# Kinematic Description
# Mobile Justin

German Aerospace Center

Institute of Robotics and Mechatronics

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Version 0.9

# Mobile Platform

## Different views with robot baseframe

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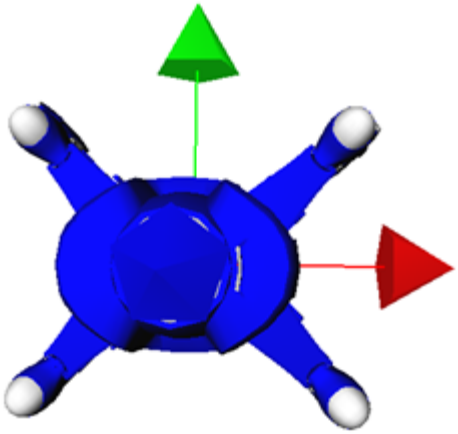
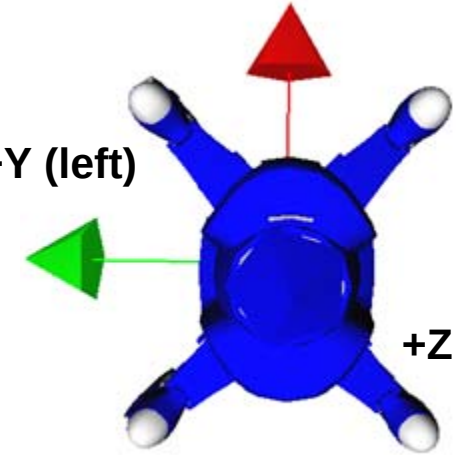
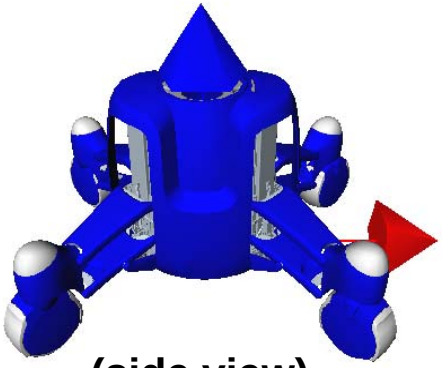
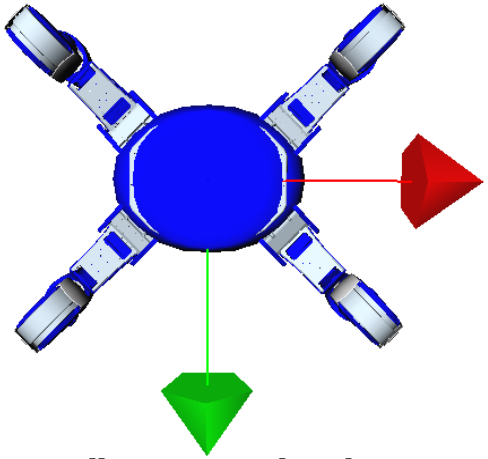


(top view)

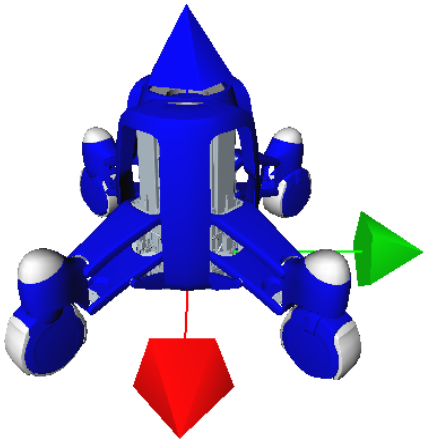


(side view)



(bottom view)



(front view)

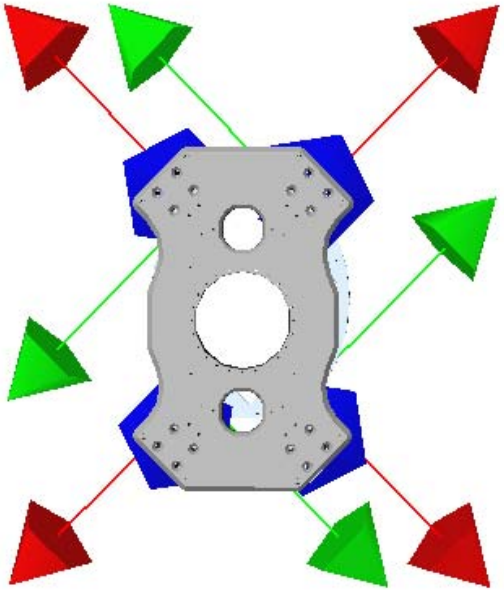
# Mobile Platform

## Mount frames for the wheels on platform body



**Wheel No. 1 (mechanics)**

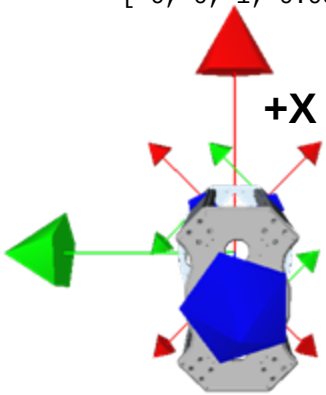
**Wheel No. 2 (mechanics)**



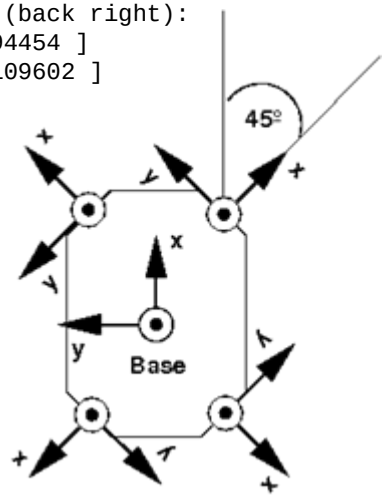
**Wheel No. 3 (mechanics)**

**Wheel No. 4 (mechanics)**

```
//-------------------------------------------------------//
//      Justin mobile platform - mount frame wheels      //
//      Collected by Ch. Borst            02.05.2008     //
//-------------------------------------------------------//
Base Frame of the wheel no. 01 (front left):
[ 0.707107, -0.707107, 0, 0.194454 ]
[ 0.707107, 0.707107, 0, 0.109602 ]
[ 0, 0, 1, 0.0085 ]

Base Frame of the wheel no. 02 (front right):
[ 0.707107, 0.707107, 0, 0.194454 ]
[ -0.707107, 0.707107, 0, -0.109602 ]
[ 0, 0, 1, 0.0085 ]

Base Frame of the wheel no. 03 (back left):
[ -0.707107, -0.707107, 0, -0.194454 ]
[ 0.707107, -0.707107, 0, 0.109602 ]
[ 0, 0, 1, 0.0085 ]

Base Frame of the wheel no. 04 (back right):
[ -0.707107, 0.707107, 0, -0.194454 ]
[ -0.707107, -0.707107, 0, -0.109602 ]
[ 0, 0, 1, 0.0085 ]
```

