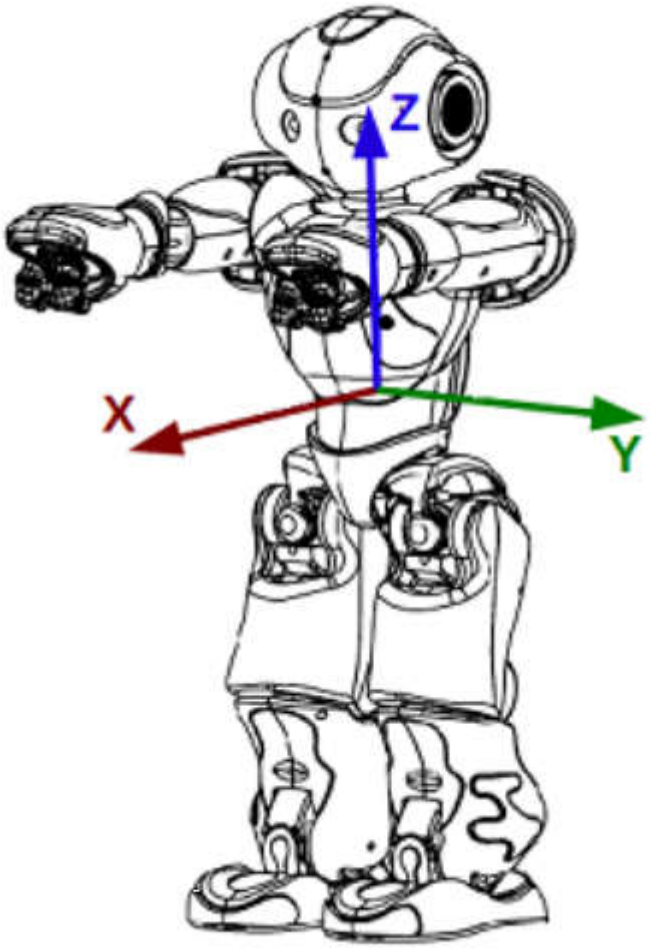
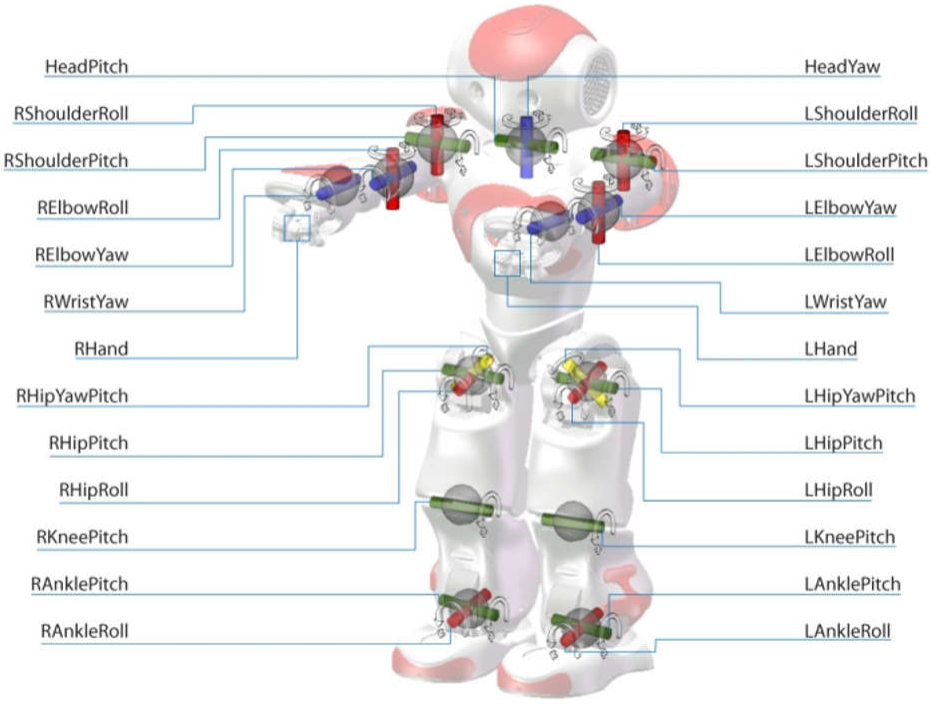
NAO - Kinematics

Frames:





Axis Convention

Actuated Hand

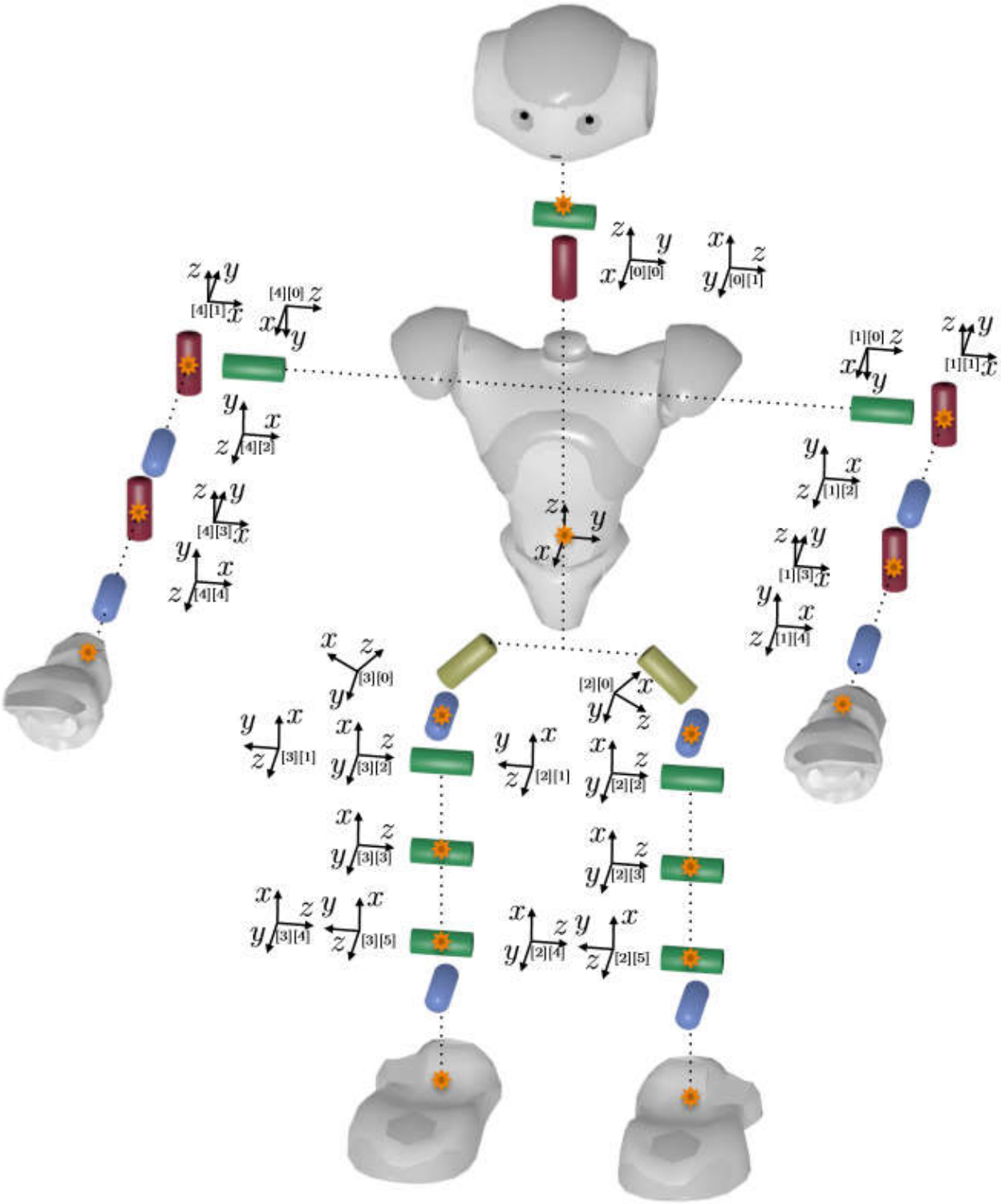
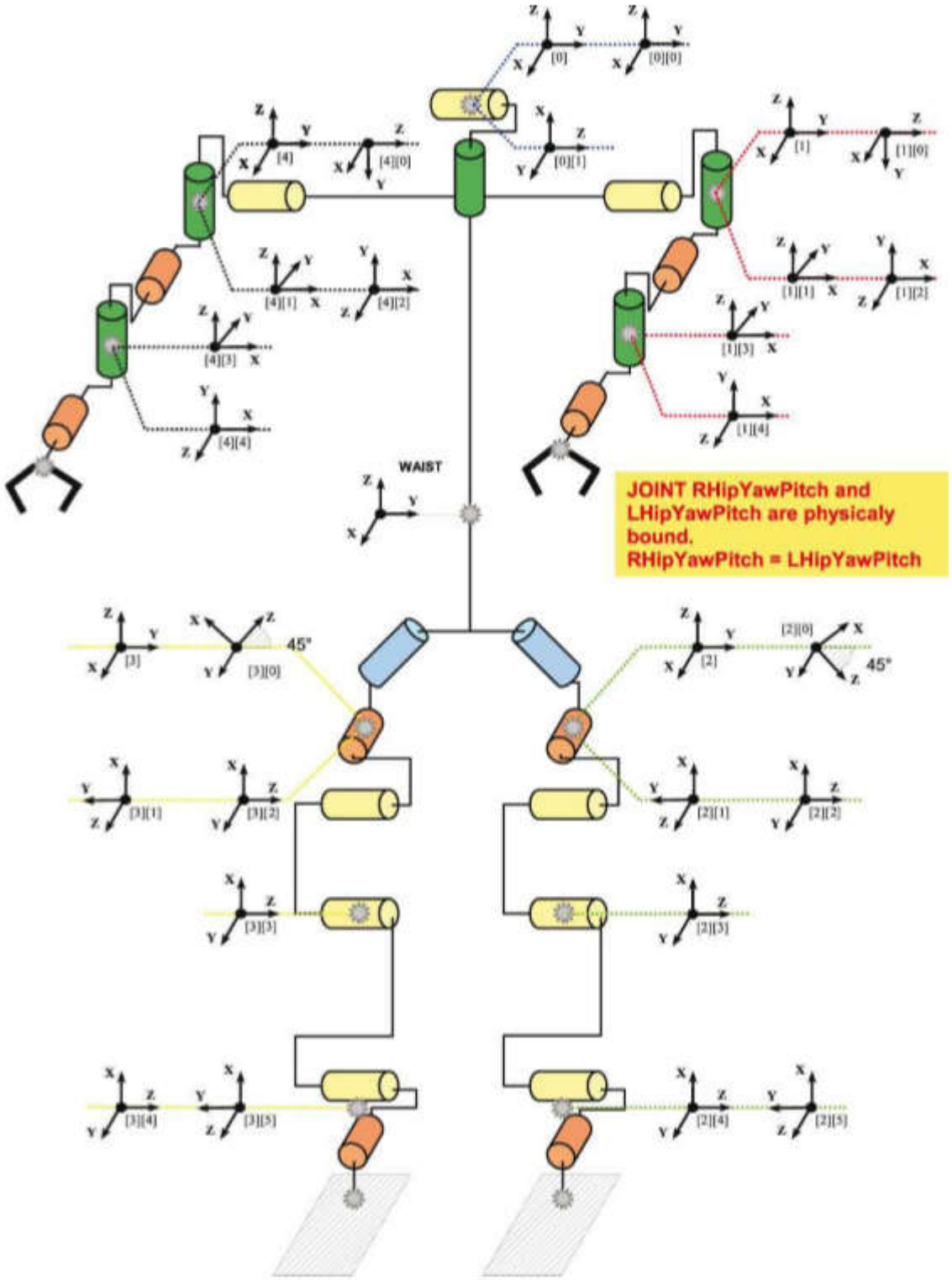


Figure 3.10: Denavit-Hartenberg joint definitions.


WAIST
JOINT RHipYawPitch and LHipYawPitch are physicaly bound.
RHipYawPitch = LHipYawPitch
45°
45°

Dimensioni LINKS:

http://doc.aldebaran.com/2-1/family/nao_h25/links_h25.html

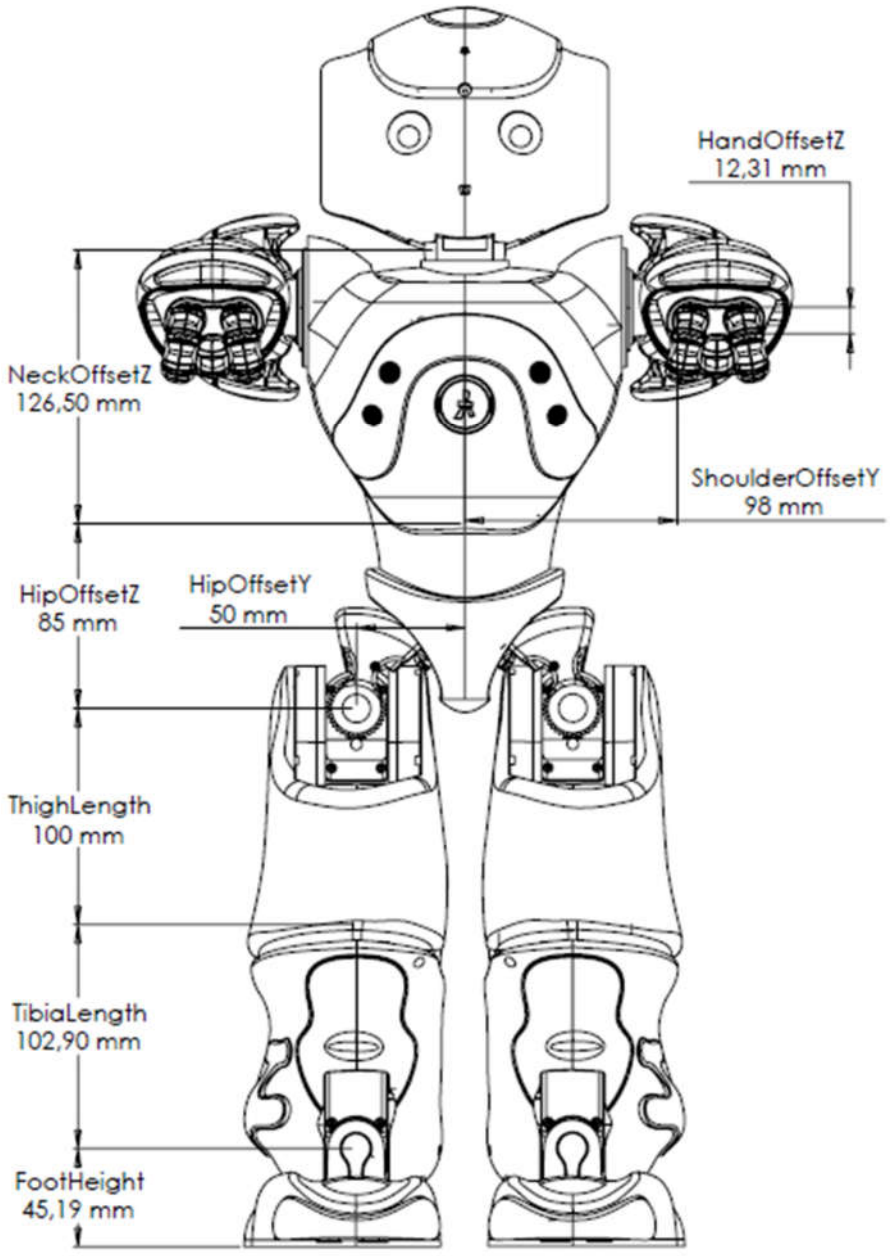
H25 - Links

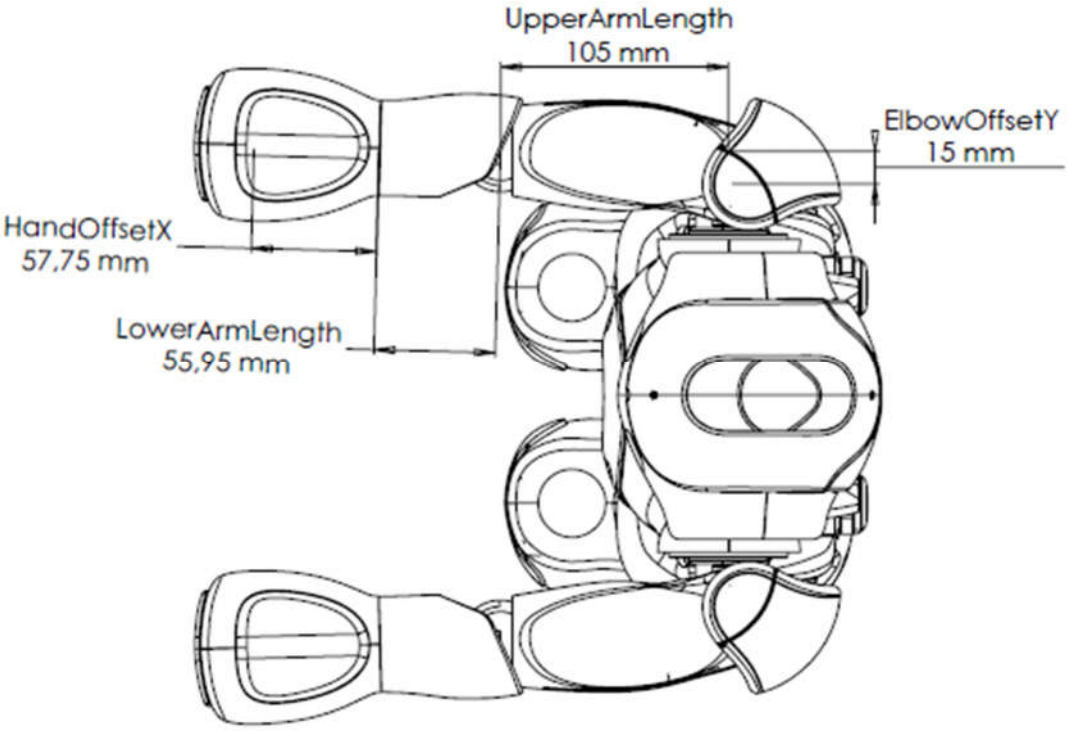
See also

V5 & V4 | V3.3 | V3.2

NAO H25 | Links

Length overview


HandOffsetZ
12,31 mm
NeckOffsetZ
126,50 mm
ShoulderOffsetY
98 mm
HipOffsetZ
85 mm
HipOffsetY
50 mm
ThighLength
100 mm
TibiaLength
102,90 mm
FootHeight
45,19 mm



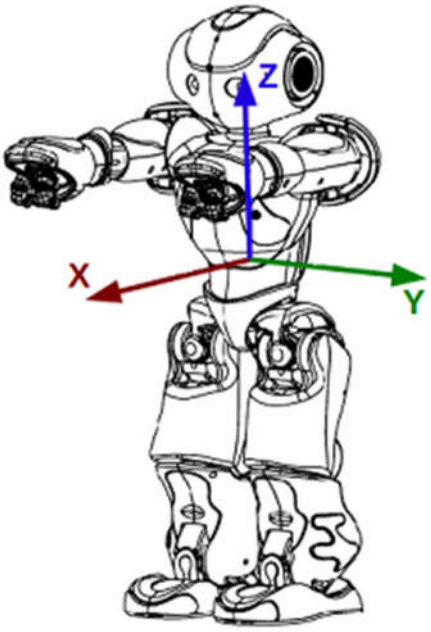
Link definition

Links are defined using:

- Joint names (see **Joints** and **Masses** section to visualize them) and,
- a point called **Torso**, located at - 126.50 Z (mm) from **HeadYaw**.

Axis definition

The **X** axis is positive toward NAO's front, the **Y** from right to left and the **Z** is vertical.



Head

From ...	To ...	X (mm)	Y (mm)
Torso	HeadYaw	0.00	0.00
HeadYaw	HeadPitch	0.00	0.00

Main length (mm)	
NeckOffsetZ	126.50

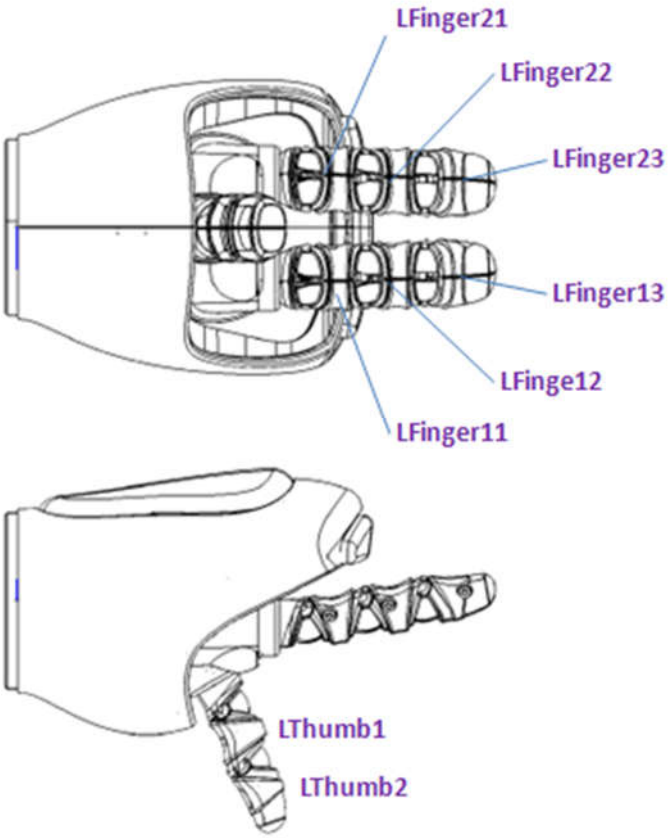
Arms

From ...	To ...	X (mm)	Y (mm)
Torso	LShoulderPitch	0.00	98.00
LShoulderPitch	LShoulderRoll	0.00	0.00
LShoulderRoll	LElbowYaw	105.00	15.00
LElbowYaw	LElbowRoll	0.00	0.00
LElbowRoll	LWristYaw	55.95	0.00

Main length (mm)	
ShoulderOffsetY	98.00
ElbowOffsetY	15.00
UpperArmLength	105.00
LowerArmLength	55.95
ShoulderOffsetZ	100.00
HandOffsetX	57.75
HandOffsetZ	12.31

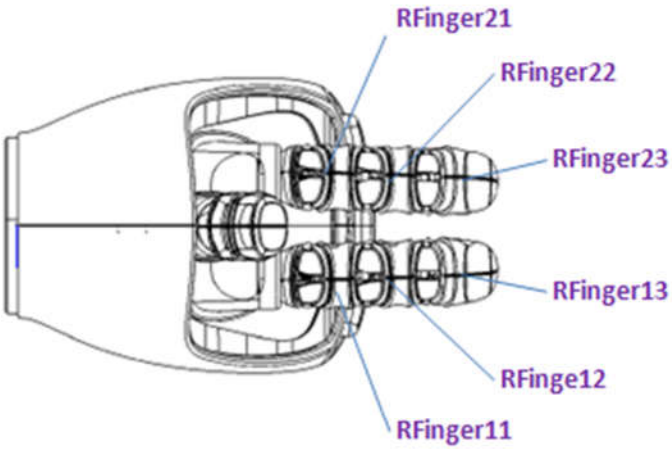
Fingers

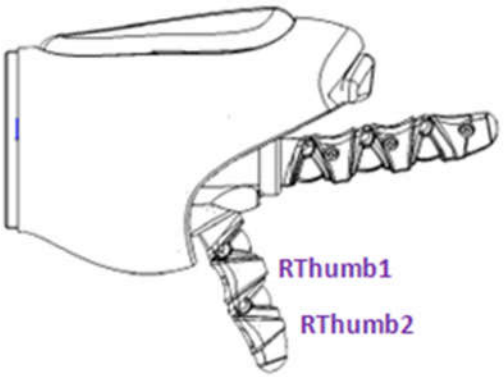
Left



From ...	To ...	X (mm)	Y (mm)
LWristYaw	LFinger11	69.07	11.57
LFinger11	LFinger12	14.36	0.00
LFinger12	LFinger13	14.36	0.00
LWristYaw	LFinger21	69.07	-11.57
LFinger21	LFinger22	14.36	0.00
LFinger22	LFinger23	14.36	0.00
LWristYaw	LThumb1	48.95	0.00
LThumb1	LThumb2	14.36	0.00

Right

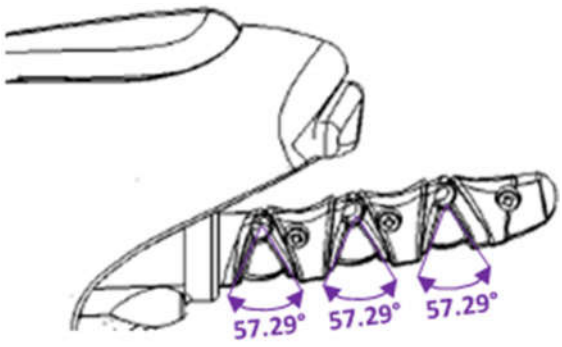




From ...	To ...	X (mm)	Y (mm)
RWristYaw	RFinger11	69.07	11.57
RFinger11	RFinger12	14.36	0.00
RFinger12	RFinger13	14.36	0.00
RWristYaw	RFinger21	69.07	-11.57
RFinger21	RFinger22	14.36	0.00
RFinger22	RFinger23	14.36	0.00
RWristYaw	RThumb1	48.95	0.00
RThumb1	RThumb2	14.36	0.00

