

LOBSTER

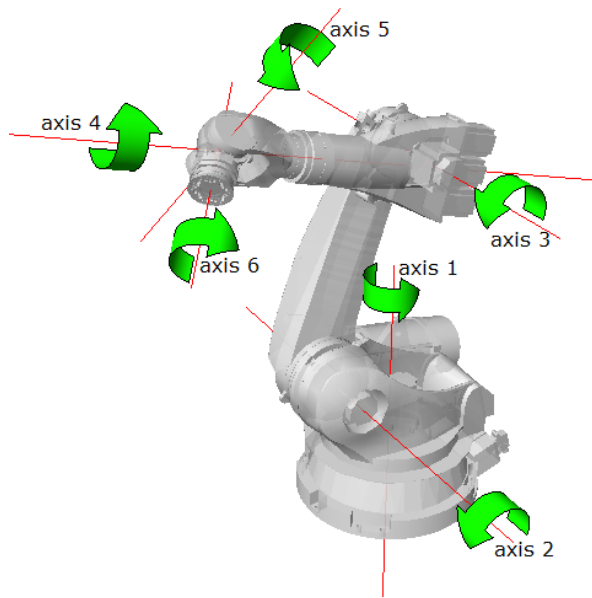


Inverse kinematics for 6-axis robotic arms

Lobster is a tool for solving the inverse kinematics problem within Grasshopper.

i.e. Given a desired position for the end of the arm, what is the necessary combination of joint angles to put it there.

6-axis arms are common in industrial robotics - so called because of their 6 revolute joints:



These 6 axes give the end effector (the part where the tool is attached - eg a gripper or drill) the full 6 degrees of freedom for location and orientation in space.

Note that axes 4, 5 and 6 intersect in a common point.

This is a very important characteristic (known as a *spherical wrist*) which allows the *kinematic decoupling* which is essential for how Lobster works. Luckily almost all modern industrial 6 axis arms have spherical wrists.

Also note that axis 3 and axis 4 do not necessarily intersect, and are often offset by a small amount, and also axis 1 and 2 often do not intersect. However it is only the intersection at the wrist which is important for Lobster.

Setup guide

This guide will take you through the steps in configuring Lobster to work with the correct dimensions for your particular robot.

You will need a 3D model of your robot

These are often downloadable from the manufacturer's website, eg http://www.kuka-robotics.com/united_kingdom/en/downloads/

<http://www.abb.com/abblibrary/DownloadCenter/>

<http://www.staubli.com/en/robotics/products/cad-download/>

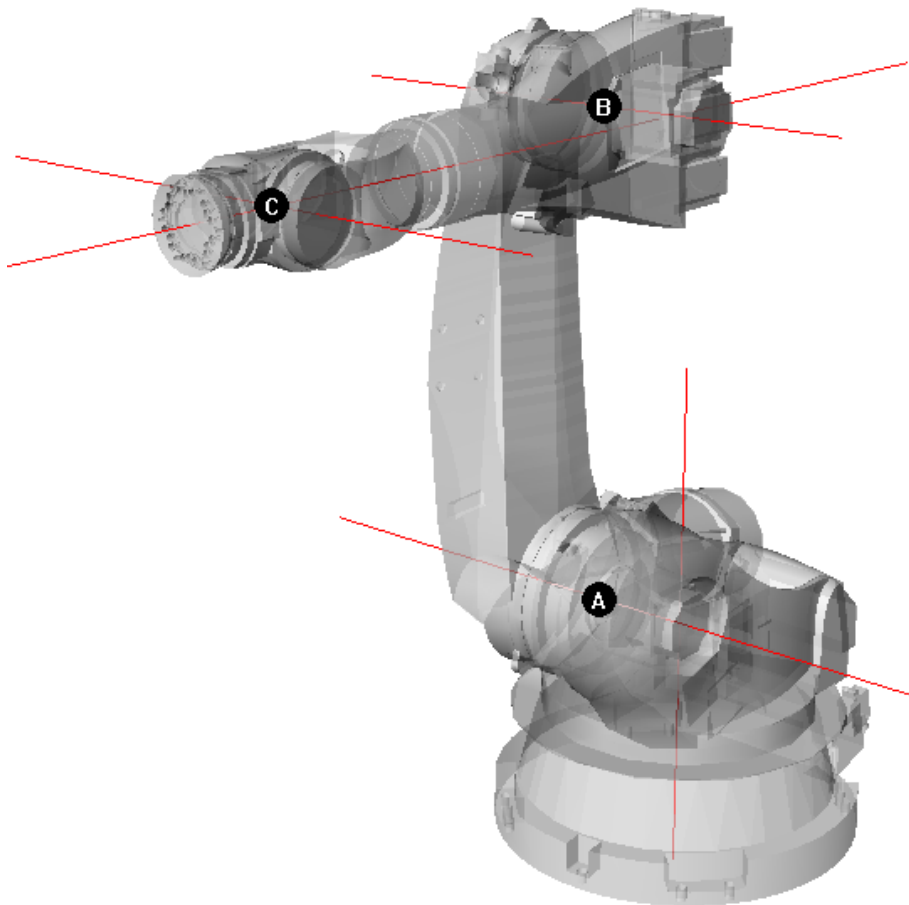
(Alternatively if all you have is a datasheet or measurements of your robot, you can draw a simplified version yourself in Rhino, taking care that all the distances between axes are correct.)