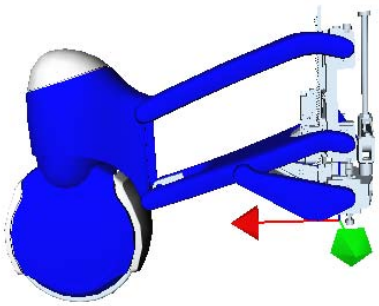


**+X (front)**

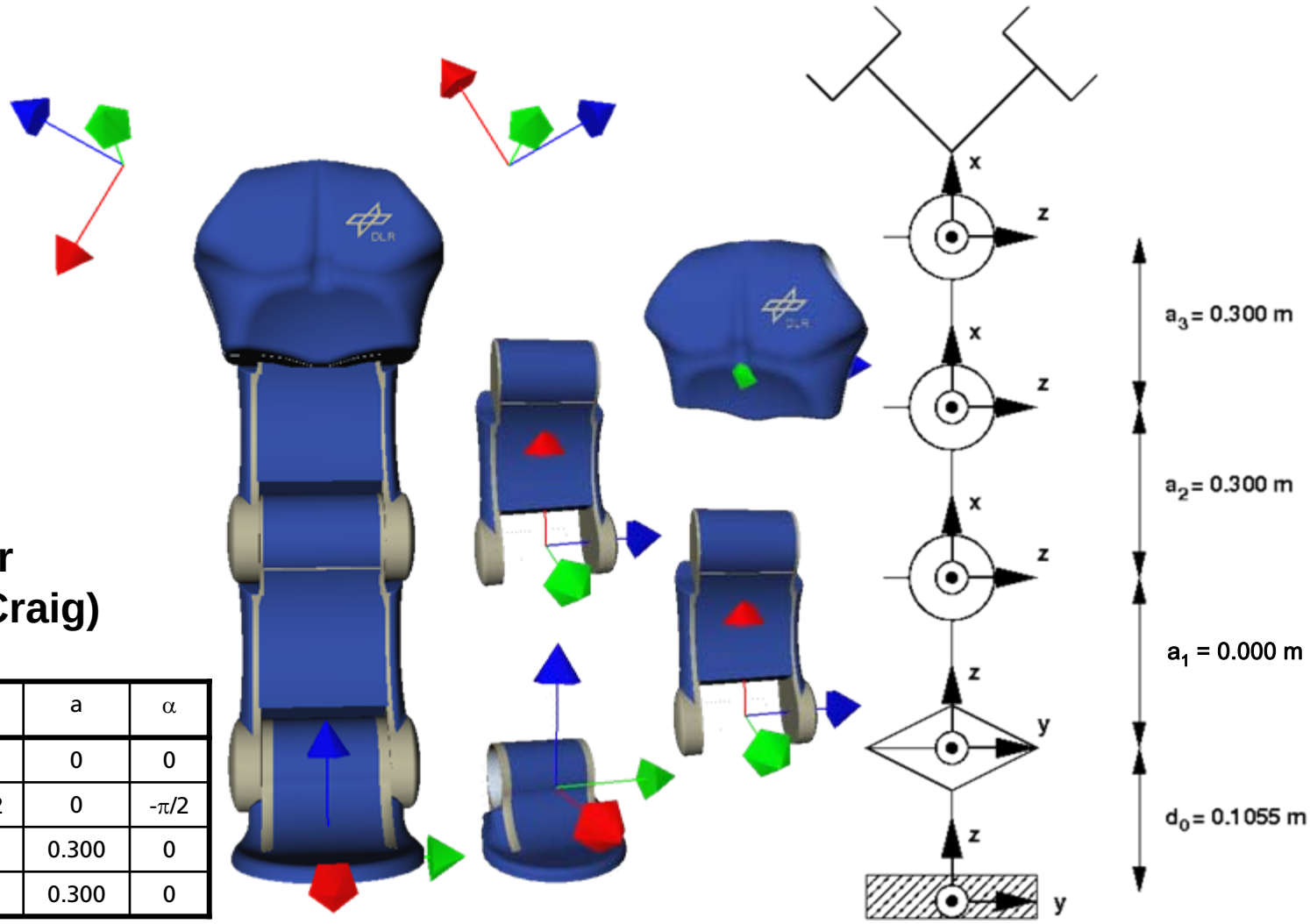


# Mobile Platform

## Complete wheel (base frame and movable frames)



# Torso




## DH Parameter (Yoshikawa/Craig)

| Joint | d | θ | a | α |
|---|---|---|---|---|
| 0 | 0.1055 | 0 | 0 | 0 |
| 1 | 0 | -π/2 | 0 | -π/2 |
| 2 | 0 | 0 | 0.300 | 0 |
| 3 | 0 | 0 | 0.300 | 0 |

# Kinematic Torso Body

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```
/-------------------------------------------------------/
/ DH Description (Yoshikawa / Craig) (Torso)            /
/-------------------------------------------------------/
setDH (real d,    real phi, real a, real alpha)
MatDHCraig<double> Link0(0.1055,      0.0,  0.000,  0.0);
MatDHCraig<double> Link1(0.000, -M_PI/2.0,  0.000, -M_PI/2.0);
MatDHCraig<double> Link2(0.000,       0.0,  0.300,  0.0);
MatDHCraig<double> Link3(0.000,       0.0,  0.300,  0.0);

