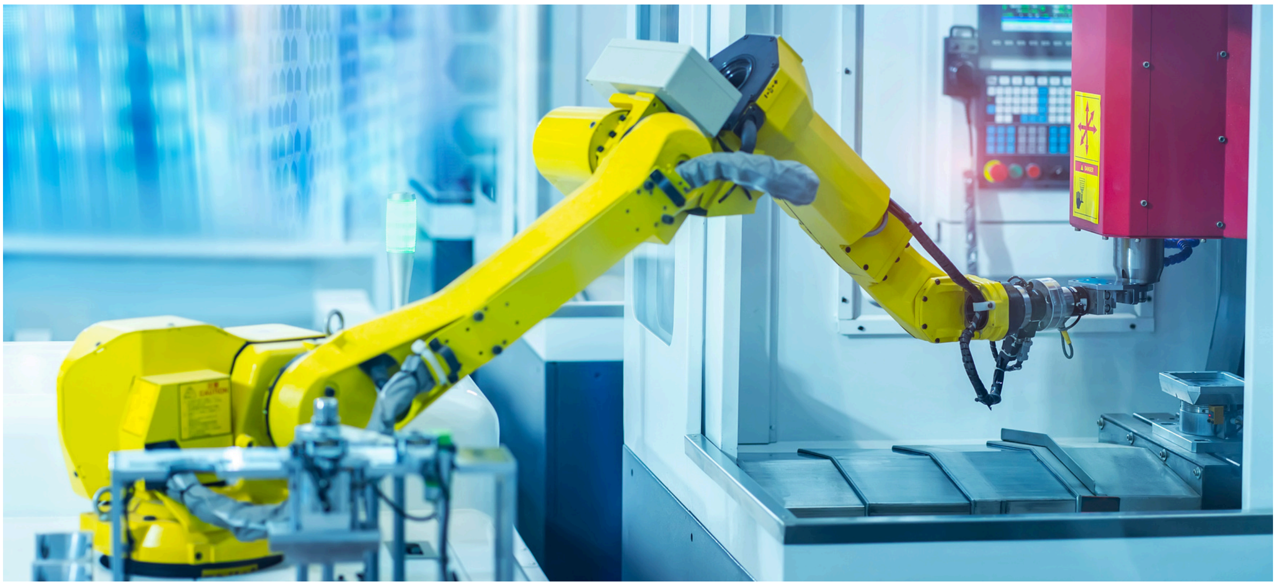
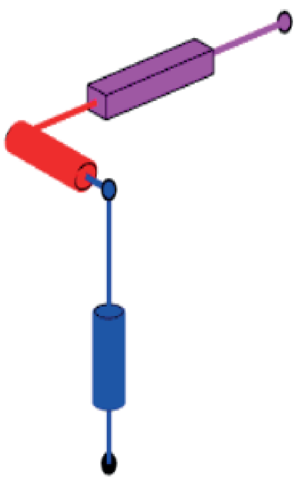
Cobot
Company

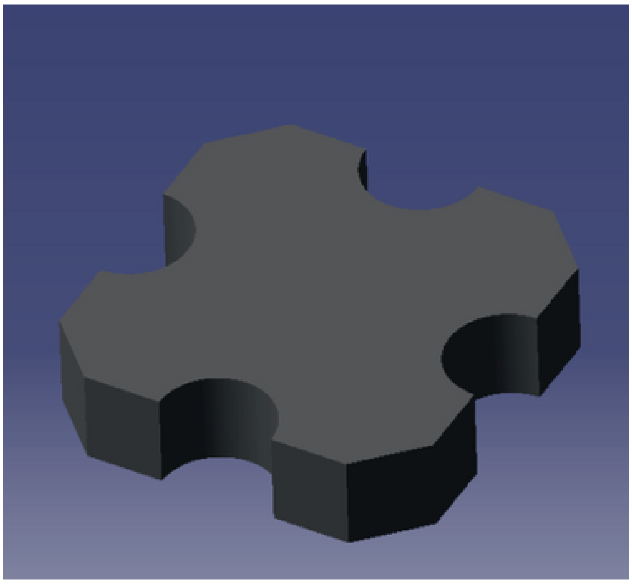
Emma
DURAND
IND

PRESENTING
THE R²P

The R²P is our new revolutionary product. It's a 3DOF cobot with a RRP architecture that can perform 3D printing of a simple object.







