A ROS 2 Package for Online Cobots Impedance Modulation

Liana Bertoni[1,2], Luca Muratore[1], and Nikos Tsagarakis[1]

[1] Humanoids and Human Centered Mechatronics (HHCM), Istituto Italiano di Tecnologia, Genova, Italy
[2] Dipartimento di Ingegneria Informatica (DII), University of Pisa, Pisa, Italy

Flexibility Adaptability

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At this purpose:

we propose a **ROS2 package** aimed to unlock
flexibility and **adaptability** of robot behaviors and interactions
by exploiting a **variable impedance modulation** targeting
human-robot applications.

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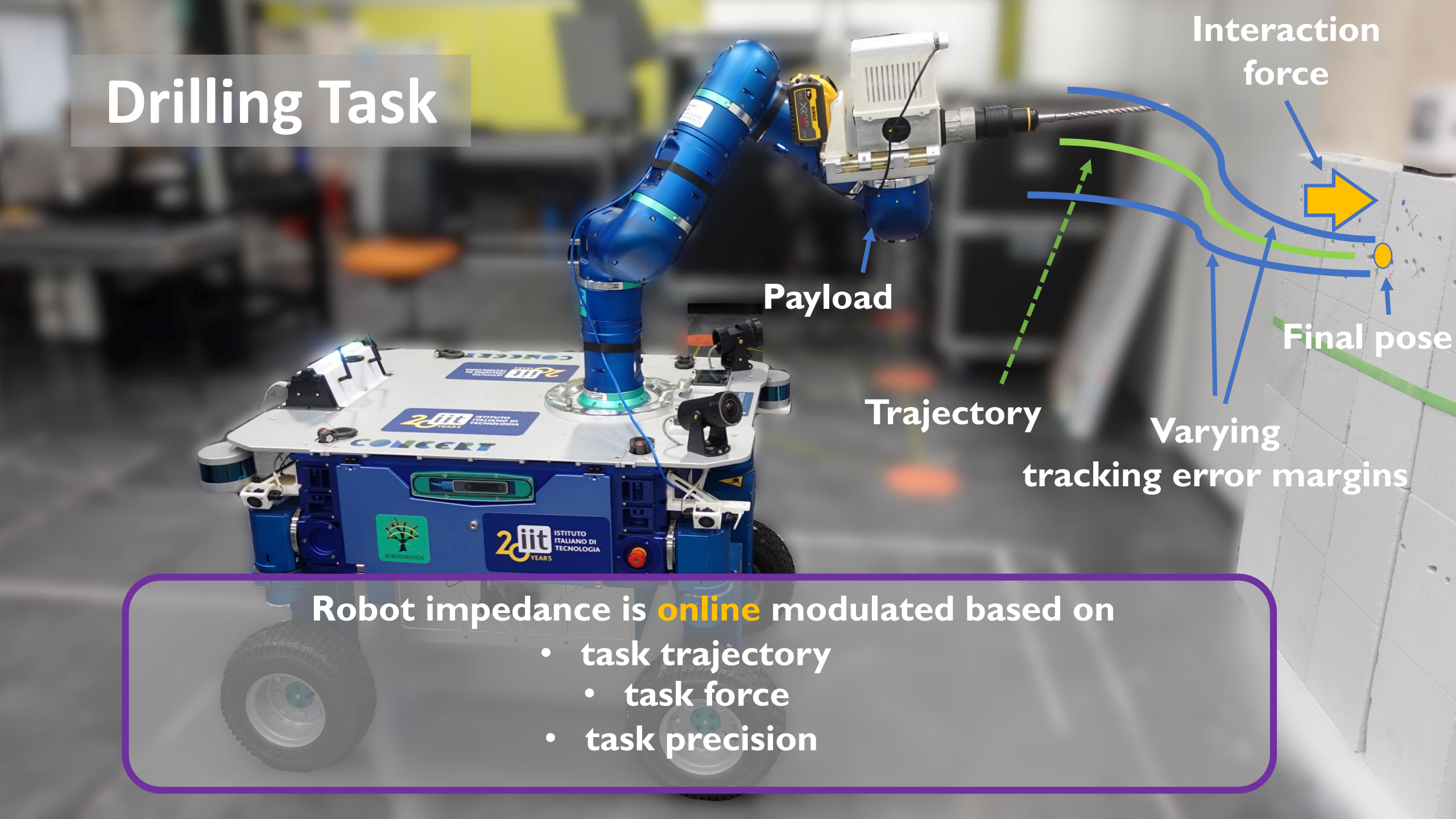
Principle behind

