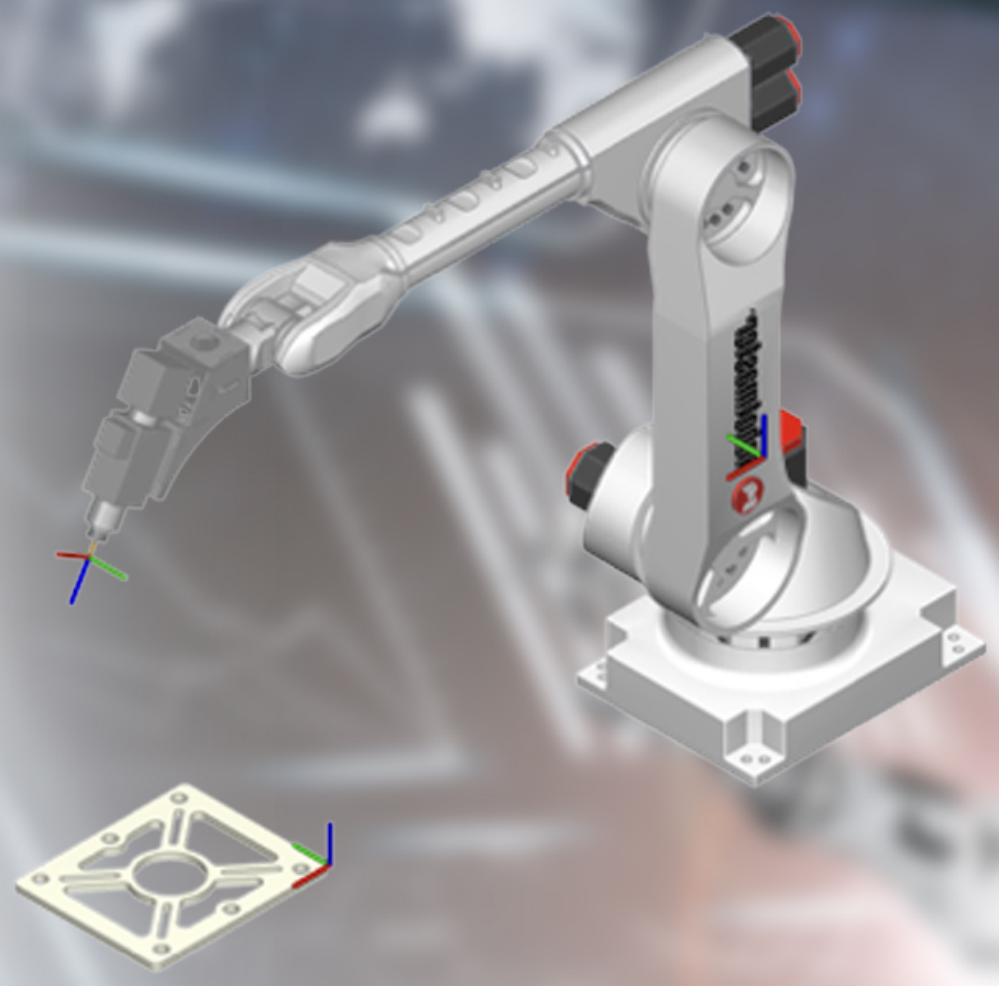
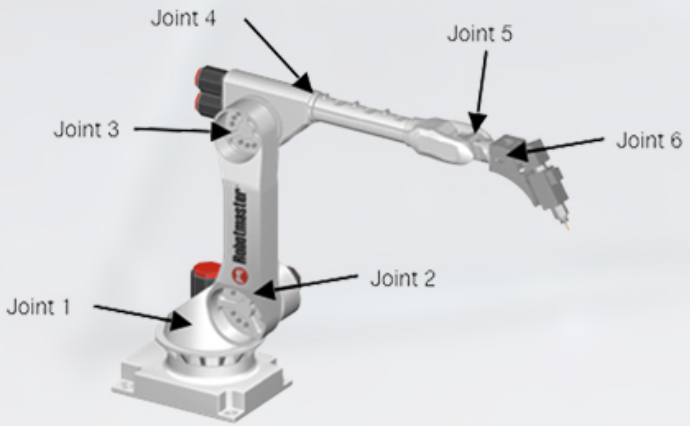
INTRODUCTION