CobotCompany

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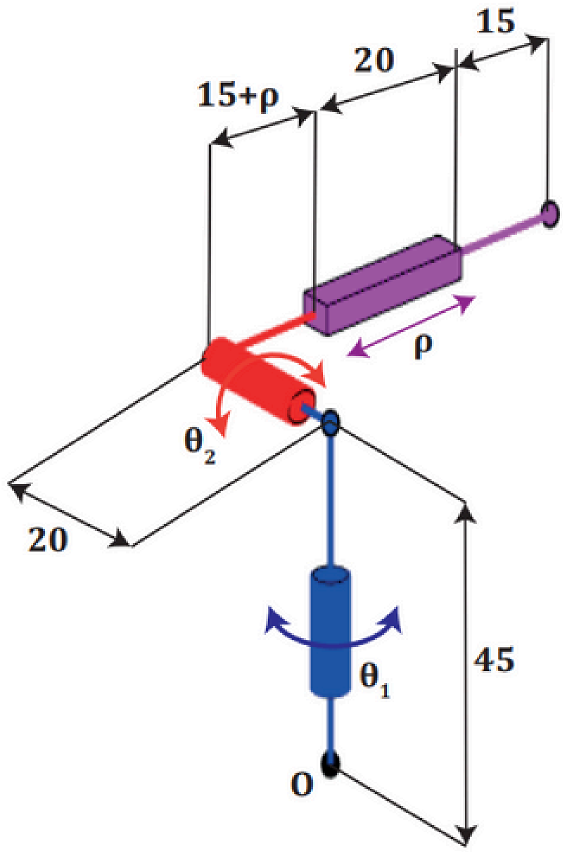
PRESENTATION

In Cobot Company, innovation meets precision

We are specialize in designing and developing advanced robotic solutions tailored for dynamic industrial and research applications.

In this catolog, we are going to present you our knew product especially made for De Vinci Research Center (DVRC) :

The R²P



$\theta_1 \rightarrow [0, 2\pi]$
$\theta_2 \rightarrow [0, \pi]$
$\rho \rightarrow [0, 100]$

The R²P Cobot is a 3-degree-of-freedom (3-DOF) robotic arm designed for high-precision tasks such as 3D printing. While 6-axis cobots are a common solution, their size can be a limitation in practical deployment that's why to simplify the process we choose a more compact 3-DOF configuration.

Unlike traditional 6-axis cobots, the R²P prioritizes simplicity, efficiency, and space optimization without compromising functionality. Its architecture—featuring two rotary joints and one prismatic joint—ensures a perfect balance between flexibility and compactness, making it an ideal candidate for rapid prototyping tasks.

PRESENTATION

To move the robot, it exists two spaces :

- the joint space
- the workspace

We need each one to move the robot and we can use 2 different methods.

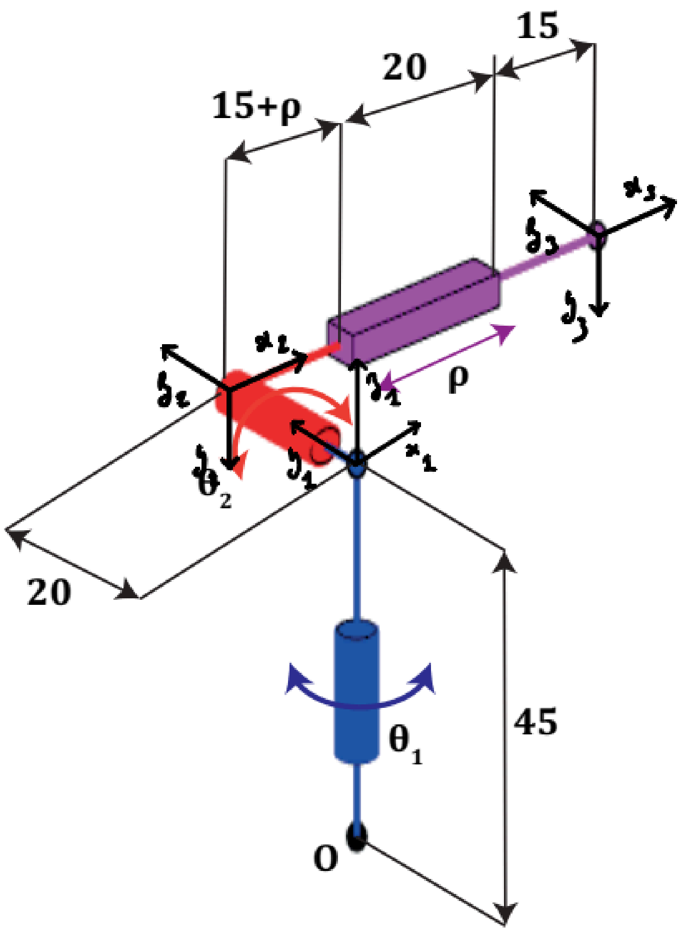
Direct Kinematics (DKP)

