theta_1/2))) )
```

In [17]:
```
dxdtheta_1= simplify(diff(x,theta_1))
print(dxdtheta_1)
dxdtheta_2= simplify(diff(x,theta_2))
print(dxdtheta_2)
dydtheta_1= simplify(diff(y,theta_1))
print(dydtheta_1)
dydtheta_2= simplify(diff(y,theta_2))
print(dydtheta_2)
```

```
sqrt(2)*(l_1**2*sin(theta_1/2 + theta_2/2)/2 - l_1**2*sin(3*theta_1/2 - theta_2/2)/2 - l_1*l_2*
sqrt(2)*(l_1**2*sin(theta_1/2 - 3*theta_2/2)/2 + l_1**2*sin(theta_1/2 + theta_2/2)/2 - l_1*l_2*
sqrt(2)*(-l_1**2*cos(theta_1/2 + theta_2/2)/2 + l_1**2*cos(3*theta_1/2 - theta_2/2)/2 + l_1*l_2
sqrt(2)*(l_1**2*cos(theta_1/2 - 3*theta_2/2)/2 - l_1**2*cos(theta_1/2 + theta_2/2)/2 + l_1*l_2*
```

In [19]:
```
pi = 3.14
J_11 = dxdtheta_1.subs([(theta_1,45/180*pi),(theta_2,135/180*pi),(l_1,0.1), (l_2,0.1)])
J_12 = dxdtheta_2.subs([(theta_1,45/180*pi),(theta_2,135/180*pi),(l_1,0.1), (l_2,0.1)])
J_21 = dydtheta_1.subs([(theta_1,45/180*pi),(theta_2,135/180*pi),(l_1,0.1), (l_2,0.1)])
J_22 = dydtheta_2.subs([(theta_1,45/180*pi),(theta_2,135/180*pi),(l_1,0.1), (l_2,0.1)])
```

In [20]:
```
print(J_11)
print(J_12)
print(J_21)
print(J_22)
```

```
-0.0499800878673014*sqrt(2)
-0.0500596888252485*sqrt(2)
0.0500199042059942*sqrt(2)
-0.0499402398344191*sqrt(2)
```

In [ ]: