

Fondamenti di Robotica Manipolatori



UNIMORE
UNIVERSITÀ DEGLI STUDI DI
MODENA E REGGIO EMILIA

Cos'è un manipolatore?



Cos'è un manipolatore?

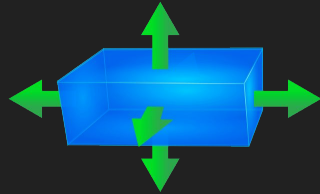


Un **manipolatore robotico** è un **dispositivo meccanico programmabile**, dotato di più **gradi di libertà**, utilizzato per **manipolare oggetti**.

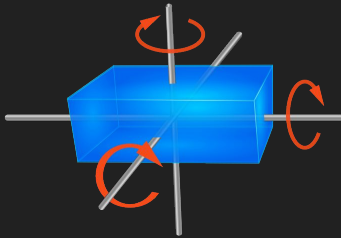


Gradi di libertà (DoF)?

È il **numero di variabili indipendenti** necessarie per determinare univocamente la sua **posizione nello spazio**.



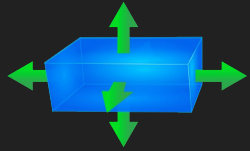
Traslazione



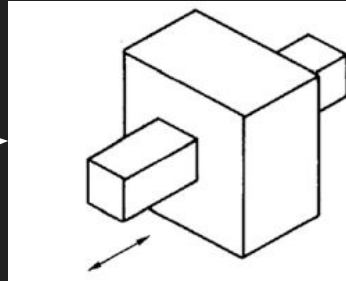
Rotazione

Gradi di libertà (DoF)?

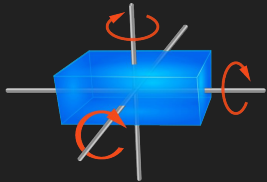
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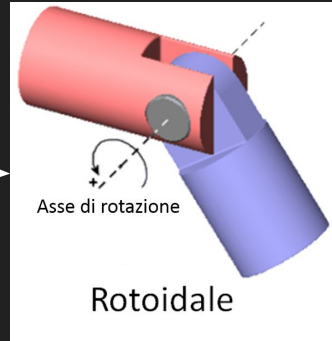
Traslazione



Giunto Prismatico

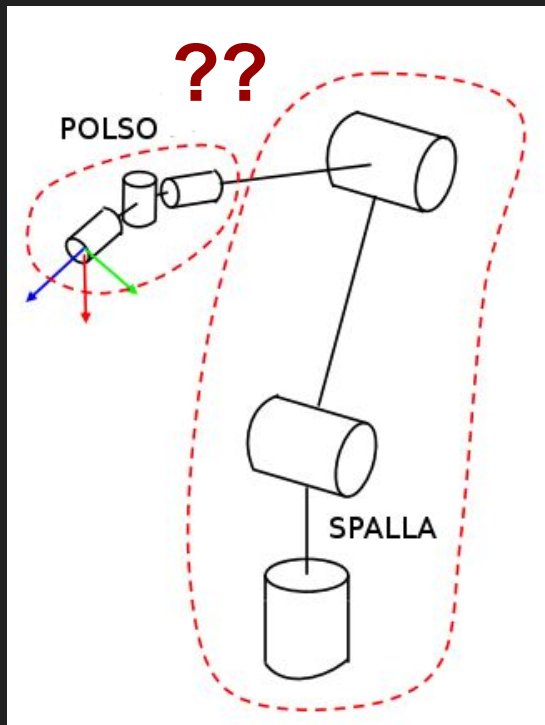


Rotazione

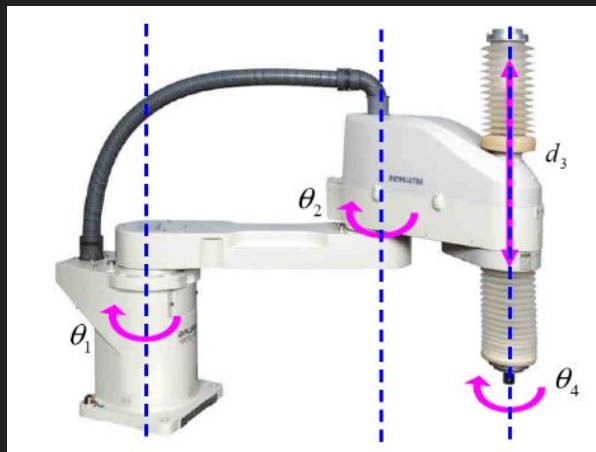


Giunto Rotoidale

Giunti e Assi

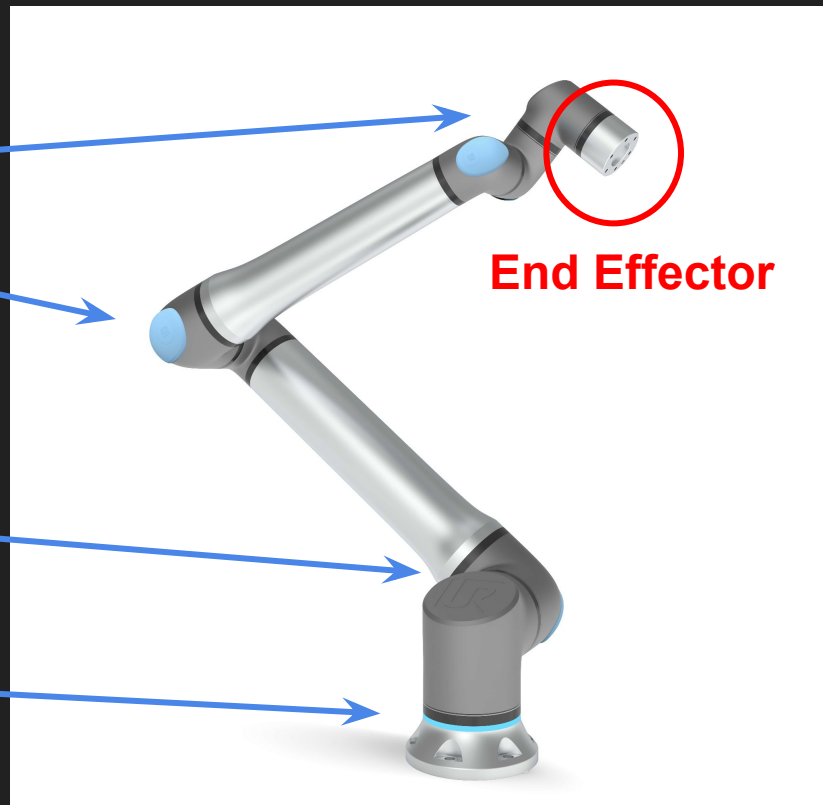
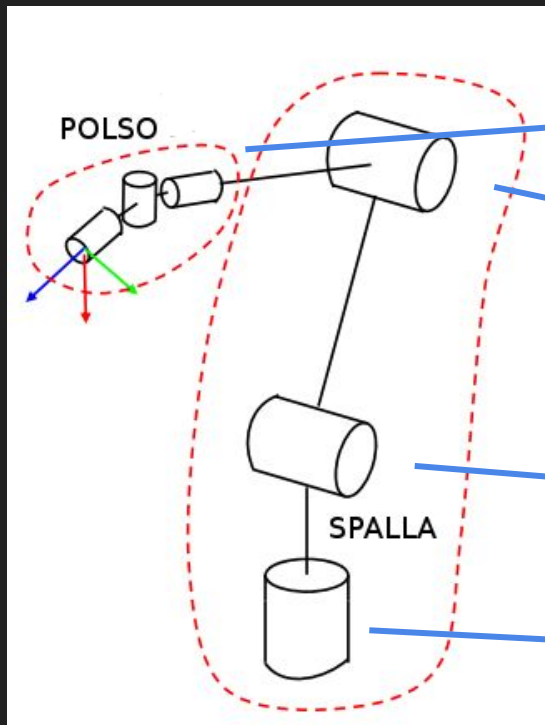


Manipolatore
Cartesiano

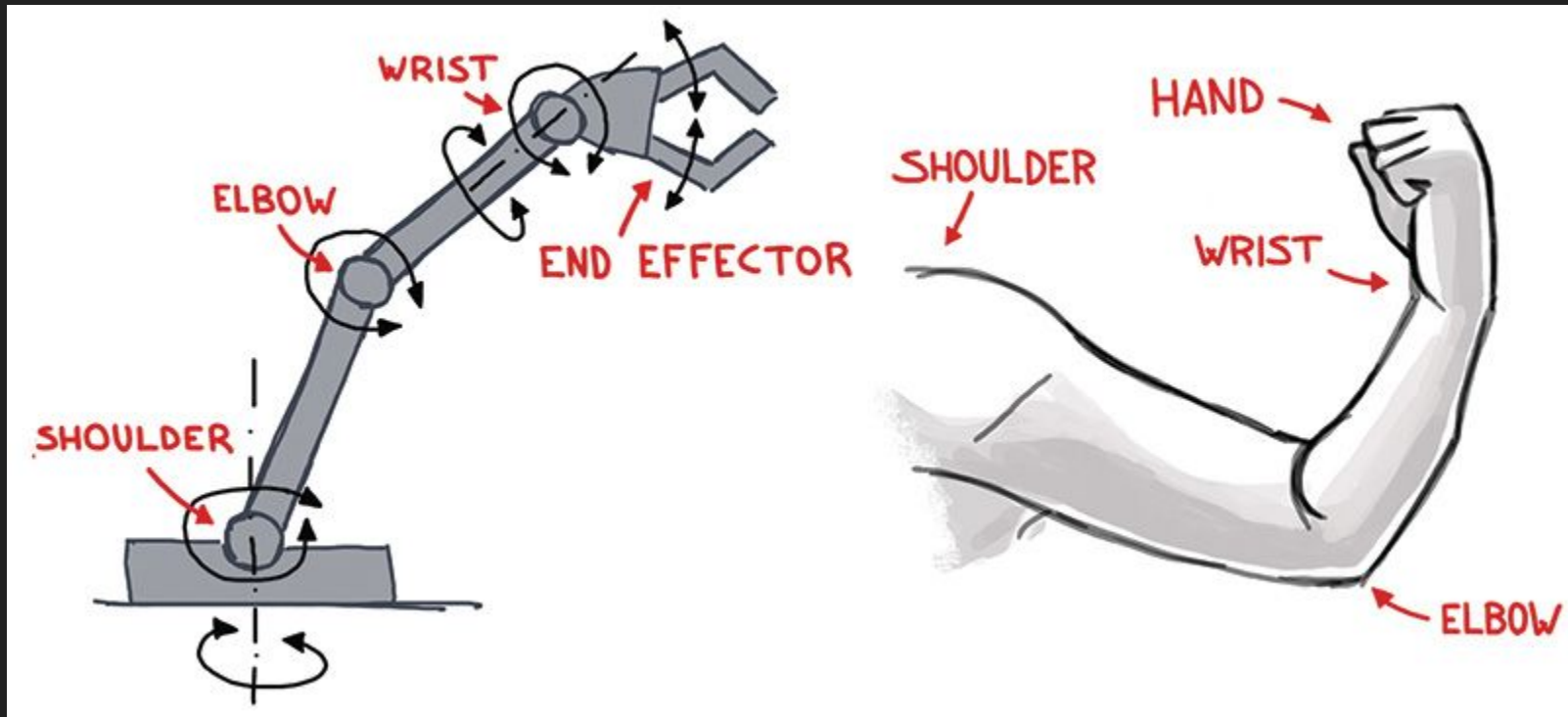


Manipolatore **SCARA**

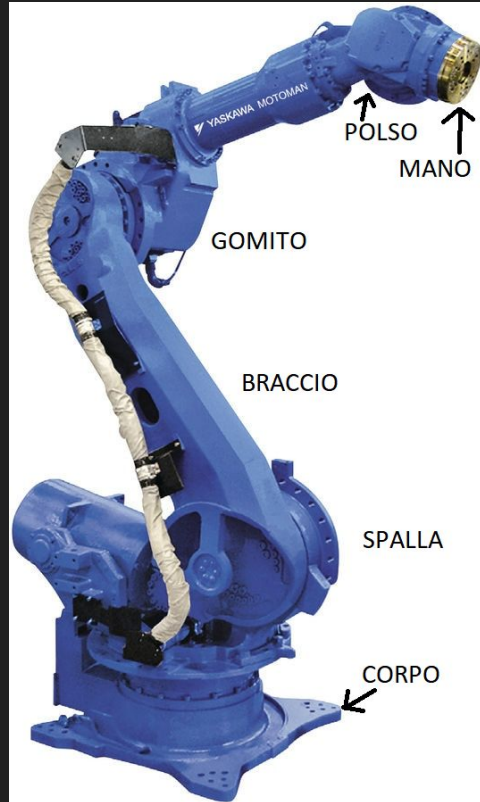
Giunti e Assi



Giunti e Assi

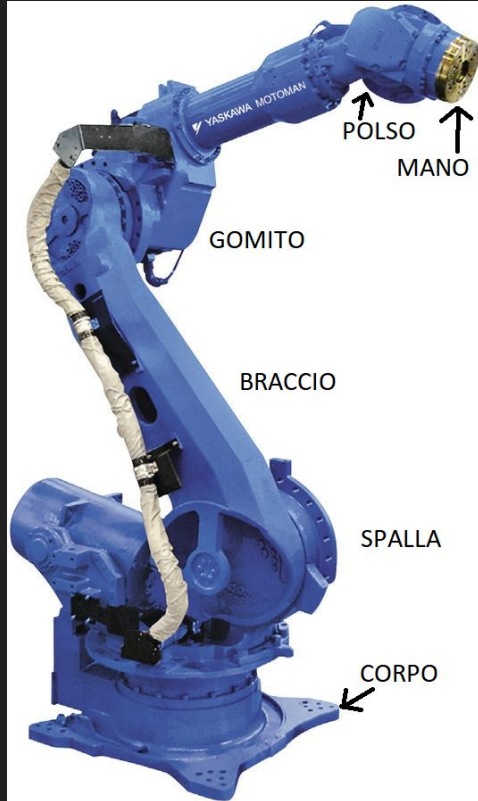


Robot antropomorfi



Quanti **gradi di libertà** ha?
Pensate al vostro braccio

Robot antropomorfi

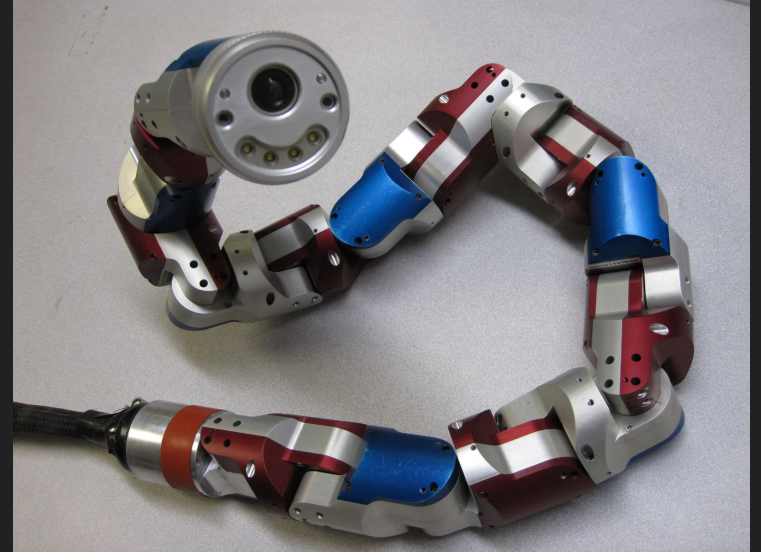
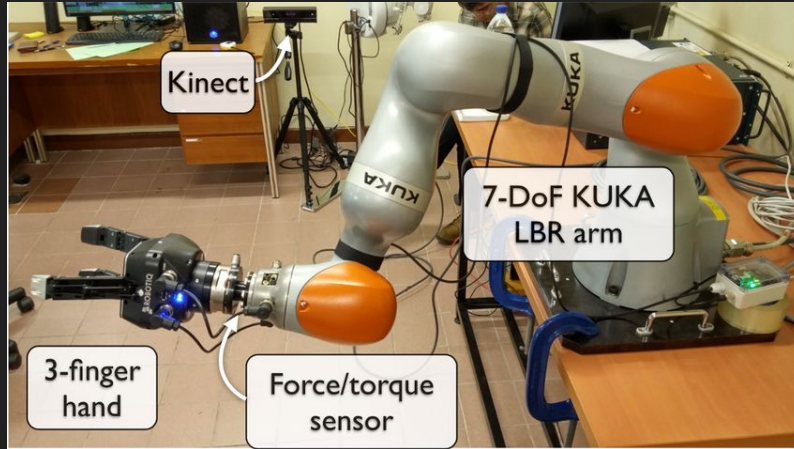


Quanti **gradi di libertà** ha?
Pensate al vostro braccio

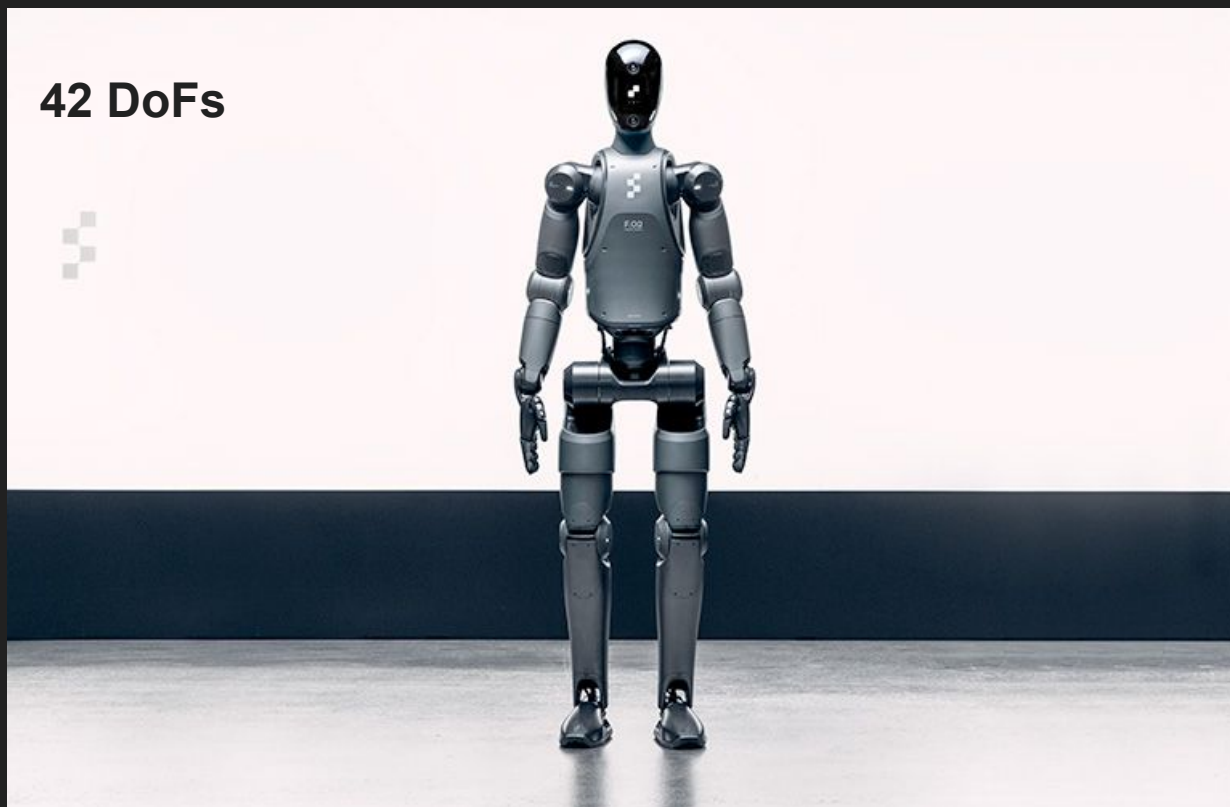
Almeno 6, e se ne ha di più?

Robot ridondanti

+ gradi di libertà == + libertà di movimento



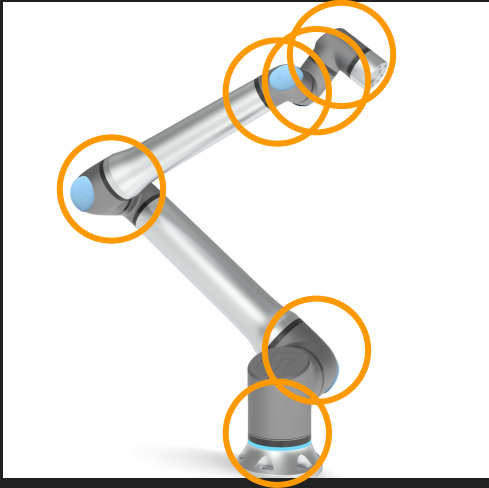
Robot ridondanti



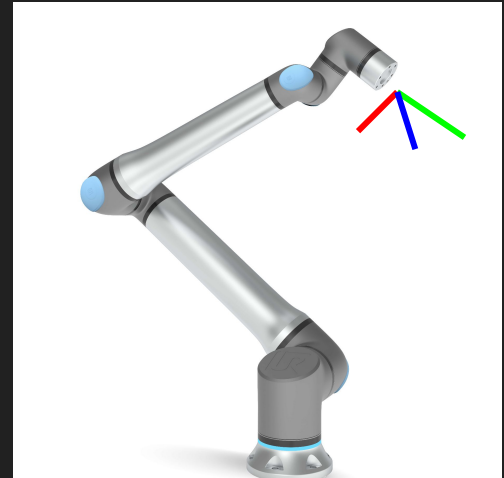
Configurazione di un robot

Ne descrive il suo **STATO**

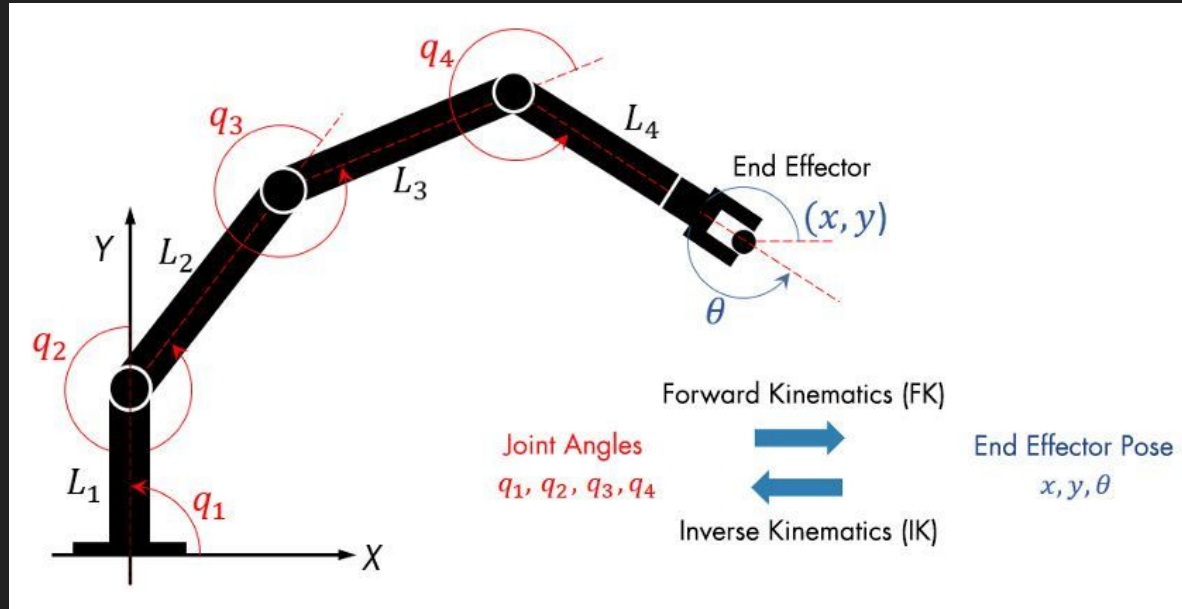
Si può esprimere in termini di
GIUNTO



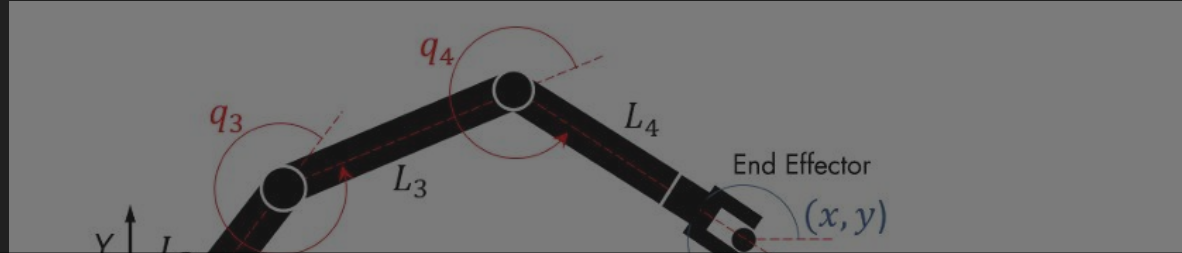
Si può esprimere in termini di
POSA



Cinematica diretta e indiretta



Cinematica diretta e indiretta

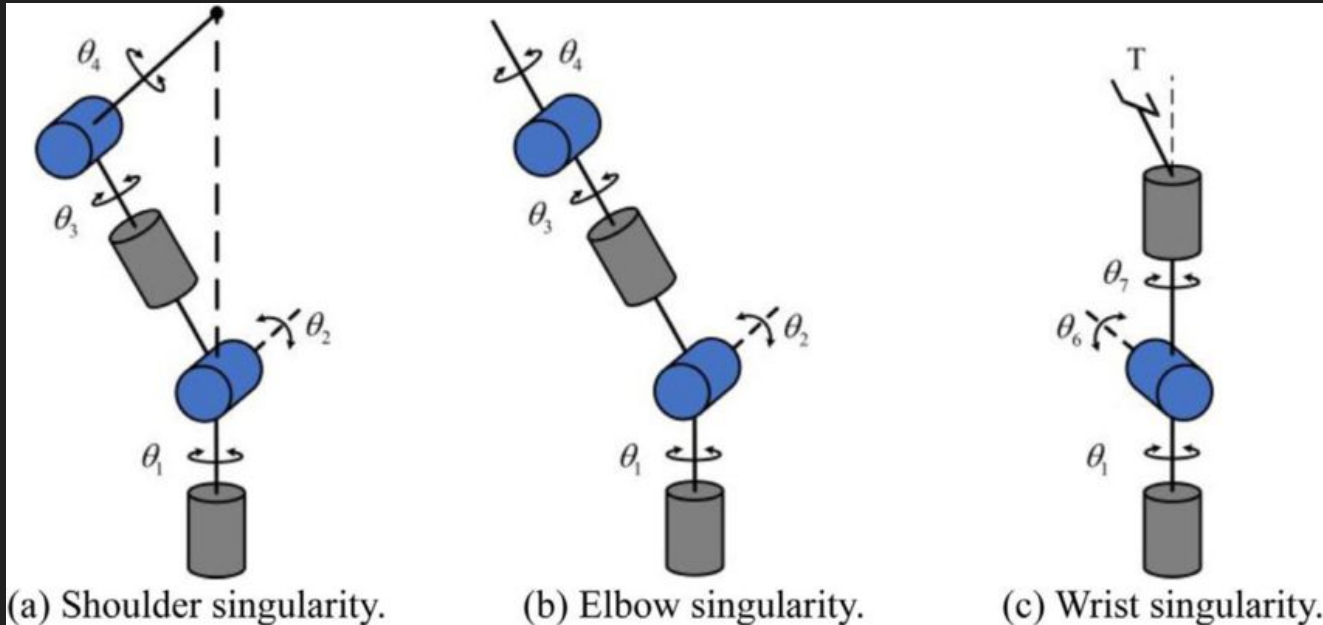


La cinematica inversa (IK) è difficile da risolvere



Configurazione di singolarità

È una configurazione in cui si **PERDE** un grado di libertà



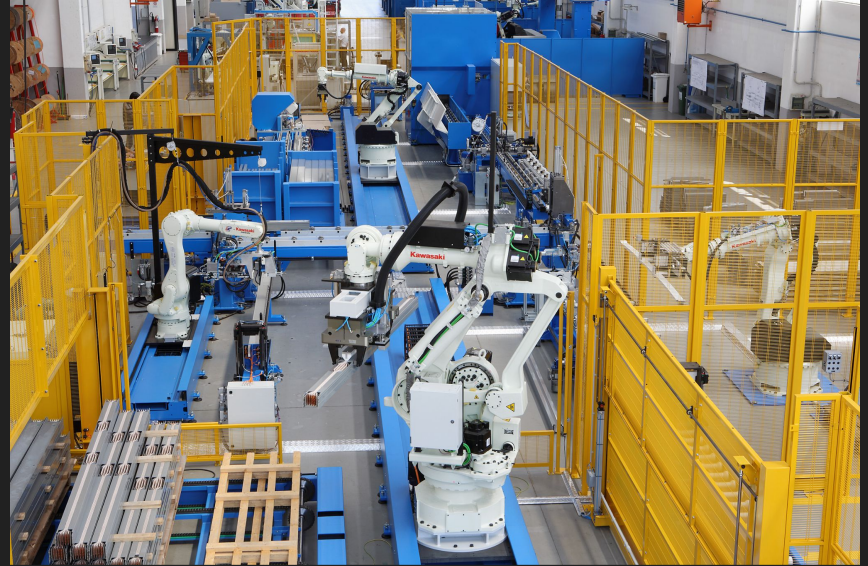
Una grande distinzione



Una grande distinzione



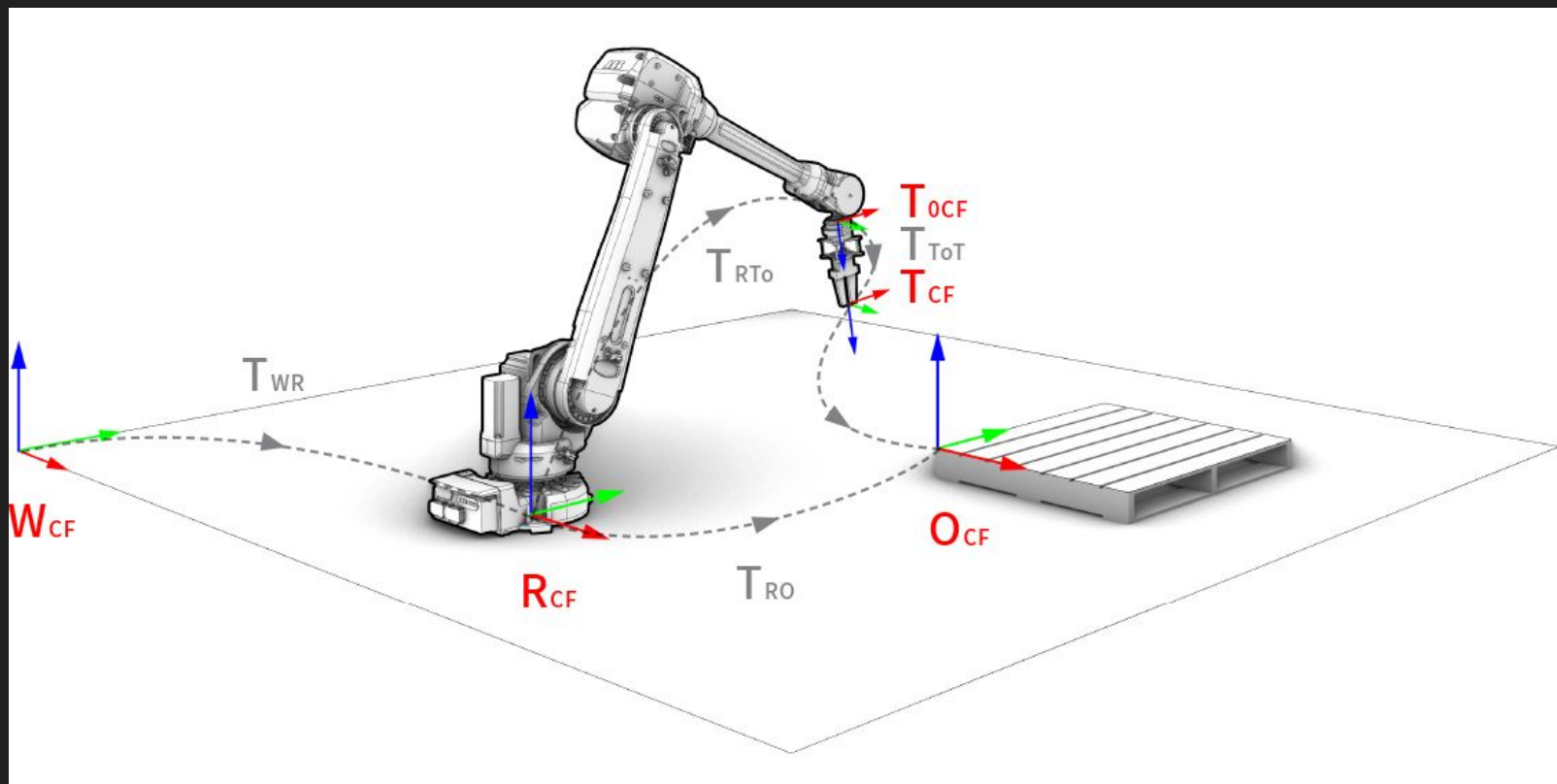
Robot Collaborativi (COBOT)



Robot Industriali



Sistemi di riferimento



Kahoot!

Niryo Studio

Connessione al robot:

- WiFi
- Hotspot (WiFi del robot)
- Ethernet (con cavo)

Prima cosa da fare: **Calibrazione**

Cosa **NON** fare con il robot

- **Sbattere contro oggetti** - chi rompe paga (in gruppo) :(ul> - Succede spesso, ma attenzione!
- Spegnerlo staccando l'alimentazione se non in caso di emergenza
- Farlo passare per delle singolarità
- Modificare le impostazioni di connessione (IP e nome del robot)
- Staccare cavi e modificare hardware



Niryo Robot b2-5c2-8f0 ● Connected ⓘ 📶 Hotspot 🔌 Disconnect

🟢 Calibration OK

My connected equipments

➕ New scan



Standard gripper
✓ Detected

Settings

⚡ Missing tools you'd like to use and go beyond today's capacities?