Typically this model will be in the configuration shown below with the axes positioned orthogonally.

You will need to identify and draw in the axis lines if they are not already in the model.

Axis 4 and Axis 6 coincide in this configuration.

Take your 3D robot model and reference the following points into the corresponding points in the Lobster.ghx

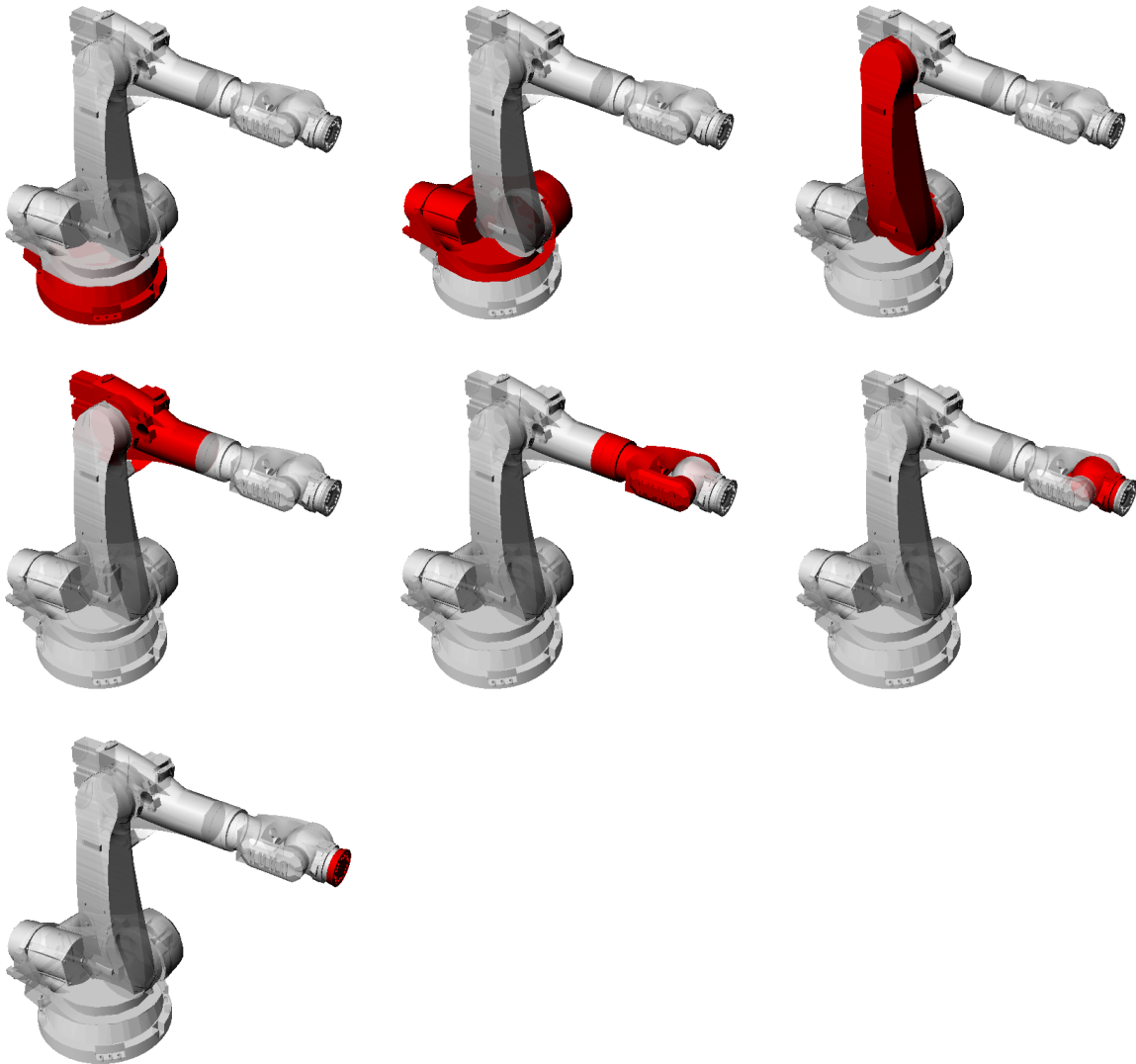


(All points are in the plane through axes 1 and 4, typically the XZ plane. A is the intersection of

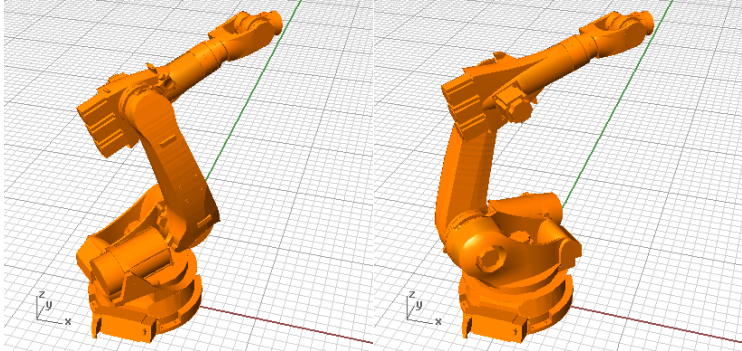
this plane with axis 2, B is the intersection of this plane with axis 3, and C is the intersection of axes 4,5 and 6)

You will also need to group the different moving parts of the robot and join them into single meshes to reference into the Lobster definition.

The parts are as follows:

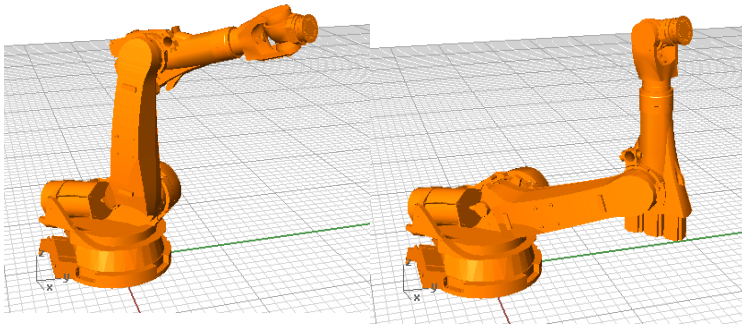


Generally if a point is within reach of the arm, it has a number of choices for how to reach it. The robot can be facing forwards towards the target, or away and reaching back overhead.



the same effector position in the forward and backward facing modes

Also the elbow can be either up or down.



the same effector position in the elbow-up and elbow-down modes

These options can be switched between using the boolean toggles in Lobster.