

Collaborative robots in ROS

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About EIT Manufacturing



EIT Manufacturing

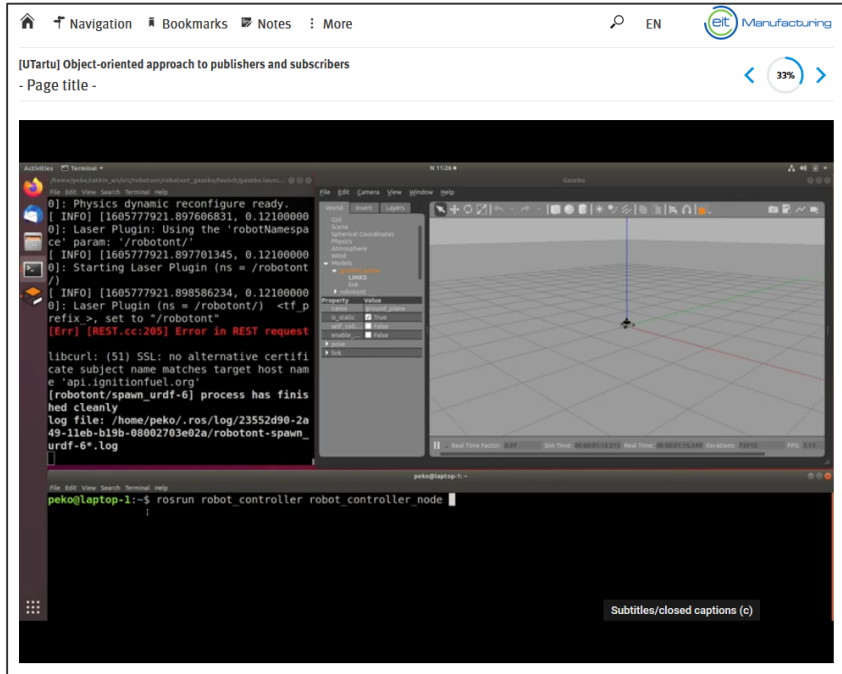
- Pan-European consortium
 - <https://eitmanufacturing.eu/partners>
- Three pillars:
 - Innovation
 - Business Creation
 - Education



Digital learning on GLP (Guided Learning Platform)

- Pan-European digital learning platform
- Starting from this year (2020), European universities and companies are developing learning nuggets
- Access to learning nuggets is free of charge
- Certificates for a fee