DKP calculates the position of the robot's end effector in the workspace with the joint variables of the R²P robot, the Denavit-Hartenberg parameters :

- θ1: Specifies the orientation in the horizontal plane.
- θ2: Determines the vertical tilt or extension.
- ρ: Controls the height of the nozzle.

Denavit-Hartenberg Table:

i	α	r	d	θ
1	0	45	0	θ_1
2	$\pi/2$	25	0	θ_2
3	0	0	50+ρ	0



Direct Kinematics Solution:

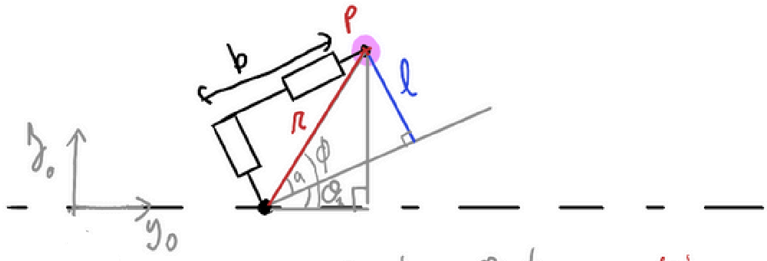
x= 20*sin(θ1) + cos(θ1)*cos(θ2)*(ρ + 50)
y= cos(θ2)*sin(θ1)*(ρ + 50) + 20* cos(θ1)
z = sin(θ2)*(ρ + 50) + 45

PRESENTATION

Inverse Kinematics (IKP)

It's the opposite of DKP. It calculates the joint variables (θ1 , θ2 , ρ) of the R²P robot with the end-effector position(x,y,z) in the workspace.

R²P top view



$a + \theta_1 = \phi \Leftrightarrow \theta_1 = \phi - a$

$$\phi = atan\left(\frac{P_x}{P_y}\right)$$

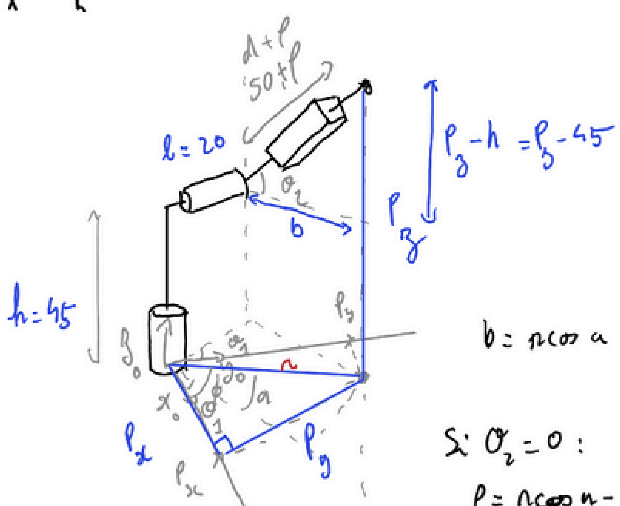
$R = \sqrt{P_x^2 + P_y^2}$ $\quad P = \begin{pmatrix} P_x \\ P_y \\ P_z \end{pmatrix}$

$$a = asin\left(\frac{l}{R}\right)$$

$$a = asin\left(\frac{l}{\sqrt{P_x^2 + P_y^2}}\right)$$

$$\theta_1 = atan\left(\frac{P_x}{P_y}\right) - asin\left(\frac{l}{\sqrt{P_x^2 + P_y^2}}\right)$$

R²P 3D schema view



Inverse Kinematics Solution:

θ1 = atan(x/y)-asin(20/sqrt(x²+ y²))
θ2 = atan(sqrt(x²+ y²)*(20/sqrt(x²+ y²)/z-45)

if θ2 =0 :
ρ = (20/sqrt(x²+ y²))-50
else :
ρ = -(((z-45)/sin(θ2)) + 50)

$b = r\cos a$

Si $\theta_2 = 0$:
$\rho = r\cos a - 50 = b - 50$

Sinon :
$$\rho = -\left(\frac{P_z - 45}{\sin(\theta_2)} + d\right)$$

$$\tan(\theta_2) = \frac{\quad}{P_z - 45} = \frac{r\cos a}{P_z - 45}$$

DKP SIMULATION

As it is show below the R²P robot can be used in Direct Kinematics.