/-------------------------------------------------------/
/ relative dh-frames            absolute dh-frames
/-------------------------------------------------------/
TR_Link0:                      Link0TF:
[ 1, 0, 0, 0 ]                 [ 1, 0, 0, 0 ]
[ 0, 1, 0, 0 ]                 [ 0, 1, 0, 0 ]
[ 0, 0, 1, 0.1055 ]            [ 0, 0, 1, 0.1055 ]

TR_Link1:                      Link1TF:
[ 0, 1, 0,  0.000 ]            [ 0, 1, 0,  0.000 ]
[ 0, 0, 1,  0.000 ]            [ 0, 0, 1,  0.000 ]
[ 1, 0, 0,  0.000 ]            [ 1, 0, 0,  0.1055 ]

TR_Link2:                      Link2TF:
[ 1, 0, 0, 0.300 ]             [ 0, 1, 0,  0.000 ]
[ 0, 1, 0, 0.000 ]             [ 0, 0, 1,  0.000 ]
[ 0, 0, 1, 0.000 ]             [ 1, 0, 0,  0.4055 ]

TR_Link3:                      Link3TF:
[ 1, 0, 0, 0.300 ]             [ 0, 1, 0,  0.000 ]
[ 0, 1, 0, 0.000 ]             [ 0, 0, 1,  0.000 ]
[ 0, 0, 1, 0.000 ]             [ 1, 0, 0,  0.7055 ]
```

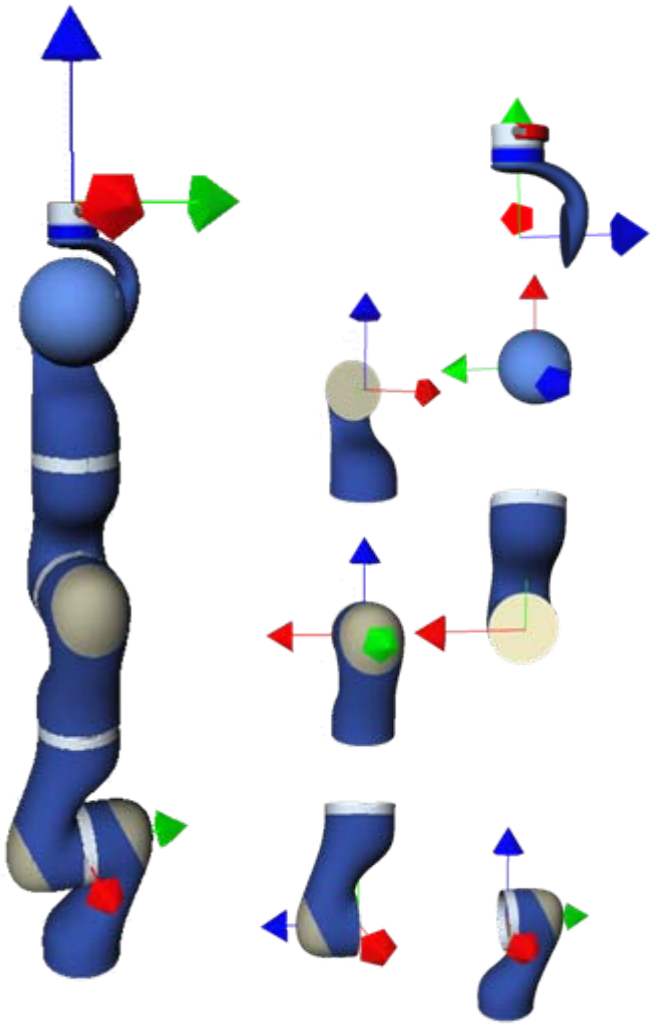
```
/-------------------------------------------------------/
/ relative arm and head docking frames
/-------------------------------------------------------/
Dock Frame (last axis torso -> first axis left arm):
LA_DockTF:
[  0.866, 0, 0.5,   0.190 ]
[  0,     1, 0,     0.088 ]
[ -0.5,   0, 0.866, 0.256 ]

Dock Frame (last axis torso -> first axis right arm):
RA_DockTF:
[ -0.866, 0,  0.5,    0.190 ]
[  0,     1,  0,      0.088 ]
[ -0.5,   0, -0.866, -0.256 ]