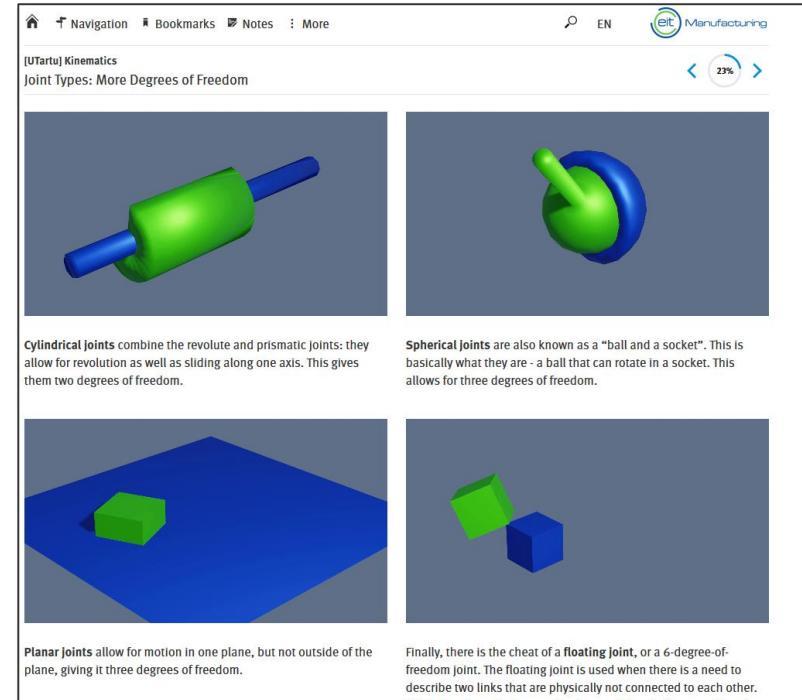
Preview of the GLP



The screenshot displays a ROS2 environment. At the top, there is a navigation bar with 'Navigation', 'Bookmarks', 'Notes', and 'More' options, along with a search icon and 'EN' language setting. Below this, the page title is '[U Tartu] Object-oriented approach to publishers and subscribers - Page title -'. The main content area is a terminal window showing the following logs:

```
0]: Physics dynamic reconfigure ready.  
[ INFO ] [166577921.897606831, 0.12100000  
0]: Laser Plugin: Using the 'robotNamespa  
ce' param: '/robotont/'  
[ INFO ] [166577921.897701345, 0.12100000  
0]: Starting Laser Plugin (ns = '/robotont  
)  
[ INFO ] [166577921.898586234, 0.12100000  
0]: Laser Plugin (ns = '/robotont/) <tf_p  
refix>, set to '/robotont'  
[Err] [REST.cc:205] Error in REST request  
libcurl: (51) SSL: no alternative certifi  
cate subject name matches target host nam  
e 'api.ignitionfuel.org'  
[robotont/spawn_urdf-6] process has finis  
hed cleanly  
log file: /home/peko/.ros/log/23552d90-2a  
49-11eb-b19b-08002703e02a/robotont-spawn  
_urdf-6-.log
```

Below the terminal, a command is entered: `peko@laptop-1:~$ rosrn robot_controller robot_controller_node`. The 3D visualization shows a robot arm in a grey environment with a grid floor. The interface includes a 'Layers' panel on the right and a 'Subtitles/closed captions (c)' button at the bottom.



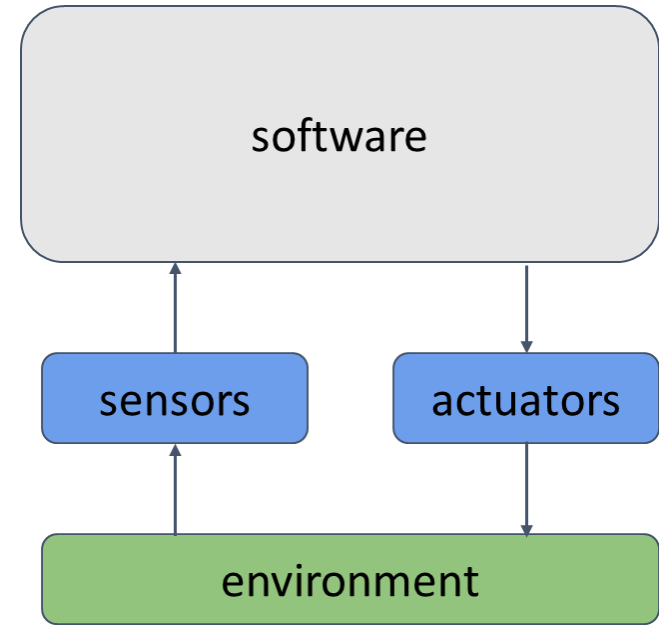
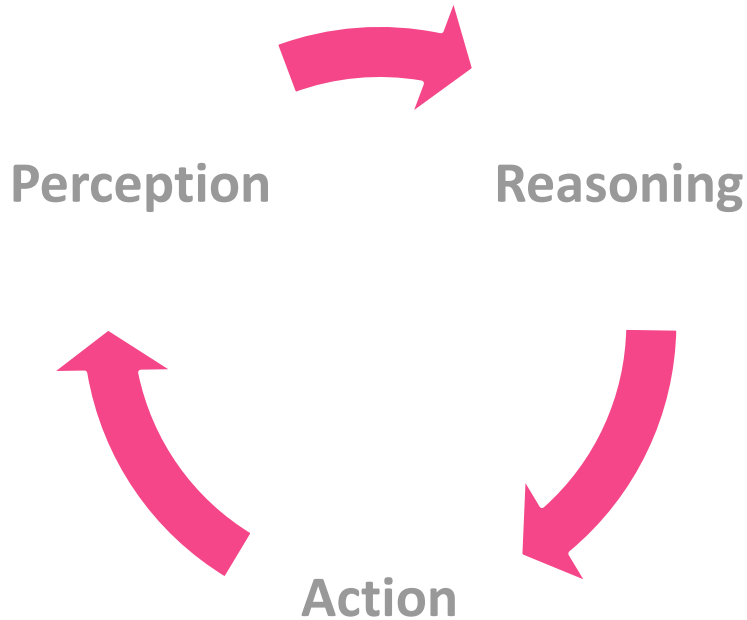
The presentation slide is titled 'Joint Types: More Degrees of Freedom' and features four images of joints with corresponding text descriptions:

- Cylindrical joints** combine the revolute and prismatic joints: they allow for revolution as well as sliding along one axis. This gives them two degrees of freedom.
- Spherical joints** are also known as a "ball and a socket". This is basically what they are - a ball that can rotate in a socket. This allows for three degrees of freedom.
- Planar joints** allow for motion in one plane, but not outside of the plane, giving it three degrees of freedom.
- Finally, there is the cheat of a **floating joint**, or a 6-degree-of-freedom joint. The floating joint is used when there is a need to describe two links that are physically not connected to each other.

Collaborative robots and ROS



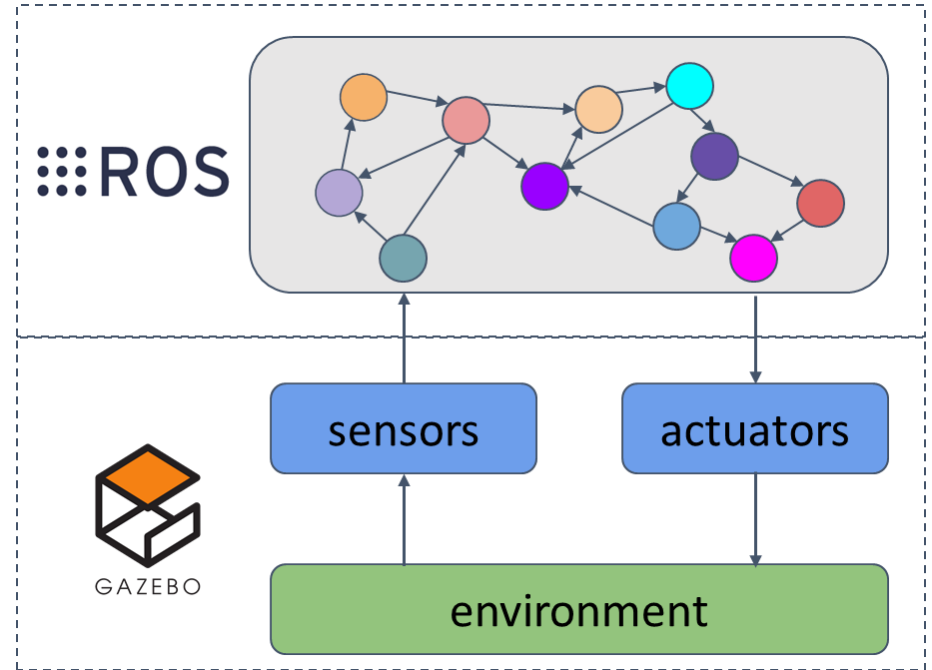
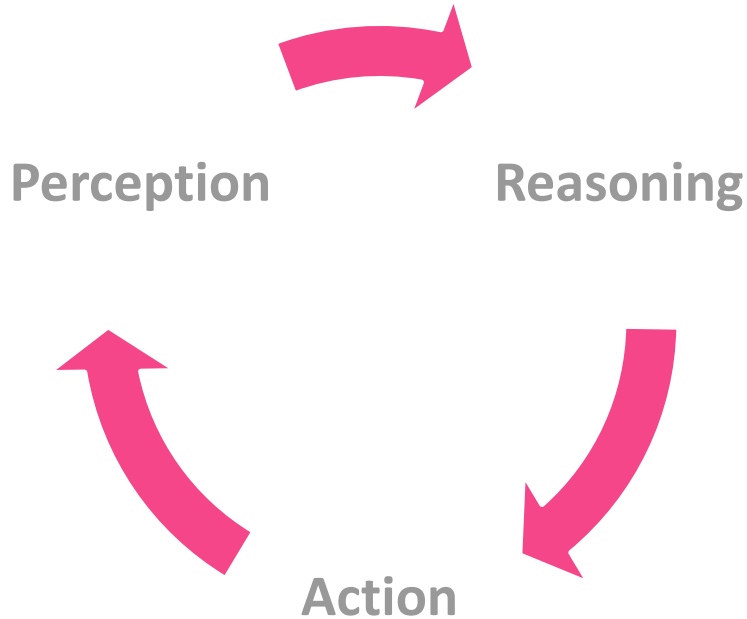
Functional description of a robot