To perform the simulation, we invite you to download ours files directly in our website :

[CobotCompany](https://github.com/EclairOChocolat/Cobotics_Emma_Durand)

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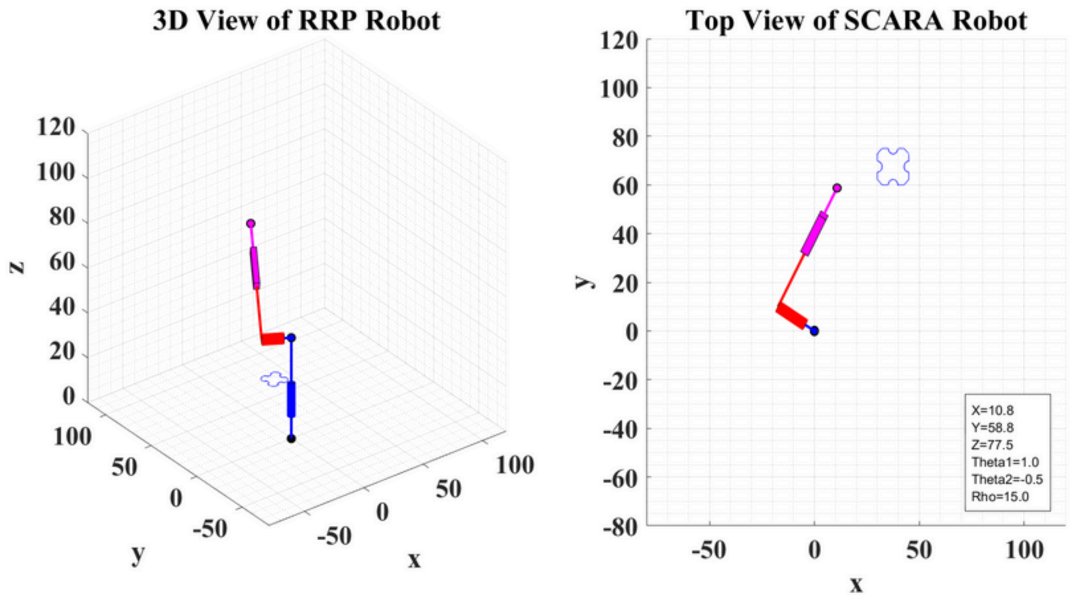


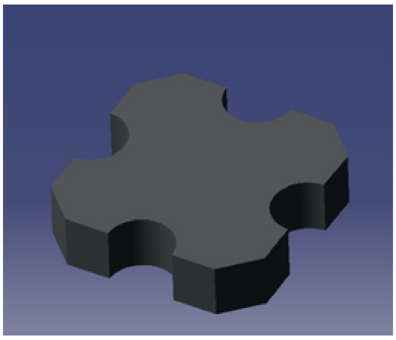
In this simulation, the robot is connected to a controller of frequency 3 Hz.
It begins with the joint variables (θ1 , θ2 , ρ) equals to (0,0,0) and finish at (pi/3, -pi/6, 15).

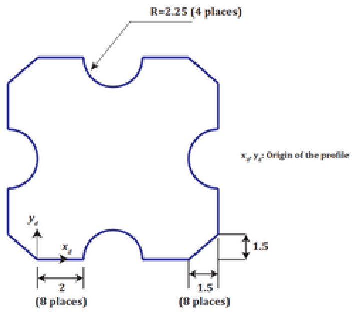
Jacobian Matrix

$$\begin{bmatrix} 20 * cos(\theta_1) - cos(\theta_2) * sin(\theta_1) * (\rho + 50) & -cos(\theta_1) * sin(\theta_2) * (\rho + 50) & cos(q1) * cos(q\theta_2) \\ 20 * sin(\theta_1) + cos(\theta_1) * cos(\theta_2) * (\rho + 50) & -sin(\theta_1) * sin(\theta_2) * (\rho + 50) & cos(\theta_2) * sin(q1) \\ 0 & cos(q2) * (\rho + 50) & sin(\theta_2) \end{bmatrix}$$