Angles

Angle between two phalanges: 57.29 degrees



Left

"LFinger11": RotX(10.0)

"LFinger21": RotX(-10.0)

"LThumb1": RotX(180.0)*RotY(-60.0)

Right

"RFinger11": RotX(10.0)

"RFinger21": RotX(-10.0)

"RThumb1": RotX(180.0)*RotY(-60.0)

Legs

From ...	To ...	X (mm)	Y (mm)
Torso	LHipYawPitch	0.00	50.00
LHipYawPitch	LHipRoll	0.00	0.00
LHipRoll	LHipPitch	0.00	0.00
LHipPitch	LKneePitch	0.00	0.00
LKneePitch	LAnklePitch	0.00	0.00
LAnklePitch	LAnkleRoll	0.00	0.00

Main length (mm)	
HipOffsetZ	85.00
HipOffsetY	50.00
ThighLength	100.00
TibiaLength	102.90
FootHeight	45.19

JOINTS:

http://doc.aldebaran.com/2-1/family/nao_h25/joints_h25.html

H25 - Joints

See also

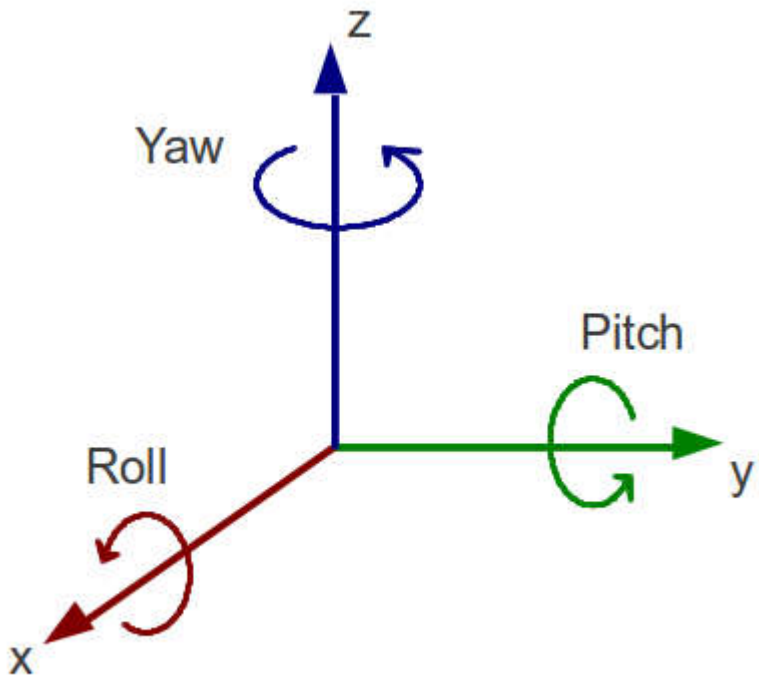
V5 & V4 | V3.3 | V3.2

NAO H25 | Joints

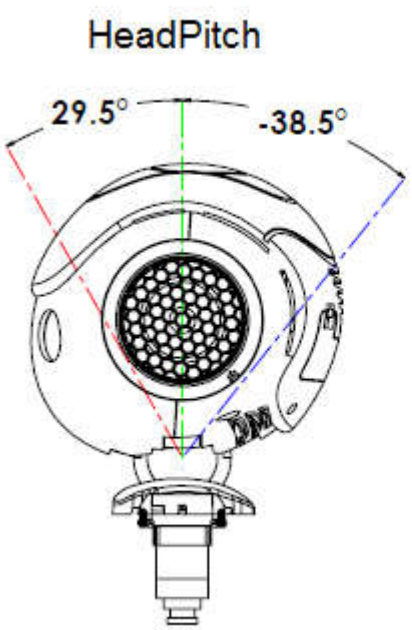
Sign convention

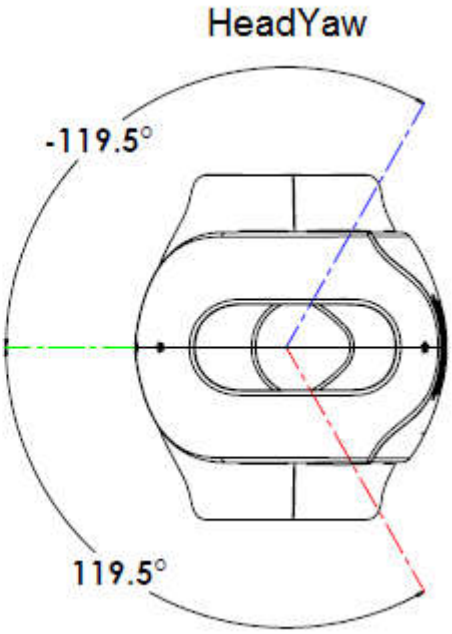
Given a joint that links two body parts of the robot, the body part that is closer to the trunk is considered to be fixed and the body part that is farther from the trunk is the one that rotates around the joint axis.

To perform the rotation of the body parts, we place a frame at each joint. When the robot is at the zero pose, all joint frames have the same orientation. Then, roll rotations take place around the X axis, pitch rotations around the Y axis and yaw rotations around the Z axis.



Head joints





Motion range

Joint name	**Motion**	**Range** *(degrees)*
HeadYaw	Head joint twist (Z)	-119.5 to 119.5
HeadPitch	Head joint front and back (Y)	-38.5 to 29.5

Click the joint name to see all related ALMemory *key names*.