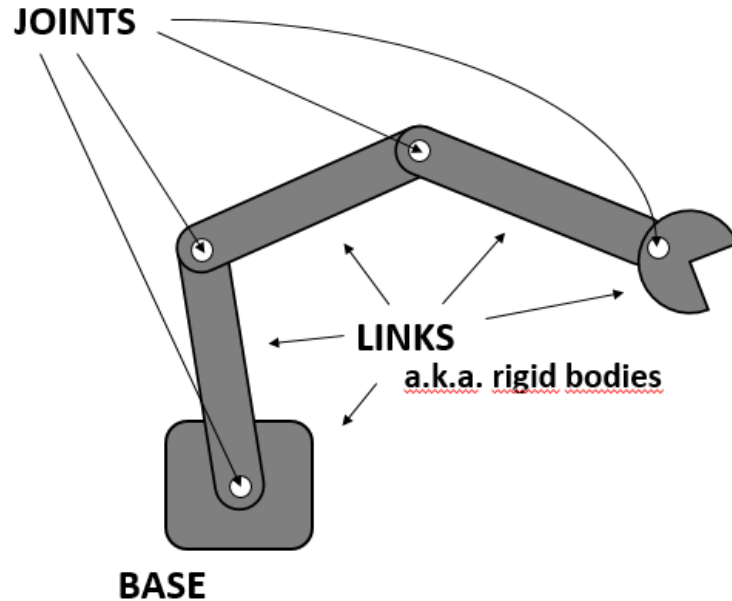
What is ROS

- Open-source solution for implementing cutting-edge robotics software
- Unified framework for integrating hardware from different manufacturers
- Easy-to-use existing functionality, i.e., modular approach for re-using previous code
- Huge selection of amazing development tools for robot builders

Functional description of a robot (revisited)



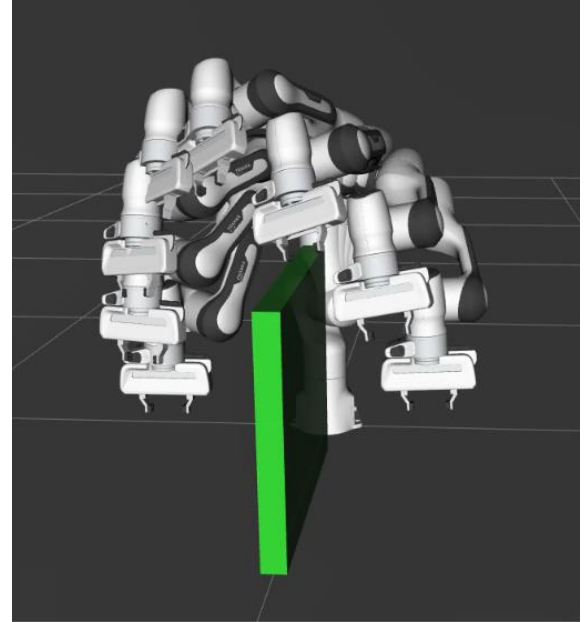
Components of manipulator robots



An END EFFECTOR is the device at the end of a robotic arm, designed to interact with the environment. The exact nature of this device depends on the application of the robot.