3D PRINTING

The piece that we want to print is a very simple one





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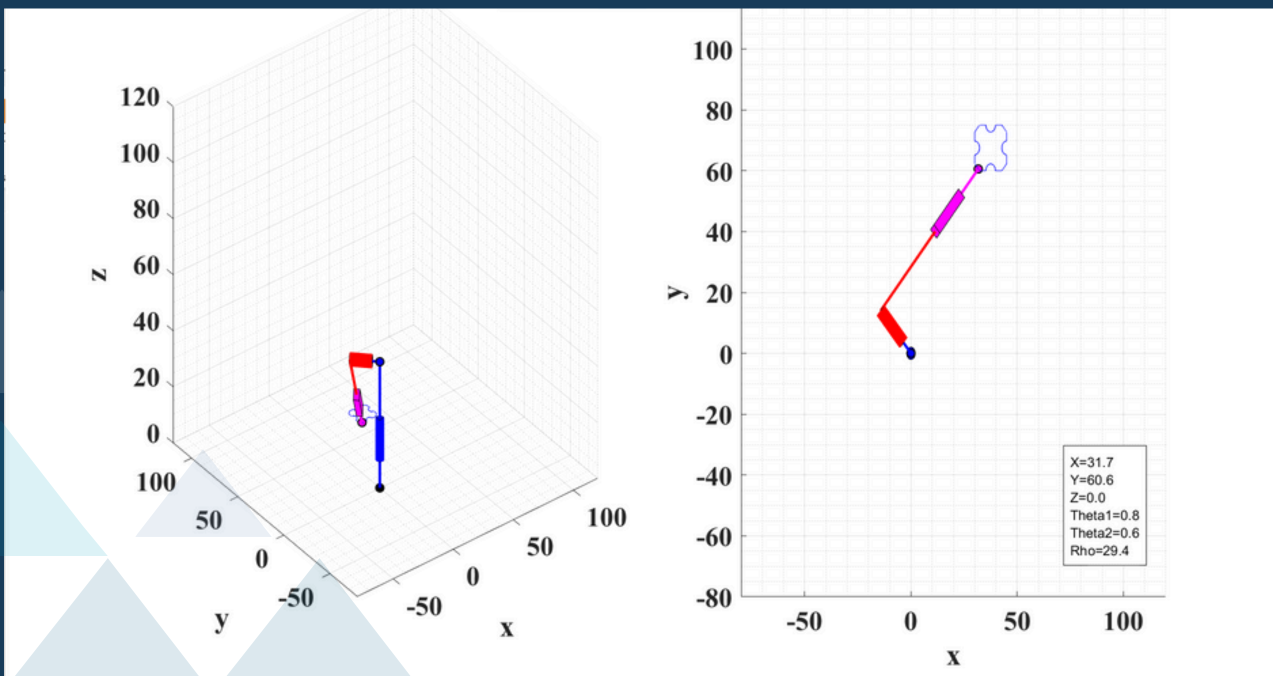

OUR GOAL

In Cobot Company, our goal is to revolutate the world of industry through compact, efficient, and user-friendly robots. We aim to create innovative tools that increase productivity, creativity, and simplify complex processes.

With the R^{2}P Cobot, we strive to bridge the gap between human ingenuity and robotic precision, enabling seamless Human-Robot Interaction (HRI) in 3D printing.

FLEXIBLE

Explore the possibilities of robotic deployment with Cobot Company. Our cobots are lightweight, space saving and easy to re-deploy. The program is open source which makes it ajustable for all your project and your needs.

USER-FRIENDLY

The R^{2}P Cobot is designed with user-friendliness at its core, ensuring that both experts and newcomers can operate it with ease.

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THANK YOU

Thank you for taking the time to explore our catalog and learn about the capabilities of the R²P. At Cobot Company, we are dedicated to delivering innovative and practical solutions to meet your 3D printing and cobotic needs.

We look forward the opportunity to collaborate with De Vinci Research Center (DVRC) and contribute to advancing 3D printing technologies.

Contact Us

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Check our website

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