Shop now

My latest programs

See all

circle_example

Description

ned2 | App | Python 3

Saved 1/12/25, 3:12 PM



Open Python

movements

Programma semplice

ned2 | App | Python 3

Saved 1/12/25, 3:12 PM



Open Python

pick_and_place

Description

ned2 | App | Python 3

Saved 1/12/25, 3:12 PM



Open Python

Ned2_demo

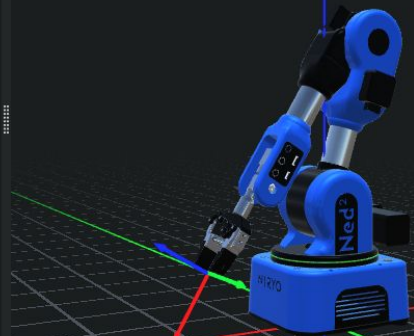
A small demonstration program to show the Ned2 capabilities

ned2 | Robot | Python 3

Saved 10/18/23, 12:36 PM



Open Python



☒ Base ☒ TCP

⊖ New Frames

Joints (rad)

J1: 0.001	J2: 0.299	J3: -1.301	J4: 0.000	J5: -0.000	J6: -0.003
-----------	-----------	------------	-----------	------------	------------

Base ^

Position (mm)

X: 179.998	Y: 0.142	Z: 93.452
------------	----------	-----------

Orientation (rad)

R: -0.003	P: 1.001	Y: 0.001
-----------	----------	----------

TCP Speed (ms) 0.000

Direct Move

Per controllare direttamente il robot o prendere informazioni necessarie:

- TCP position (Tool Center Point)
- Joint Position
- Muovere il robot in modo preciso



Direct move

New Open Save

App

Move mode ☒ Set up and play ☐ Real time

Joint Position

TCP Position

FreeMove

Joints

J1 - Base

-2.99

0.001

2.99

0.001

rad

J2 - Shoulder

-1.83

0.299

0.61

0.299

rad

J3 - Elbow

-1.34

-1.301

1.57

-1.301

rad

J4 - Forearm Rotation

-2.09

0.000

2.09

0.000

rad

J5 - Wrist

-1.92

0.000

1.92

0.000

rad

J6 - Hand Rotation

-2.53

-0.003

2.53

-0.003

rad

Current position

Need more informations about your robot joints ?

Learn more

Arm speed

100

 100 %

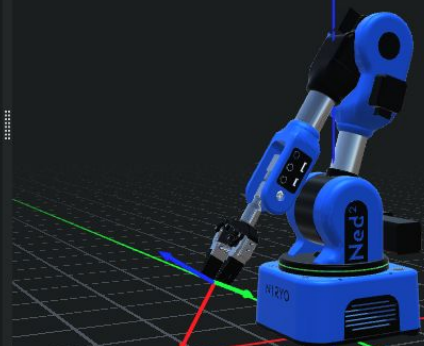
Standard gripper

Open

Close

Home position

Play



☒ Base ☒ TCP ☐ New Frame

Joints (rad)

J1: 0.001	J2: 0.299	J3: -1.301	J4: 0.000	J5: -0.000	J6: -0.003
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Base ^

Position (mm)

X: 179.998	Y: 0.142	Z: 93.452
------------	----------	-----------

Orientation (rad)

R: -0.003	P: 1.001	Y: 0.001
-----------	----------	----------

TCP Speed (ms) 0.000

Equipment

Per controllare gli accessori collegati al robot e la scheda di controllo (I/O)



Standard gripper

✓ Connected

Open

Close

Gripper settings

Open torque

100

100

%

Closed torque

100

100

%

Hold torque (open)

100

100

%

Hold torque (closed)

100

100

%



Equipment

Accessories

Input / Output

Digital Input
Panel

DI - 1

DI1



DI - 2

DI2



DI - 3

DI3



DI - 5

DI5



End Effector

DI - 4

DI4



Digital Output
Panel

DO - 1

DO1



On

Off

DO - 2

DO2



On

Off

DO - 3

DO3



On

Off

End Effector

DO - 4

DO4



On

Off

Analog Input

AI - 1

0V

5V

0.02 V

AI - 2

0V

5V

0.02 V

Analog Output

AO - 1

0

0V

5V

0

V

AO - 2

0

0V









5V


0

V


My Robot


N







My robot

Niryo Robot b2-5c2-8f0 

 New calibration

 Shutdown

 Reboot

Information

Settings

Raspberry Pi

Available disk size on SD card: 16172 MB

Purge ROS logs


Logs size on SD card: 29 MB

Purge ROS logs on start up: ☒

Purge (> 50 MB)


Application version

Current app version 1.7.1

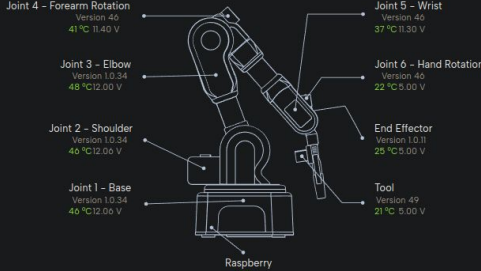
App logs 

Robot software version

Current software version 5.6.2-b04

Robot logs 

Hardware status



Joint 4 - Forearm Rotation

Version 4b

41 °C 11.40 V

Joint 3 - Elbow

Version 1.0.34

48 °C 12.00 V

Joint 2 - Shoulder

Version 1.0.34

46 °C 12.00 V

Joint 1 - Base

Version 1.0.34

46 °C 12.00 V

Raspberry

47 °C

Joint 5 - Wrist

Version 4b

37 °C 11.30 V

Joint 6 - Hand Rotation

Version 4b

22 °C 5.00 V

End Effector

Version 1.0.11

25 °C 5.00 V

Tool

Version 49

21 °C 5.00 V

Tool reboot

Reboot motors

Feedback sulla lezione?

