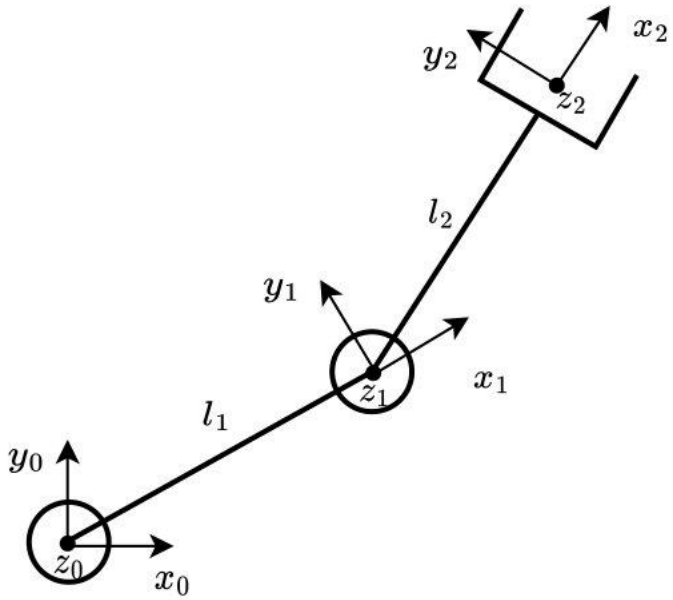
# Manipolabilità del robot RR planare

## Robot RR planare




```
clear
clc
syms q1 q2 l1 l2 real
l1 = 1;
l2 = 1;
DHRRplanare = [l1, 0, 0, q1;
               l2, 0, 0, q2]
```

DHRRplanare =

$$\begin{pmatrix} 1 & 0 & 0 & q_1 \\ 1 & 0 & 0 & q_2 \end{pmatrix}$$

```
tList = cinDirDH(DHRRplanare);
T03 = tList{3}
```

T03 =

$$\begin{pmatrix} \cos(q_1+q_2) & -\sin(q_1+q_2) & 0 & \cos(q_1+q_2)+\cos(q_1) \\ \sin(q_1+q_2) & \cos(q_1+q_2) & 0 & \sin(q_1+q_2)+\sin(q_1) \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

```
r = T03(1:2, 4);
J = [diff(r(1), q1), diff(r(1), q2);
     diff(r(2), q1), diff(r(2), q2)]
```

J =

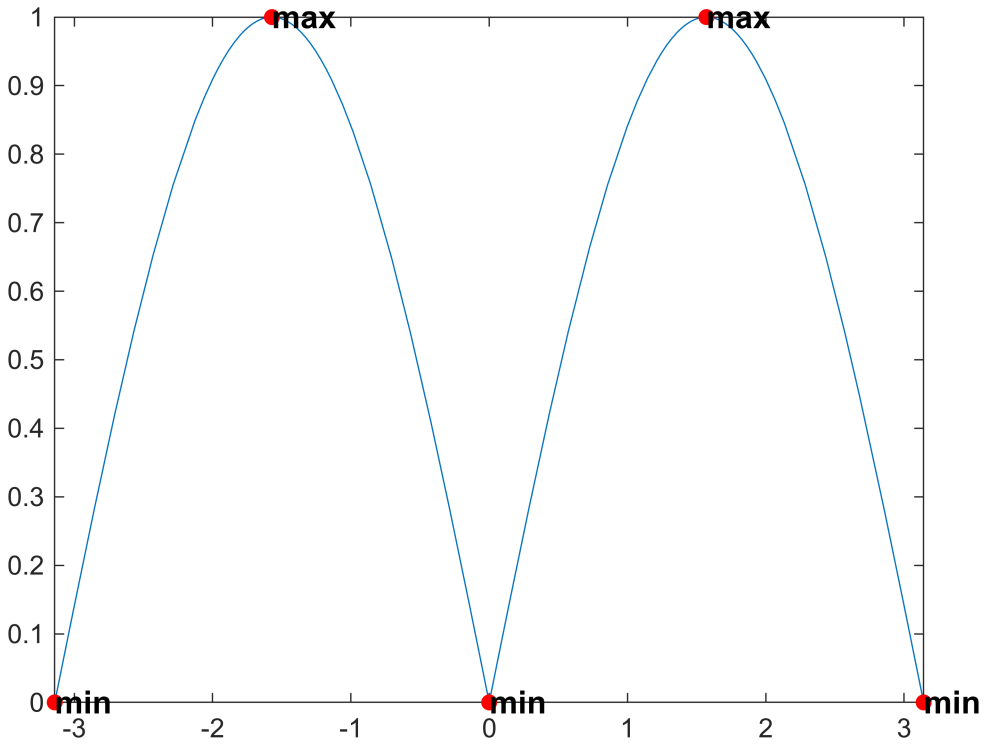
$$\begin{pmatrix} -\sin(q_1+q_2)-\sin(q_1) & -\sin(q_1+q_2) \\ \cos(q_1+q_2)+\cos(q_1) & \cos(q_1+q_2) \end{pmatrix}$$

## Elissoide di manipolabilità

```
w = simplify(sqrt(det(J*J.')))
```

w = $|\sin(q_2)|$

```
figure
fplot(w,[-pi, pi])
hold on
maxManConf = [-pi/2, pi/2];
minManConf = [-pi, 0, pi];
for i=1:size(maxManConf, 2)
    q_2 = maxManConf(i);
    scatter(q_2, subs(w, q2, q_2), 'filled', 'MarkerFaceColor', 'r');
    text(q_2, subs(w, q2, q_2), "max", 'FontSize', 12, 'FontWeight', 'bold');
end
for i=1:size(minManConf, 2)
    q_2 = minManConf(i);
    scatter(q_2, subs(w, q2, q_2), 'filled', 'MarkerFaceColor', 'r');
    text(q_2, subs(w, q2, q_2), "min", 'FontSize', 12, 'FontWeight', 'bold');
end
hold off
```



```
q = linspace(0, pi, 5);
q_1 = 0;
colors = ['r', 'g', 'b', 'm', 'k'];

figure
for i=1:size(q,2)

    q_2 = q(i);
    center = subs(r, [q1, q2], [q_1, q_2]);
    Jq = double(subs(J, [q1, q2], [q_1, q_2]));
    drawManEllipse(Jq, center, colors(i));

    drawPlanarRobot([1, 1], [q_1, q_2], colors(i))
    axis equal
end
```