

aligned with link1 actuation fixed in link0	parameters	distances	parameters	rotations	variables	ROS xacro limits	axis	ROS xacro limits
1	d_1	= 0.554 m			d_1	= [0, 1] m		[0 0 1] elevation
2	a_2	= 0.186 m	R_2	= $R_z(\pi/2)R_x(\pi)$ rad	θ_2	= [-1.5708, 1.5708] rad		[0 0 1] arm_yaw1
3	b_3	= 0.583 m	R_3	= $R_z(\pi/2)R_x(-\pi)$ rad	θ_3	= [-2.8000, 2.8000] rad		[0 0 -1] arm_yaw2
4	a_4	= 0.479 m			θ_4	= [-2.8000, 2.8000] rad		[0 0 -1] arm_yaw3
5	a_5	= 0.057 m, d_5	= 0.198 m		θ_5	= [-1.5708, 1.5708] rad		[-1 0 0] arm_roll1
6	a_6	= 0.352 m, d_6	= -0.117 m		θ_6	= [-2.8000, 2.8000] rad		[0 0 1] arm_yaw4
7	a_7	= -0.042 m, d_7	= 0.161 m		θ_7	= [-1.5708, 1.5708] rad		[1 0 0] hand_roll
8			R_8	= $R_y(-0.288)$ rad	θ_8	= [-0.8000, 1.0000] rad		[0 -1 0] hand_pitch
9	a_9	= 0.011 m, d_9	= 0.186 m	R_9	= $R_y(0.288)R_x(\pi)$ rad			[0 1 0] upper_bar
10	a_{10}	= 0.520 m	R_{10}	= $R_x(\pi)$ rad				[0 -1 0] instr_holder
11	d_{11}	= -0.120 m			d_{11}	= [-0.1200, 0.1200] m		[0 0 1] instr_slide
12	a_{12}	= 0.052 m	R_{12}	= $R_z(\pi/2)R_x(\pi)$ rad	θ_{12}	= [-4.7124, 4.7124] rad		[0 0 1] instr_roll
13	d_{13}	= 0.177 m			θ_{13}	= [-1.5000, 1.5000] rad		[-1 0 0] instr_pitch
14L	d_{14L}	= 0.009 m	R_{14L}	= $R_y(\pi/2)R_x(\pi/2)$ rad	θ_{14L}	= [-1.8000, 1.8000] rad		[0 0 -1] jaw_left
14R	d_{14R}	= 0.009 m	R_{14R}	= $R_y(\pi/2)R_x(\pi/2)$ rad	θ_{14R}	= [-1.8000, 1.8000] rad		[0 0 1] jaw_right

The diagram illustrates the kinematic chain of the robot arm, showing the sequence of joints and the corresponding coordinate frames. The joints are labeled as follows:

- p4_arm_elevation**: Revolute joint (R) around the z_7 axis.
- p4_arm_yaw1**: Revolute joint (R) around the x_7 axis.
- p4_arm_yaw2**: Revolute joint (R) around the y_8 axis.
- p4_arm_yaw3**: Revolute joint (R) around the x_8 axis.
- p4_arm_roll1**: Revolute joint (R) around the z_9 axis.
- p4_hand_roll**: Revolute joint (R) around the y_9 axis.
- p4_hand_pitch**: Revolute joint (R) around the x_9 axis.
- p4_hand_pitch2**: Revolute joint (R) around the z_{10} axis.
- p4_hand_pitch2b**: Revolute joint (R) around the y_{10} axis.
- p4_hand_pitch3**: Revolute joint (R) around the x_{10} axis.
- p4_instrument_slide**: Revolute joint (R) around the z_{11} axis.
- p4_instrument_roll**: Revolute joint (R) around the y_{11} axis.
- p4_instrument_pitch**: Revolute joint (R) around the x_{11} axis.
- p4_instrument_jaw_left**: Revolute joint (R) around the z_{12} axis.
- p4_instrument_jaw_right**: Revolute joint (R) around the x_{12} axis.

The coordinate frames are labeled as follows:

- rcm_pivot_plate**: Frame 7, with axes x_7 and z_7 .
- rcm_parallelagram_base**: Frame 8, with axes x_8 and y_8 .
- rcm_parallelagram_upper_bar**: Frame 9, with axes x_9 and z_9 .
- rcm_instrument_holder**: Frame 10, with axes x_{10} and y_{10} .
- needle_driver_house**: Frame 11, with axes x_{11} and y_{11} .
- needle_driver**: Frame 12, with axes x_{12} and z_{12} .

Diagram illustrating a 2D coordinate system with axes x_{13} , y_{13} and x_{14} , y_{14} . The origin is marked with a red circle containing a cross. The axes are labeled x_{13} , y_{13} , x_{14} , and y_{14} . The text "p4_instrument_head" and "p4_instrument_jawbone_left/right" is visible near the origin.