What is motion planning

- Finding a collision-free path that guides the tool from point A to B
- In addition to external object-avoidance, every tool pose along this path must be kinematically feasible for the give manipulator
- The resulting path is converted into series of joint values for every joint of the manipulator

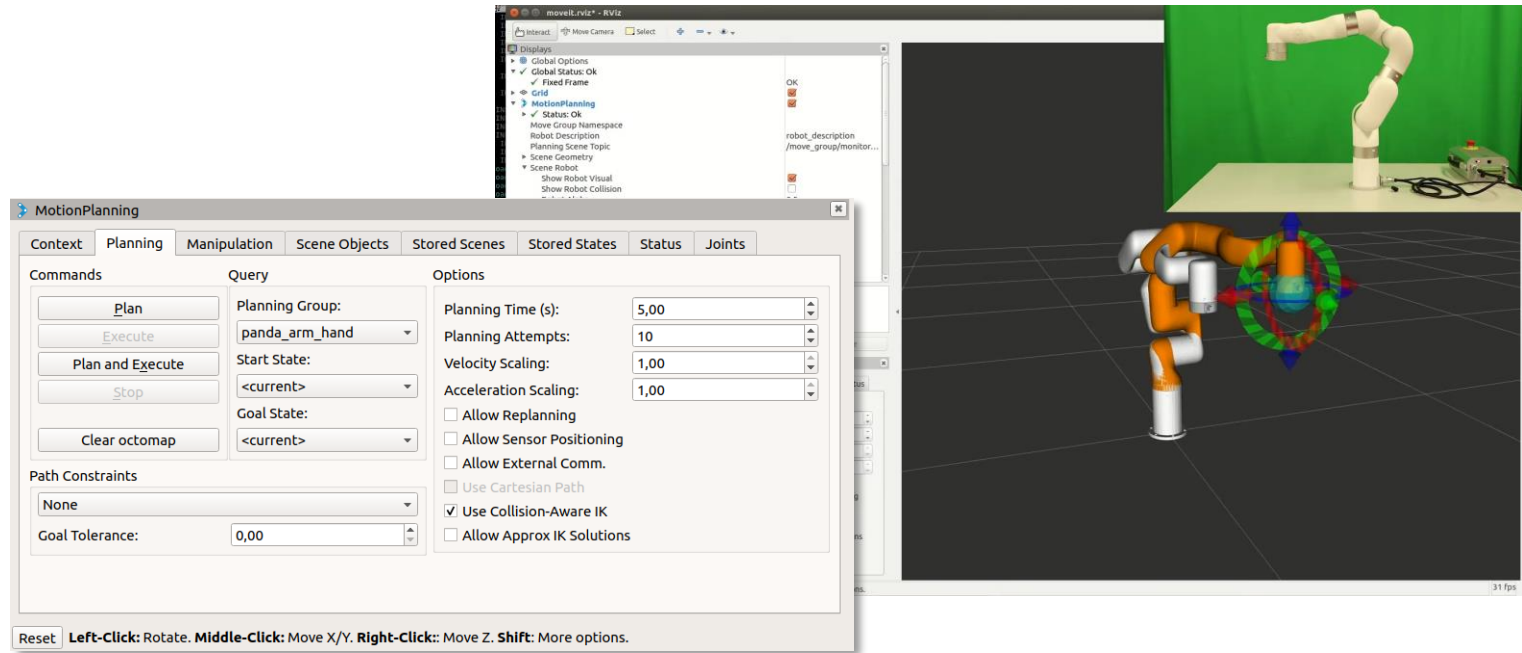


MoveIt

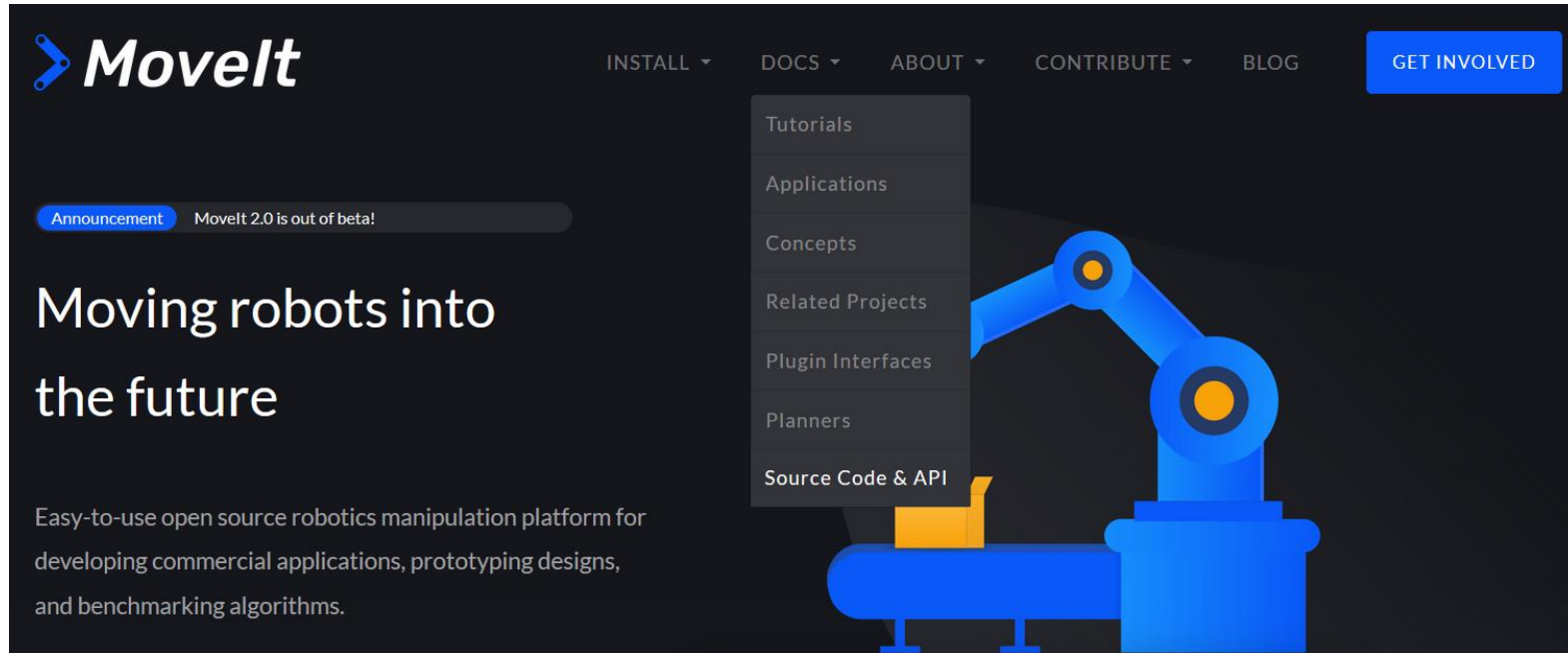
- moveit.ros.org
- Easy-to-use robotics manipulation platform for developing applications, evaluating designs, and building integrated products
- It binds together robot description, computations of kinematics, algorithms of motion planning, graphical user interface, and ROS

Movelt GUI

- Nugget „Operating xArm7 with Movelt GUI“ is available on the GLP



MoveGroup C++ API web page



The screenshot shows the MoveIt website homepage. At the top left is the MoveIt logo, which consists of a blue robot arm icon followed by the text "MoveIt" in white. To the right of the logo is a navigation menu with the following items: "INSTALL", "DOCS", "ABOUT", "CONTRIBUTE", and "BLOG". A blue button labeled "GET INVOLVED" is positioned to the right of the navigation menu. Below the navigation menu, there is a dark grey announcement bar with a blue "Announcement" label and the text "MoveIt 2.0 is out of beta!". The main heading is "Moving robots into the future" in white. Below the heading is a paragraph: "Easy-to-use open source robotics manipulation platform for developing commercial applications, prototyping designs, and benchmarking algorithms." On the right side of the page, there is a blue robotic arm illustration. A dark grey dropdown menu is open over the arm, listing the following items: "Tutorials", "Applications", "Concepts", "Related Projects", "Plugin Interfaces", "Planners", and "Source Code & API".