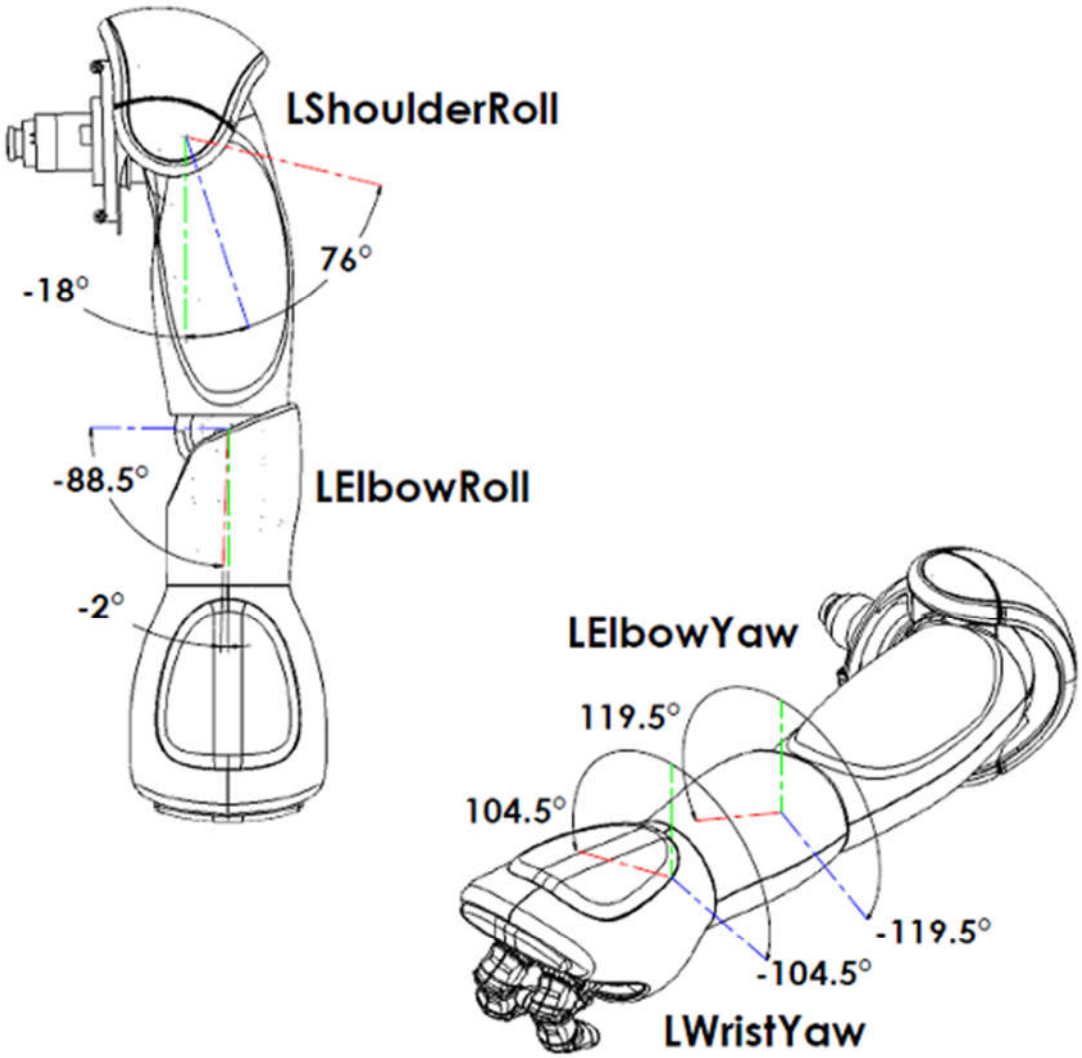
Anti collision limitation

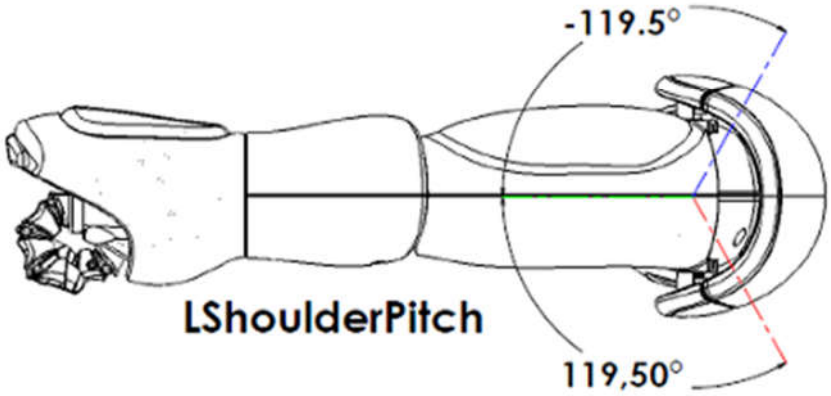
Due to potential shell collision at the head level, the **Pitch** motion range is limited according to the **Yaw** value.

HeadYaw	**HeadPitch Min**	**HeadPitch Max**		**HeadYaw**	**HeadPitch Min**
(degrees)				*(radians)*	
-119.52	-25.73	18.91		-2.086017	-0.449073
-87.49	-18.91	11.46		-1.526988	-0.330041
-62.45	-24.64	17.19		-1.089958	-0.430049
-51.74	-27.50	18.91		-0.903033	-0.479965
-43.32	-31.40	21.20		-0.756077	-0.548033

HeadYaw	HeadPitch Min	HeadPitch Max		HeadYaw	HeadPitch Min
(degrees)				*(radians)*	
-27.85	-38.50	24.18		-0.486074	-0.671951
0.0	-38.50	29.51		0.000000	-0.671951
27.85	-38.50	24.18		0.486074	-0.671951
43.32	-31.40	21.20		0.756077	-0.548033
51.74	-27.50	18.91		0.903033	-0.479965
62.45	-24.64	17.19		1.089958	-0.430049
87.49	-18.91	11.46		1.526988	-0.330041
119.52	-25.73	18.91		2.086017	-0.449073

