tower.xacro   p4_arm.xacro

base_link
link1

p4_arm_yaw1
p4_arm_base ▶
p4_arm1
axis=[0 0 1]

p4_arm_yaw2
p4_arm1 ▶ p4_arm2
axis=[0 0 -1]

p4_arm_yaw3
p4_arm2 ▶
p4_arm3
axis=[0 0 -1]

$a_6 = 0.352$

p4_arm_roll1
p4_arm3 ▶
p4_arm4
axis=[-1 0 0]

$a_9 = 0.011$

p4_rcm_instrument_holder
link11

needle_driver_neck
link13

p4_arm_elevation
base_link ▶
p4_arm_base
axis=[0 0 1]

z_5 z_4

z_3

p4_arm1
link3

x_3 y_2

$d_5 = 0.198$ y_4 y_5

p4_arm4
link6

x_1 x_4 x_6

$d_6 = -0.117$

$a_{10} = 0.520$

p4_rcm_upper_
bar_base_joint
par.. base ▶
..upper_bar
axis=[0 1 0]

p4_rcm_parallelogram_upper_bar
link10

p4_rcm_instrument_
holder_upper_bar_joint
..upper_bar ▶
instr.. holder
axis=[0 -1 0]

needle_driver_house
link12

z_{10}
z_{11}

x_{12}

p4_instrument_pitch

y_{13}

x_{13}

z_2 z_1 z_0

x_3

p4_arm2
link4

p4_arm3
link5

p4_arm_yaw4
p4_arm4 ▶
p4_rcm_base
axis=[0 0 1]

y_9 x_9 y_{10} y_{11} x_{10} x_{11} y_{12}

p4_instrument_slide
instr..holder ▶
needle_driver_house
axis=[0 0 1]

needle_driver_head
link14

z_{13} x_{14}

$d_{14} = 0.009$

z_{13} z_9 z_8 z_7

p4_rcm_parallel
ogram_base
link9

p4_hand_roll
pivot_pl.. ▶
par..base
axis=[0 -1 0]

p4_hand_roll
p4_rcm_base ▶
p4_rcm_pivot_plate
axis=[1 0 0]

p4_instrument_roll
needle_driver_house ▶
needle_driver_neck
axis=[0 0 1]

$a_{12} = 0.052$

p4_instrument_jaw_left
needle_driver_head ▶
..jawbone_left
axis=[0 0 1]

p4_instrument_jaw_right
needle_driver_head ▶
..jawbone_right
axis=[0 0 -1]

$d_2 = 0.554$

p4_arm_base
link2

x_2 y_3 y_4

x_4 x_5 x_6

p4_rcm_pivot_plate
link8

x_7 x_8 z_6

$d_{13} = 0.177$

needle_driver_neck
link13

x_{13} y_{13}

p4_instrument_pitch
needle_driver_neck ▶
needle_driver_head
axis=[1 0 0]

needle_driver
_jawbone_left
link15L

needle_driver
_jawbone_right
link15R

z_2 y_0 z_0 z_1 x_0 x_1 y_1

$a_4 = 0.479$

$a_5 = 0.057$

$b_3 = 0.583$

$d_7 = 0.161$ p4_rcm_base
link7

y_8 z_6

p4_arm_roll1

p4_arm_yaw4

z_{13}

side
view

front
view

$a_2 = 0.186$

$a_7 = -0.042$

p4_arm_elevation
R=I
o=[0 0 0]

p4_arm_yaw1
R=Rz(π/2)Rx(π)
o=[0.186 0 0.554]

p4_arm_yaw2
R=Rz(π/2)Rx(-π)
o=[0 0.583 0]

p4_arm_yaw3
R≈I
o=[0.479 0 -0.001]

p4_arm_roll1
R≈I
o=[0.057 0 0.198]

p4_arm_yaw4
R≈I
o=[0.352 0 -0.117]

p4_hand_roll
R≈I
o=[-0.042 0 0.161]

p4_hand_pitch
R=Ry(-0.288)
o=[0 0 0]

p4_rcm_upper_
bar_base_joint
R=Ry(0.288)Rx(π)
o=[0.011 0 0.186]

p4_rcm_instrument_
holder_upper_bar_joint
R=Rx(π)
o=[0.520 0 0]

p4_instrument_slide
R=I
o=[0 0 0]

p4_instrument_roll
R=Rz(π/2)Rx(π)
o=[0.052 0 0]

p4_instrument_pitch
R=I
o=[0 0 0.177]

p4_instrument_jaw_left/right
R=Ry(π/2)Rx(π/2)
o=[0 0 0.009]