Our tasks today!

Let's complete the following nuggets from the GLP:

- 1) Connecting to xArm7 via network cable
- 2) Operating xArm7 collaborative robot with xArmStudio
- 3) Operating xArm7 with MoveIt GUI
- 4) Pick-and-place task with xArm7

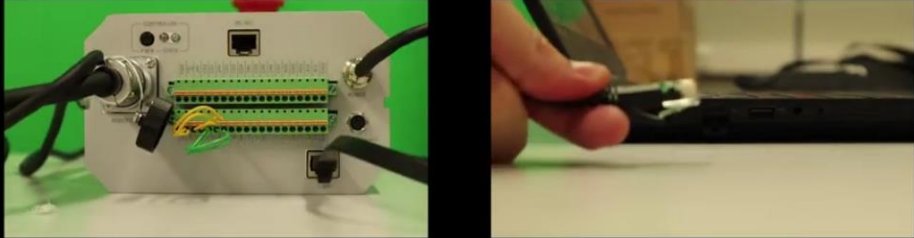
Connecting to xArm7 via network cable

Navigation Bookmarks Notes More

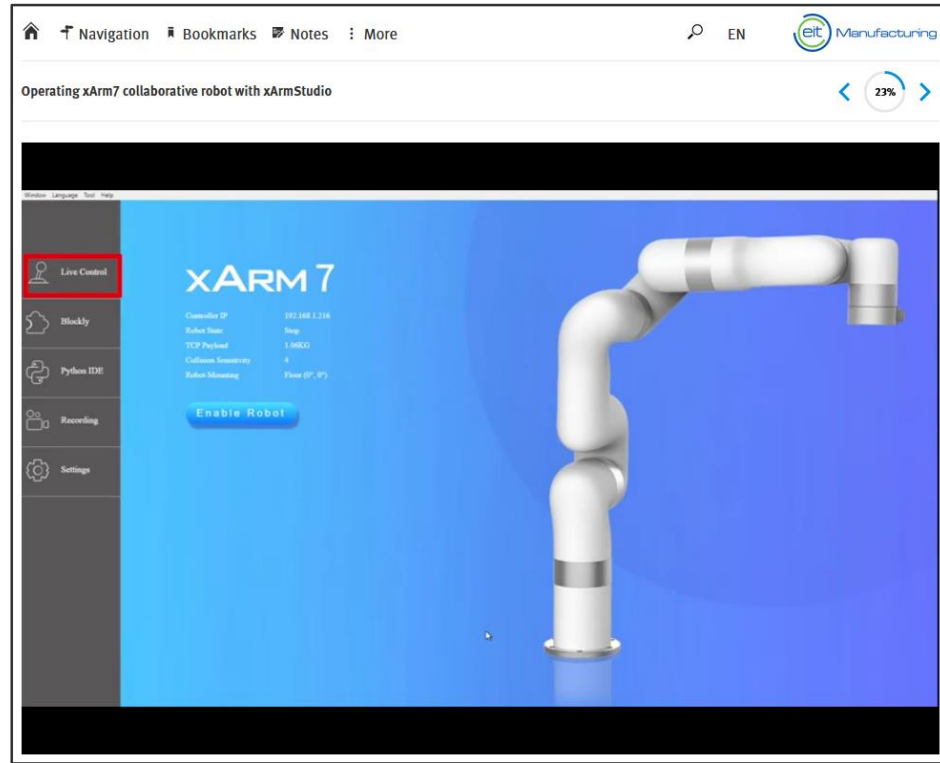
EN eit Manufacturing

Connecting to xArm7 via network cable 38%

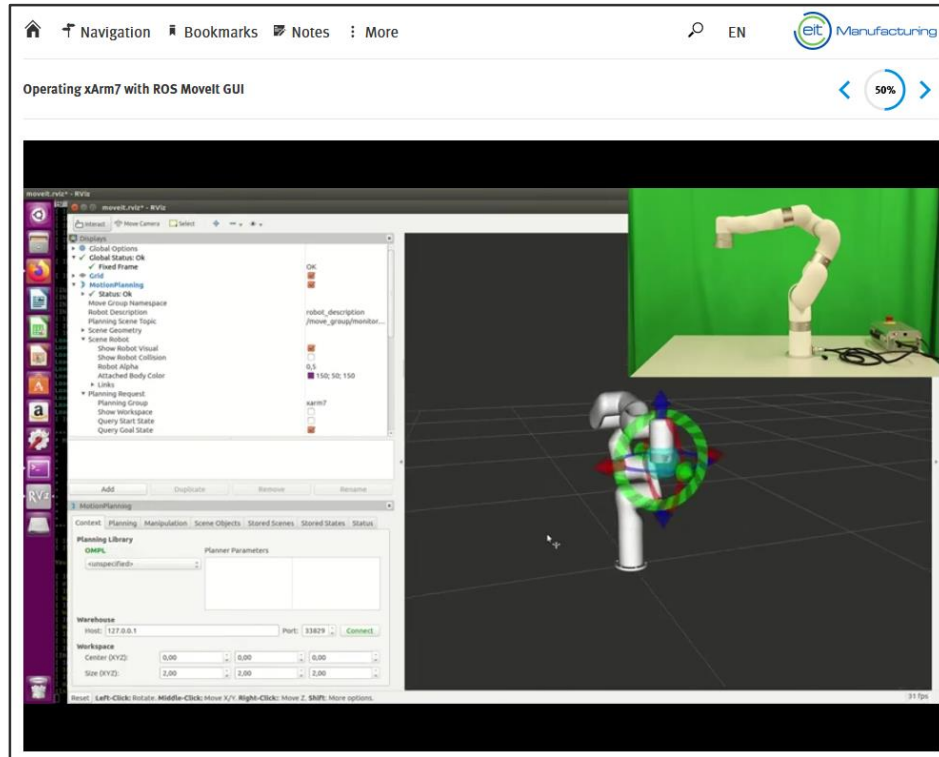
Step 1: Connect the computer with xArm7 controller using a network cable.



Operating xArm7 collaborative robot with xArmStudio




