Movement planning in Robotics and Graphical Animation

Julien Carpentier

Class notes by Antoine Groudiev

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Contents

1 Introduction

2 Position and Orientation

2.1 Introduction

Kinematics studies the movement of an object – in our case of a robot – without taking into acount the forces generating it. Instead, it only handles aspects such as position, orientation, speed and momentum of bodies in movement.

Consider for instance a robotic arm. We can design a simplified scheme of the robot and its environment, to create a kinematic pipeline and reference frames associated to each of these objects.

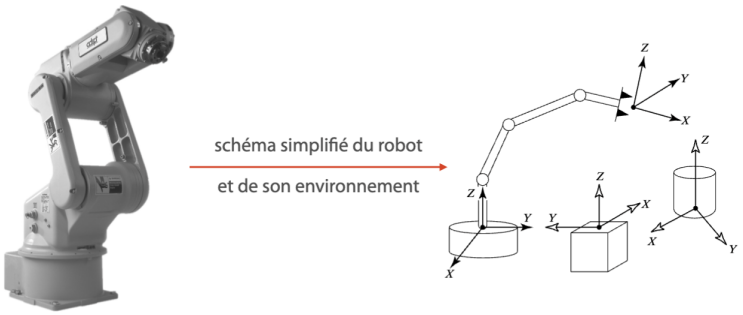
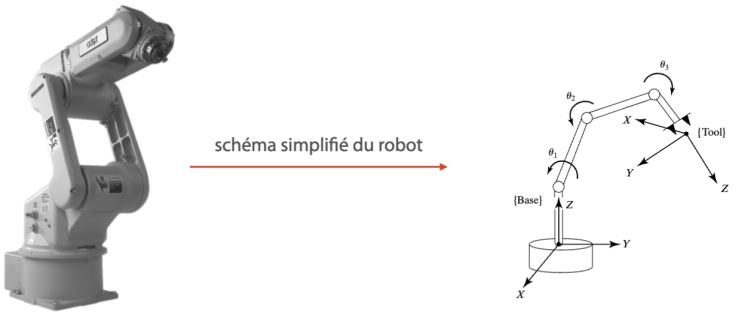


Figure 2.1: Simplified scheme of the robot feature the kinematic pipeline and reference frames.

Direct kinematics allows to compute the position and orientation of the terminal organ given, for instance, the angles of the articulations.



Invert kinematics answers the question the other way around: given the position and orientation of a boyd, how can we compute the values of the articulations angles. Invert kinematics is used for instance for trajectory tracking: given a reference trajectory, how can we compute the speed of the articulations?

2.2 Position of a point in space

Once that a frame of reference $\{A\}$ is defined, we can localize any point of the universe given a *position vector*:

$$^{A}P = \begin{bmatrix} p_x \\ p_y \\ p_z \end{bmatrix}$$

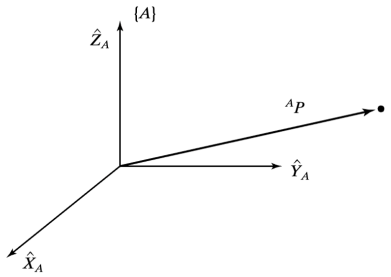


Figure 2.2: Vector and position of the point established in the frame $\{A\}$.

3 Direct Cinematic

4 Invert Cinematic

5 Reinforcement Learning

6 Locomotion