

## Homework 4

### Extending the Kinematic Description

```
C> robot.kine.joint_to_base('left_front_wheel')
[[ 1.00000000e+00  0.00000000e+00  0.00000000e+00  0.00000000e+00]
 [ 0.00000000e+00  6.12323400e-17 -1.00000000e+00  2.20000000e+01]
 [ 0.00000000e+00  1.00000000e+00  6.12323400e-17 -1.34711148e-15]
 [ 0.00000000e+00  0.00000000e+00  0.00000000e+00  1.00000000e+00]]

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[[ 1.00000000e+00  0.00000000e+00  0.00000000e+00  0.00000000e+00]
 [ 0.00000000e+00  6.12323400e-17 -1.00000000e+00 -2.20000000e+01]
 [ 0.00000000e+00  1.00000000e+00  6.12323400e-17  1.34711148e-15]
 [ 0.00000000e+00  0.00000000e+00  0.00000000e+00  1.00000000e+00]]

C> robot.kine.joint_to_base('left_hook')
[[ 1.00000000e+00  1.96115226e-34  1.00260531e-18  2.69868062e+01]
 [ 6.13918694e-35  1.00000000e+00  0.00000000e+00  2.00000000e+01]
 [ 1.00260531e-18 -1.23259516e-32  1.00000000e+00  2.31962204e+00]
 [ 0.00000000e+00  0.00000000e+00  0.00000000e+00  1.00000000e+00]]

C> robot.kine.joint_to_base('left_hook')
[[ 1.00000000e+00  1.96115226e-34  1.00260531e-18  2.69868062e+01]
 [ 6.13918694e-35  1.00000000e+00  0.00000000e+00  2.00000000e+01]
 [ 1.00260531e-18 -1.23259516e-32  1.00000000e+00  2.31962204e+00]
 [ 0.00000000e+00  0.00000000e+00  0.00000000e+00  1.00000000e+00]]
```

### Kinematics Calculations

degree: distance(mm)

-10: 102.7632

0: 105.1486

10: 104.1898

20: 99.6971

30: 92.0523

40: 83.2770

- The result is really reasonable since camera is 5 mm forward than the front axle. Thus, when the head angle is 0, the focal plan should verticle to the floor, and be 105mm infront of the front axle.

## Inverse Kinematics: Pointing the Camera

The following are results that target upper left angle of each cube.