Operating xArm7 with Movelt GUI




Pick-and-place task with xArm7

🏠 Navigation | 📖 Bookmarks | 📝 Notes | ⋮ More

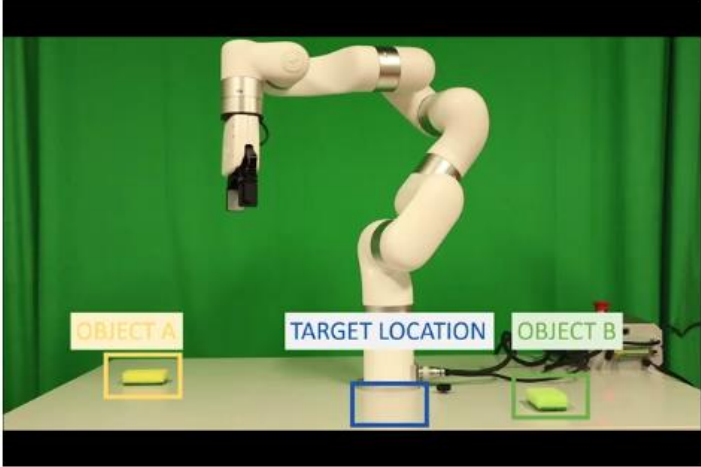
🔍 EN 

Pick-and-place task with xArm7 ◀ 0% ▶

Welcome!

 **Action**

Create a program that makes the xArm7 execute the procedure demonstrated in the video on the right. The task is considered successfully completed when the manipulator picks up two sponges from two different locations and places the sponges on top of each other in the third location.



Conclusions and Thank you!

- More information: <http://m-nest-ris.eu>



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