Drilling Task



Robot impedance is **online** modulated based on

- task trajectory
- task force
- task precision

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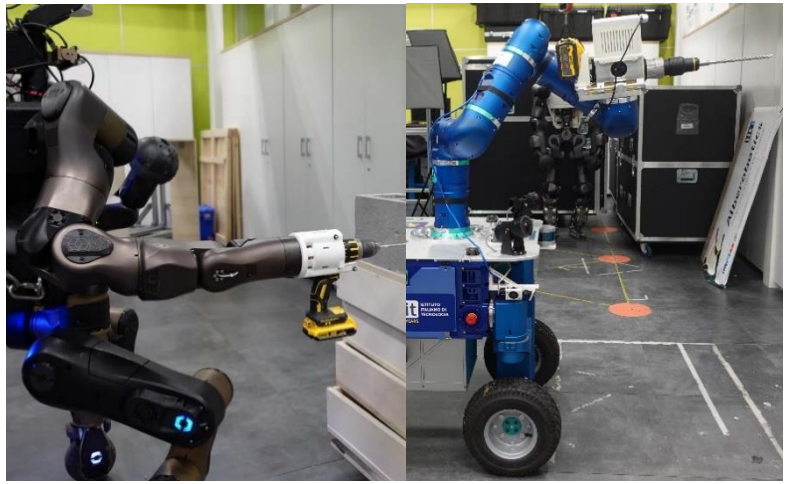
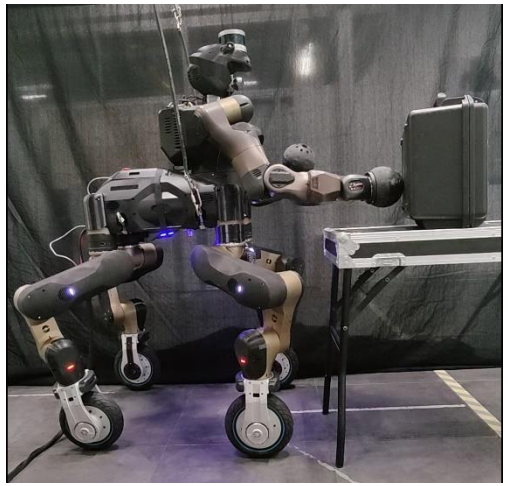
Task to Execute



drilling



pushing

assistance

- Task trajectory
- Task force
- Task precision

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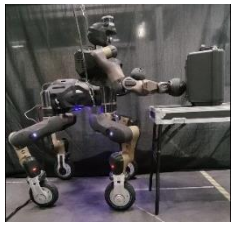
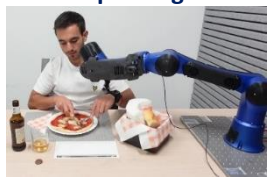
Task to Execute

drilling



pushing

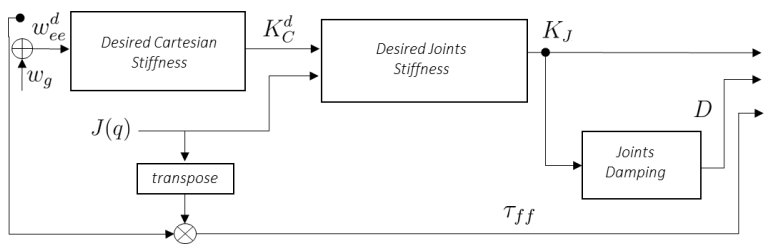


assistance

ROS2 Package Inputs

- Task trajectory
- Task force
- Task precision

Variable Impedance Modulation



ROS 2

ROS2 Package Outputs

- stiffness
- damping

Robot Control

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How to use the package
By using ROS2 topics!

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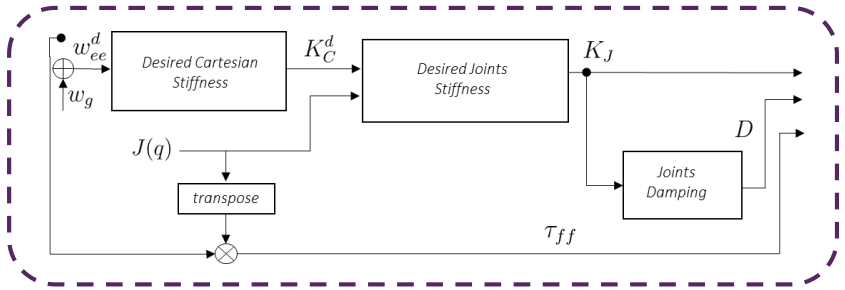
Node_Settings.yaml

stiffness_preset
stiffness_constant
stiffness_maximum
damping_preset
damping_maximum
robot_initial_config
wrench_initial
precision_initial
transition_time
robot_urdf_model_path
robot_base_frame_name
robot_tip_frame_name
topic_subscriber_name
topic_publisher_name
rate
log_path
verbose

0. Configuration

Variable Impedance Modulation



ROS 2

Params

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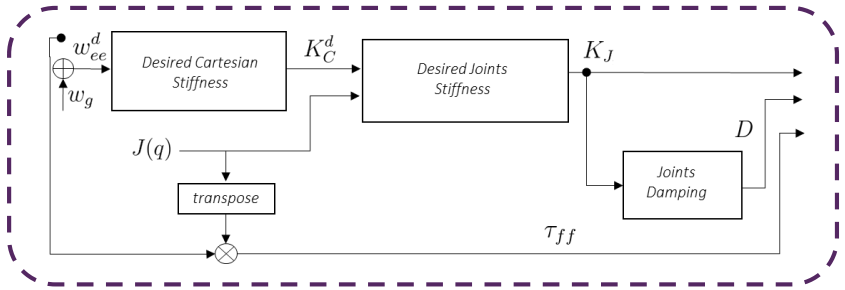