Left Arm joints

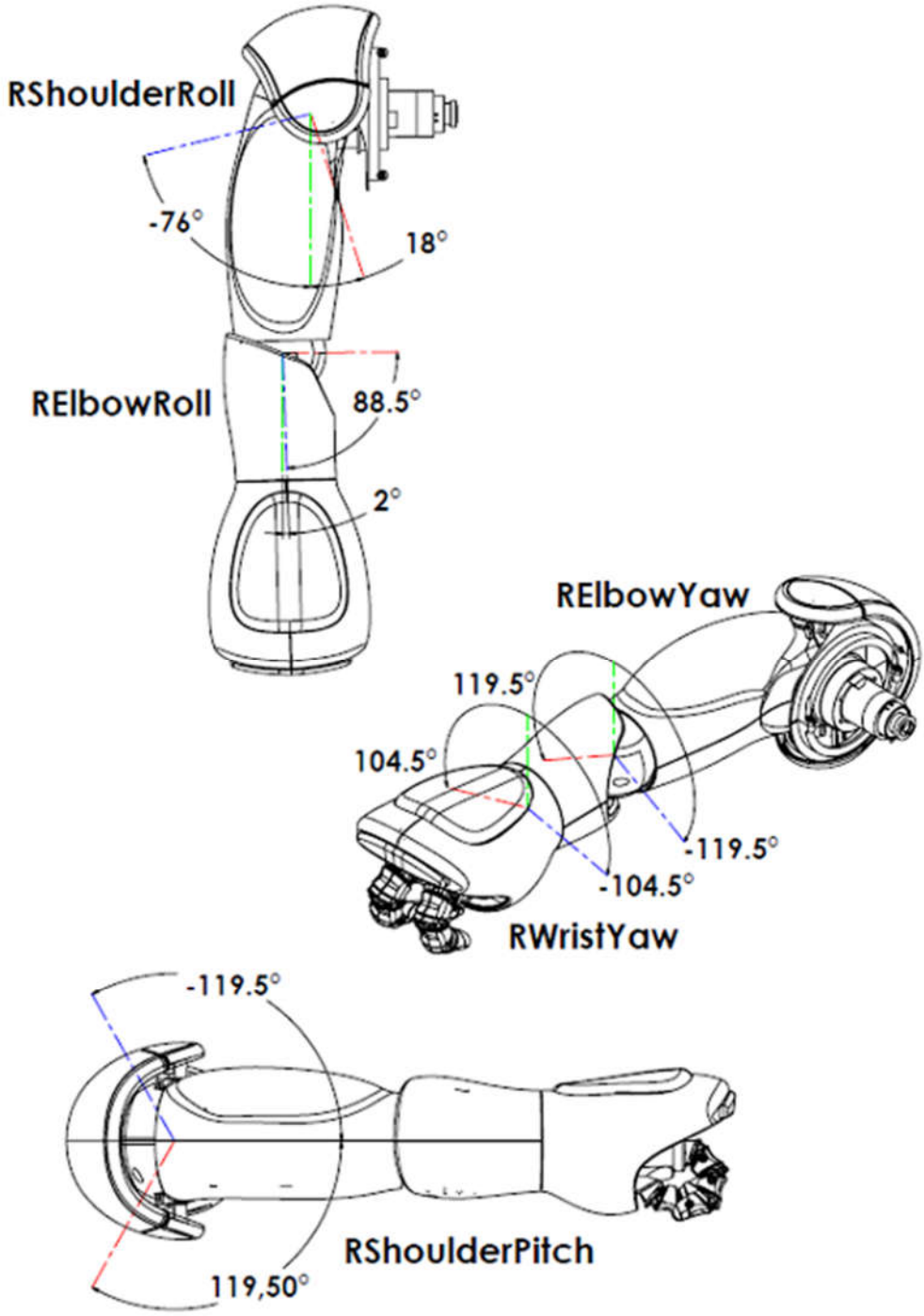




Joint name	Motion	Range (degrees)
LShoulderPitch	Left shoulder joint front and back (Y)	-119.5 to 119.5
LShoulderRoll	Left shoulder joint right and left (Z)	-18 to 76

Joint name	Motion	Range (degrees)
LElbowYaw	Left shoulder joint twist (X)	-119.5 to 119.5
LElbowRoll	Left elbow joint (Z)	-88.5 to -2
LWristYaw	Left wrist joint (X)	-104.5 to 104.5
LHand	Left hand	Open and Close
Click the joint name to see all related ALMemory *key names*.		

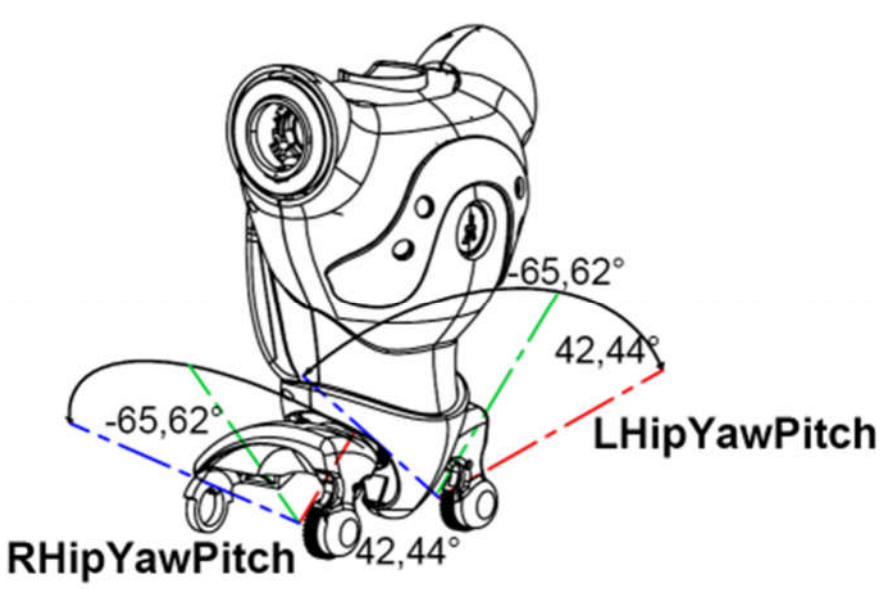
Right Arm joints



Joint name	Motion	Range (degrees)
RShoulderPitch	Right shoulder joint front and back (Y)	-119.5 to 119.5
RShoulderRoll	Right shoulder joint right and left (Z)	-76 to 18
RElbowYaw	Right shoulder joint twist (X)	-119.5 to 119.5
RElbowRoll	Right elbow joint (Z)	2 to 88.5

Joint name	Motion	Range (degrees)
RWristYaw	Right wrist joint (X)	-104.5 to 104.5
RHand	Right hand	Open and Close
Click the joint name to see all related ALMemory *key names*.		