z_0 y_0 x_0 base_link

z_1 y_1 x_1 p4_arm_base

x_2 y_2 z_2 p4_arm1

z_3 y_3 x_3 p4_arm2

z_4 y_4 x_4 p4_arm3

z_5 y_5 x_5 p4_arm4

z_6 y_6 x_6 rcm_base

z_7 y_7 x_7 rcm_pivot_plate

z_8 y_8 x_8 rcm_parallelogram_base

y_9 x_9 z_9 rcm_parallelogram_upper_bar

z_{10} y_{10} x_{10} rcm_instrument_holder

z_{11} y_{11} x_{11} needle_driver_house

x_{12} y_{12} z_{12} p4_instrument_neck

x_{13} y_{13} z_{13} p4_instrument_head

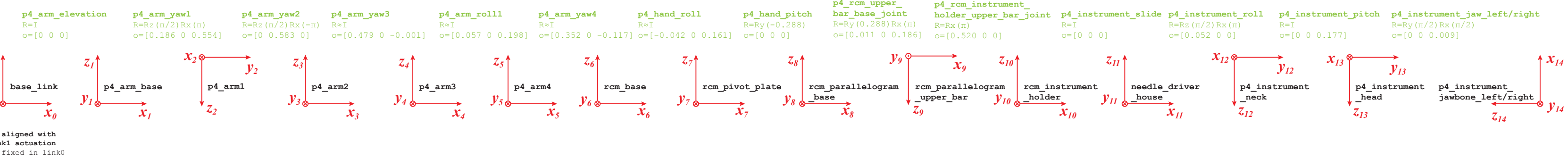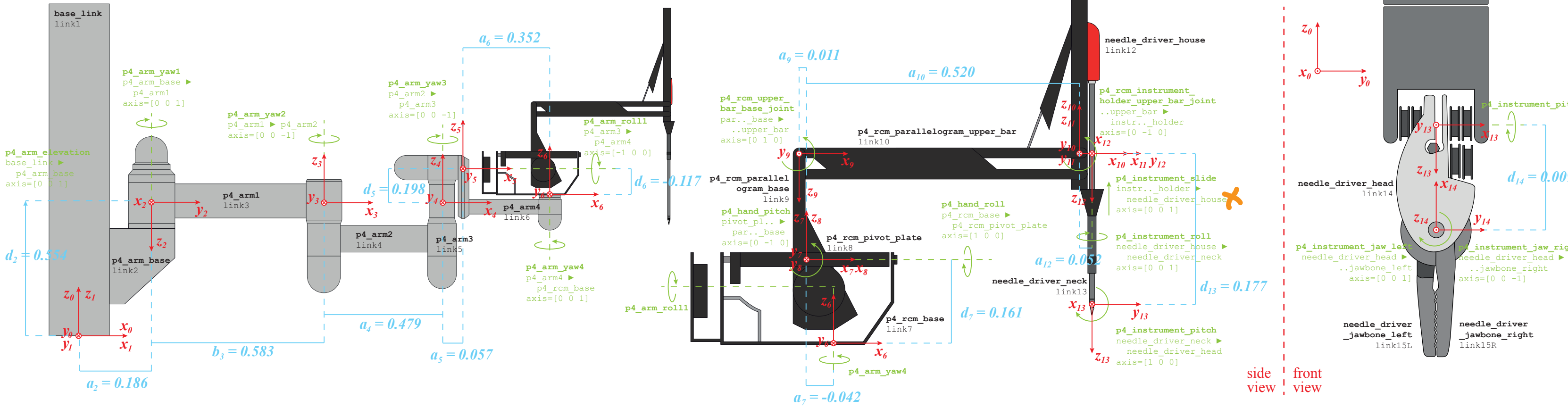x_{14} y_{14} z_{14} p4_instrument_jawbone_left/right

z0 aligned with
link1 actuation
Ψ0 fixed in link0

```
% Robot joints
p4_arm_elevation = [0 0 0]';
p4_arm_yaw1 = [0.186 0 0.5544]';
p4_arm_yaw2 = [0 0.58285 0]';
p4_arm_yaw3 = [0.47985 0 -0.001]';
p4_arm_roll1 = [0.0569999999999999 0 0.19825]';
p4_arm_yaw4 = [0.35225 0 -0.117]';
p4_hand_roll = [-0.0424999999999998 0 0.160999999999999]';
p4_hand_pitch = [0 0 0]';
p4_hand_pitch2 = [0.0108229214977171 0 0.186426149539229]';
p4_hand_pitch2b = [0 0 0.15]';
p4_hand_pitch3 = [0.52 0 0]';
p4_instrument_slide = [0 0 0]';
p4_instrument_roll = [0.0525000000003168 0 0]';
p4_instrument_pitch = [0 0 0.177]';
p4_instrument_jaw_left = [0 0 0.00900000000000001]';
p4_instrument_jaw_right = [0 0 0.00900000000000001]';
```