Dock Frame Head (last axis torso -> first axis head):
HD_DockTF:
[ 0, 0, 1, 0.235 ]
[ 1, 0, 0, 0.088 ]
[ 0, 1, 0, 0.000 ]
```

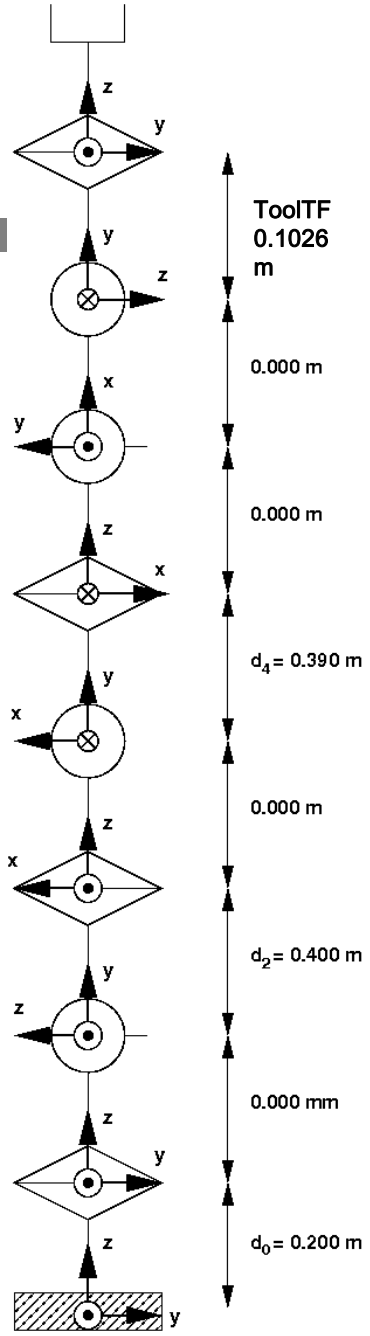
# Justin – Right Arm



## DH Parameter (Yoshikawa/Craig)

| Joint | d | θ | a | α |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | π/2 |
| 2 | 0.400 | -π/2 | 0 | -π/2 |
| 3 | 0 | 0 | 0 | π/2 |
| 4 | 0.390 | -π | 0 | -π/2 |
| 5 | 0 | π/2 | 0 | π/2 |
| 6 | 0 | -π/2 | 0 | π/2 |
| Tool | 0.1026 | -π | 0 | - π/2 |



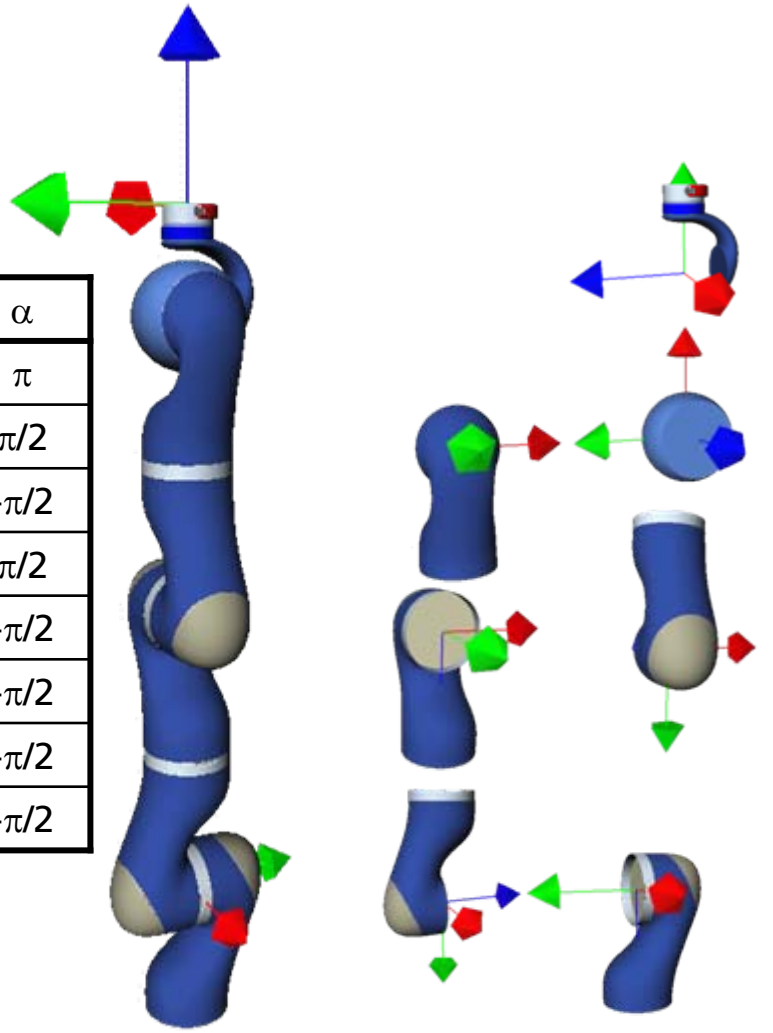


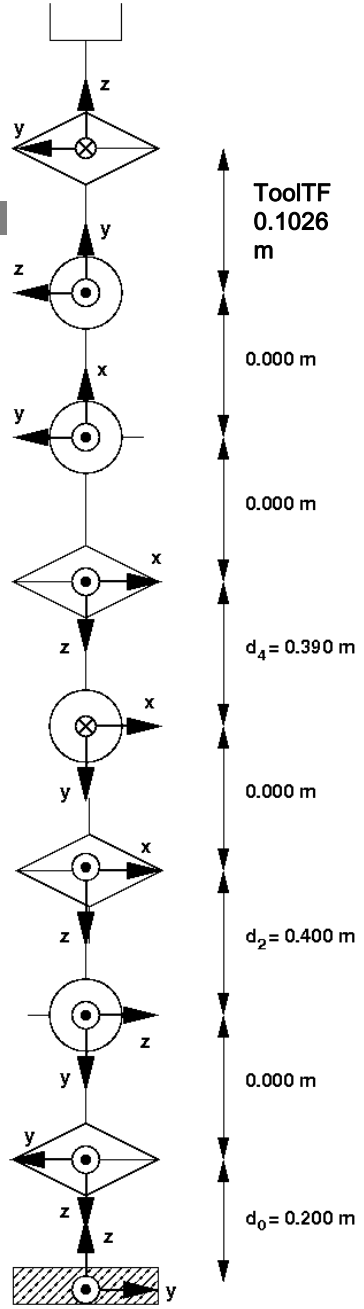
# Justin – Left Arm



## DH Parameter (Yoshikawa/Craig)

| Joint | d | θ | a | α |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | π |
| 1 | 0 | 0 | 0 | π/2 |
| 2 | -0.400 | -π/2 | 0 | -π/2 |
| 3 | 0 | 0 | 0 | π/2 |
| 4 | -0.390 | 0 | 0 | -π/2 |
| 5 | 0 | π/2 | 0 | -π/2 |
| 6 | 0 | -π/2 | 0 | -π/2 |
| Tool | 0.1026 | π | 0 | -π/2 |