TO ROBOTICS



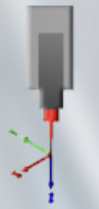
Contents

Kinematics of a robot



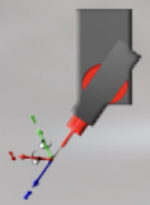
3 axis CNC

Position: (x, y, z)



5 axis CNC

Position: (x, y, z)
Orientation: (Rx, Ry)



6 axis robot

Position: (x, y, z)
Orientation: (Rx, Ry, Rz)

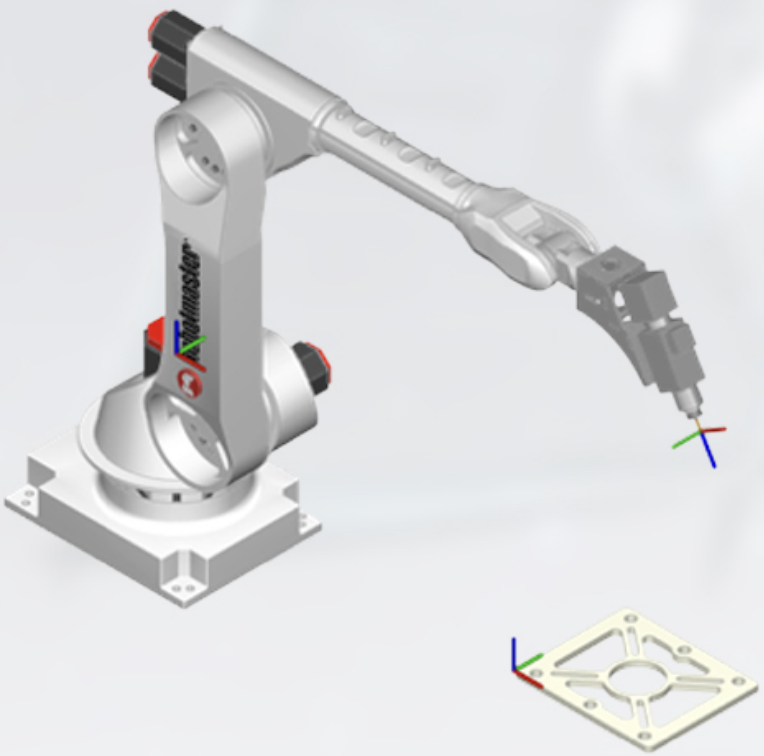
Advantage

- Adaptability
- Cost
- Size
- Repeatability

Disavantage

- Accuracy
- Complex kinematics
- Tedious programming

Positioning and frames



The User frame defines the position and orientation of the part.

It is usually defined with respect to the Base Frame of the robot.

The Tool frame or TCP defines the position and orientation of the tip of the tool.

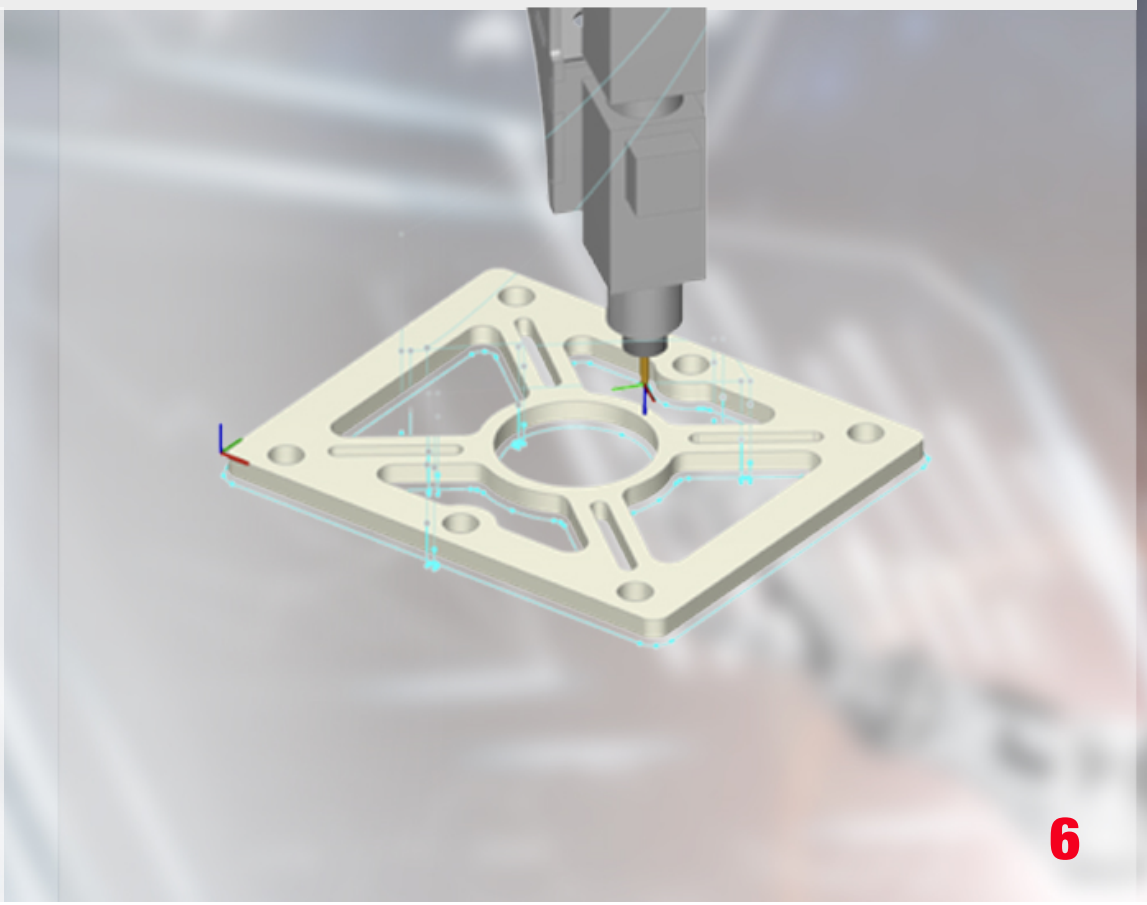
It is always defined with respect to joint 6.