Pelvis joints

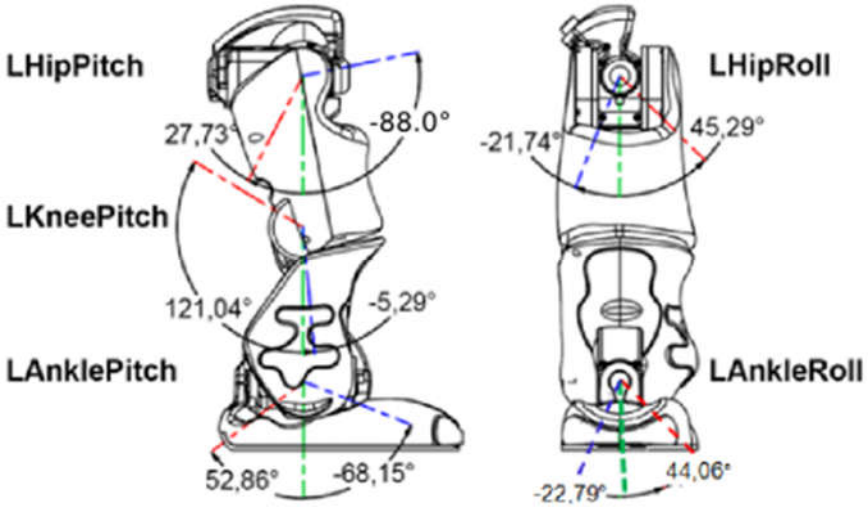


Joint name	Motion	Range (degrees)	Range (radians)
LHipYawPitch	Left hip joint twist (Y-Z 45°)	-65.62 to 42.44	-1.145303 to 0.740810
RHipYawPitch*	Right hip joint twist (Y-Z 45°)	-65.62 to 42.44	-1.145303 to 0.740810
Click the joint name to see all related ALMemory *key names*.			

Note

LHipYawPitch and **RHipYawPitch** are physically just one motor so they cannot be controlled independently. In case of conflicting orders, **LHipYawPitch** always takes the priority.

Left Leg joints



Motion range

Joint name	Motion	Range (degrees)	Range (radians)
LHipRoll	Left hip joint right and left (X)	-21.74 to 45.29	-0.379472 to 0.790477
LHipPitch	Left hip joint front and back (Y)	-88.00 to 27.73	-1.535889 to 0.484090
LKneePitch	Left knee joint (Y)	-5.29 to 121.04	-0.092346 to 2.112528
LAnklePitch	Left ankle joint front and back (Y)	-68.15 to 52.86	-1.189516 to 0.922747
LAnkleRoll	Left ankle joint right and left (X)	-22.79 to 44.06	-0.397880 to 0.769001

Click the joint name to see all related ALMemory *key names*.

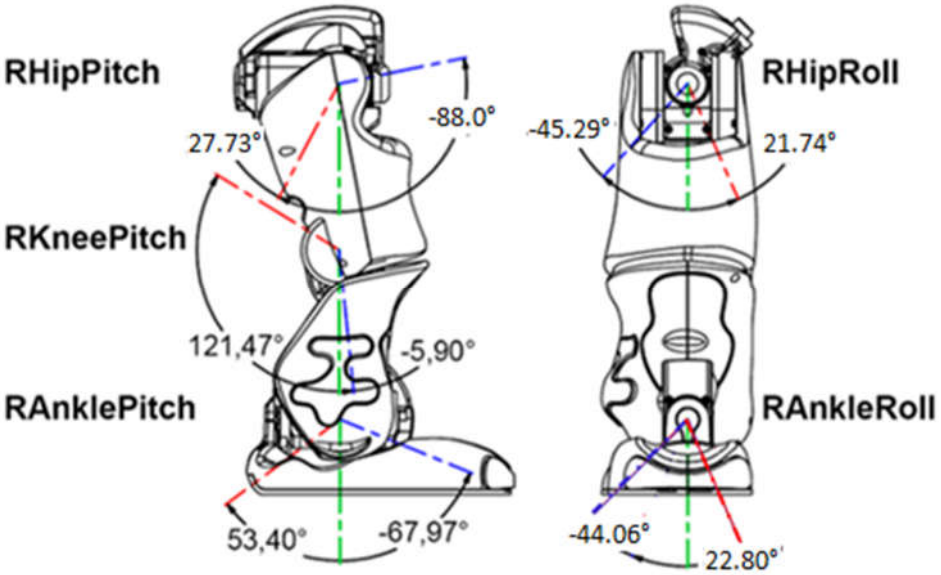
Anti collision limitation

Due to potential shell collision at the ankle level, the **Roll** motion range is limited according to the **Pitch** value.

LAnklePitch	LAnkleRoll Min	LAnkleRoll Max		LAnklePitch	LAnkleRoll Min
(degrees)				*(radians)*	
-68.15	-2.86	4.30		-1.189442	-0.049916
-48.13	-10.31	9.74		-0.840027	-0.179943
-40.11	-22.80	12.61		-0.700051	-0.397935
-25.78	-22.80	44.06		-0.449946	-0.397935

LAnklePitch	LAnkleRoll Min	LAnkleRoll Max		LAnklePitch	LAnkleRoll Min
(degrees)				*(radians)*	
5.73	-22.80	44.06		0.100007	-0.397935
20.05	-22.80	31.54		0.349938	-0.397935
52.87	0.00	2.86		0.922755	-0.000000

Right Leg joints



Motion range

Joint name	Motion	Range (degrees)	Range (radians)
RHipRoll	Right hip joint right and left (X)	-45.29 to 21.74	-0.790477 to 0.379472
RHipPitch	Right hip joint front and back (Y)	-88.00 to 27.73	-1.535889 to 0.484090
RKneePitch	Right knee joint (Y)	-5.90 to 121.47	-0.103083 to 2.120198
RAnklePitch	Right ankle joint front and back (Y)	-67.97 to 53.40	-1.186448 to 0.932056
RAnkleRoll	Right ankle joint right and left (X)	-44.06 to 22.80	-0.768992 to 0.397935

Click the joint name to see all related ALMemory *key names*.

Anti collision limitation

Due to potential shell collision at the ankle level, the **Roll** motion range is limited according to the **Pitch** value.

RAnklePitch	**RAnkleRoll Min**	**RAnkleRoll Max**		**RAnklePitch**	**RAnkleRoll Min**
(degrees)				*(radians)*	
-68.15	-4.30	2.86		-1.189442	-0.075049
-48.13	-9.74	10.31		-0.840027	-0.169995
-40.11	-12.61	22.80		-0.700051	-0.220086
-25.78	-44.06	22.80		-0.449946	-0.768992
5.73	-44.06	22.80		0.100007	-0.768992
20.05	-31.54	22.80		0.349938	-0.550477
52.87	-2.86	0.00		0.922755	-0.049916