# Joint Limits

## LWR III (left and right)

| Axis | Min. (°Deg) | Max. (°Deg) |
|---|---|---|
| 1 | -170 | 170 |
| 2 | -120 | 120 |
| 3 | -170 | 170 |
| 4 | -120 | 120 |
| 5 | -170 | 170 |
| 6 | -45 | 80 |
| 7 | -45 | 135 |

## Torso

| Axis | Min. (°Deg) | Max. (°Deg) |
|---|---|---|
| T1 | -140 | 200 |
| T2 | -90 | 90 |
| T3 | If(T2<0): –T2<br>If(T2>0): 0 | If(T2<0): 135<br>If(T2>0): 135 -T2 |
| T4 | -T2 – T3 | -T2 – T3 |

## Head (mechanical)

| Axis | Min. (°Deg) | Max. (°Deg) |
|---|---|---|
| H1 | -90 | 90 |
| H2 | -20 | 45 |

## Head (software)

| Axis | Min. (°Deg) | Max. (°Deg) |
|---|---|---|
| H1 | -45 | 45 |
| H2 | -20 | 45 |

# Justin – PanTilt & Head



## DH Parameter (Yoshikawa/Craig)

| Joint | d | θ | a | α |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | -π/2 |

## Docking Frame Head (relative last axis torso):

```
0 0 1 0.235
1 0 0 0.088
0 1 0 0.000
0 0 0   1
```