Programming challenges

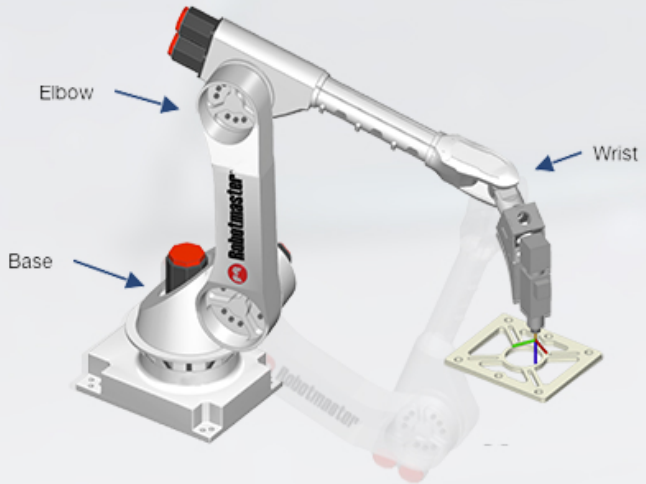
In order to program a part, we need to define the position and orientation of the tool along the toolpath

The position and orientation of the tool is defined in the cartesian space (with respect to the user frame):

(x, y, z, Rx, Ry, Rz)



Programming challenges



For every point

⬇

8 theoretical solutins

Base	Front & Back
Elbo	Up & Down
Wris	Positive & Negative

For every point

⬇

8 theoretical solutins

Base	Front & Back
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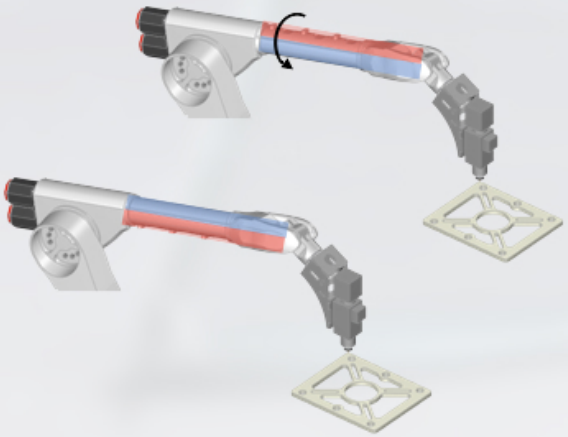
Programming challenges



For every point

⬇

8 theoretical solutins

Base	Front & Back
Elbo	Up & Down
Wris	Positive & Negative

Singularity

infinite number of solutions for a given point.

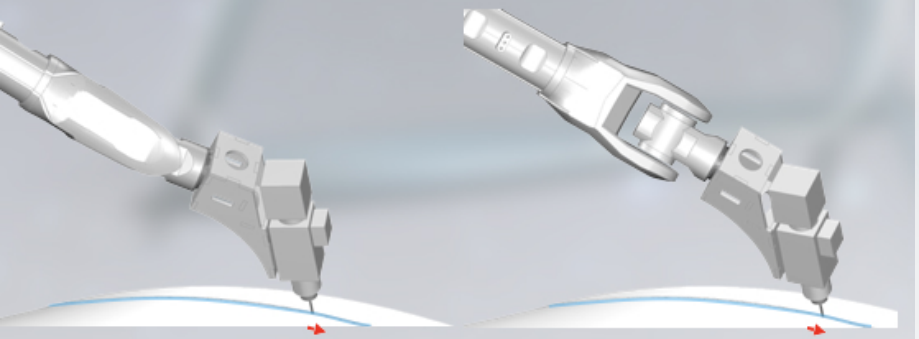
J4 is aligned with **J6**

J1 is aligned with **J6**

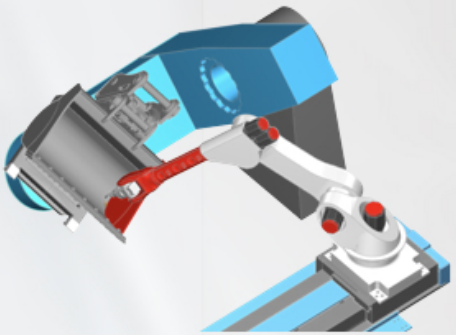
Programming challenges

Over travel
when in between 2 close points the joint of the robot joints undergo too wide angular changes:

- near singularities
- when the robots hits joints limits and has to unwind (often joint 4).

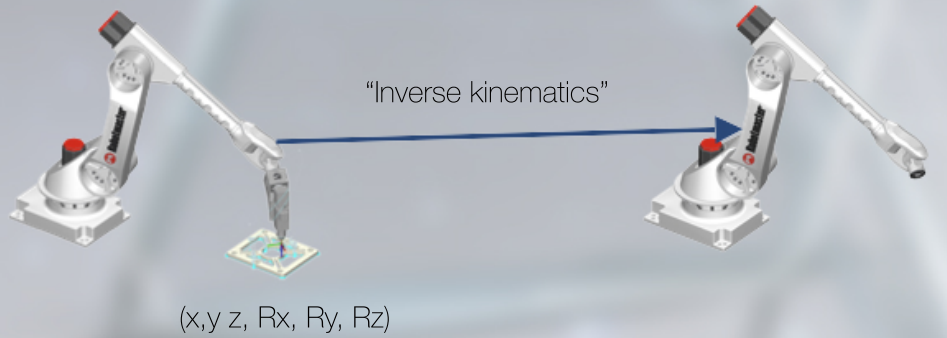


Collision:
when the robot is moving in a complex environment.



Out of reach
a point in the process that the robot cannot reach.

Motion issue



Cartesian Space

Joint Space

(x,y z, Rx, Ry, Rz)

Joint Moves

(x,y z, Rx, Ry, Rz)

(x,y z, Rx, Ry, Rz)

Linear Moves

(x,y z, Rx, Ry, Rz)

(x,y z, Rx, Ry, Rz)

Circular Moves

(x,y z, Rx, Ry, Rz)

Cartesian Space

(J1, J2 J3, J4, J5, J6)

Joint Moves

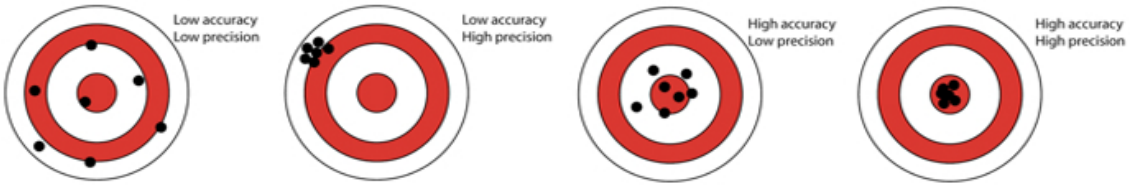
(J1, J2 J3, J4, J5, J6)

Joint Space

Motion issues

Repeatability/Precision
the measurement of how closely a robot returns to the same position n number of times.

Accuracy
the measurement of how closely the robot moves to a given target coordinate.



Robots are inherently repeatable
Robots are not inherently accurate

Corner rounding
*r*obots tend to round corners due to the nature of the joint motion.