ROS 2

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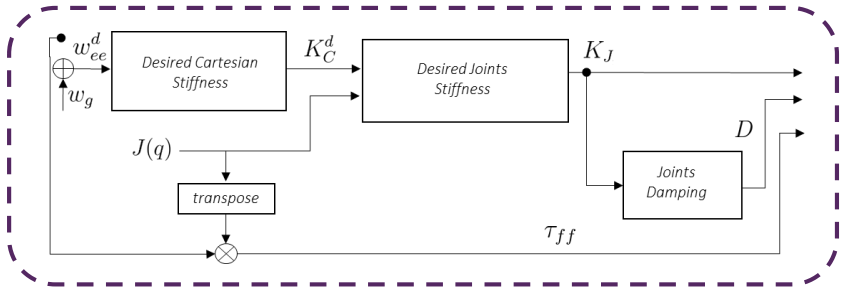

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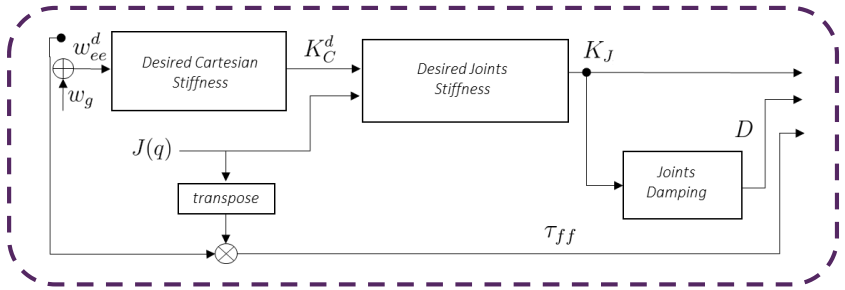

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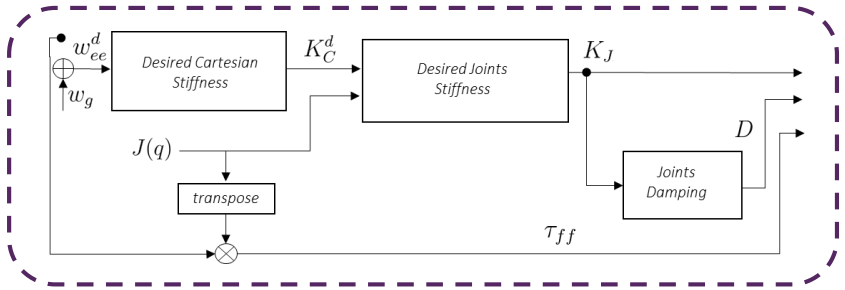

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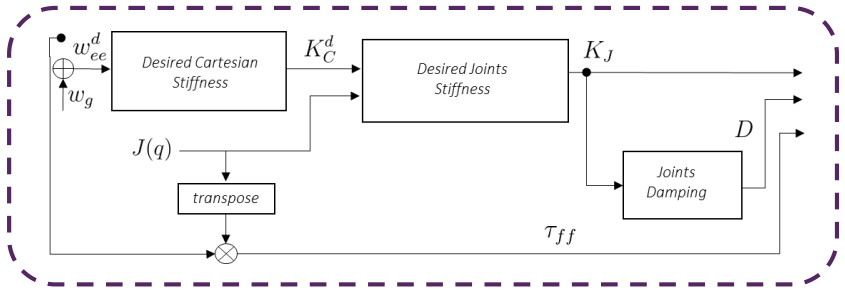

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Params

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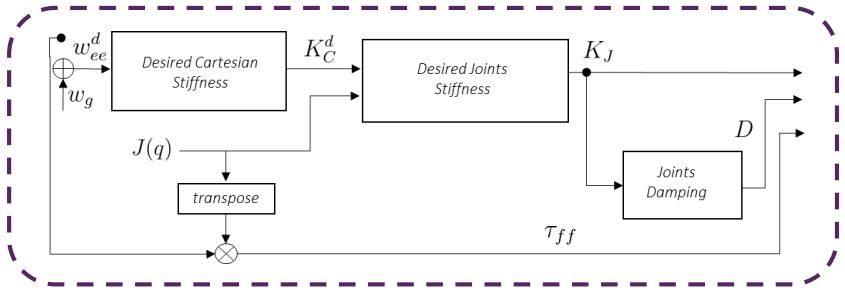
user

```
bool cartesian_space
float64[] joints_position
float64[] joints_position_reference
float64[] task_pose_reference
float64[] task_wrench
float64[] task_precision
```

1. Publish inputs

Variable Impedance Modulation



ROS 2

```
float64[] robot_stiffness
float64[] robot_damping
float64[] robot_feedforward_torque
```

2. Subscribe outputs

Every Iteration!

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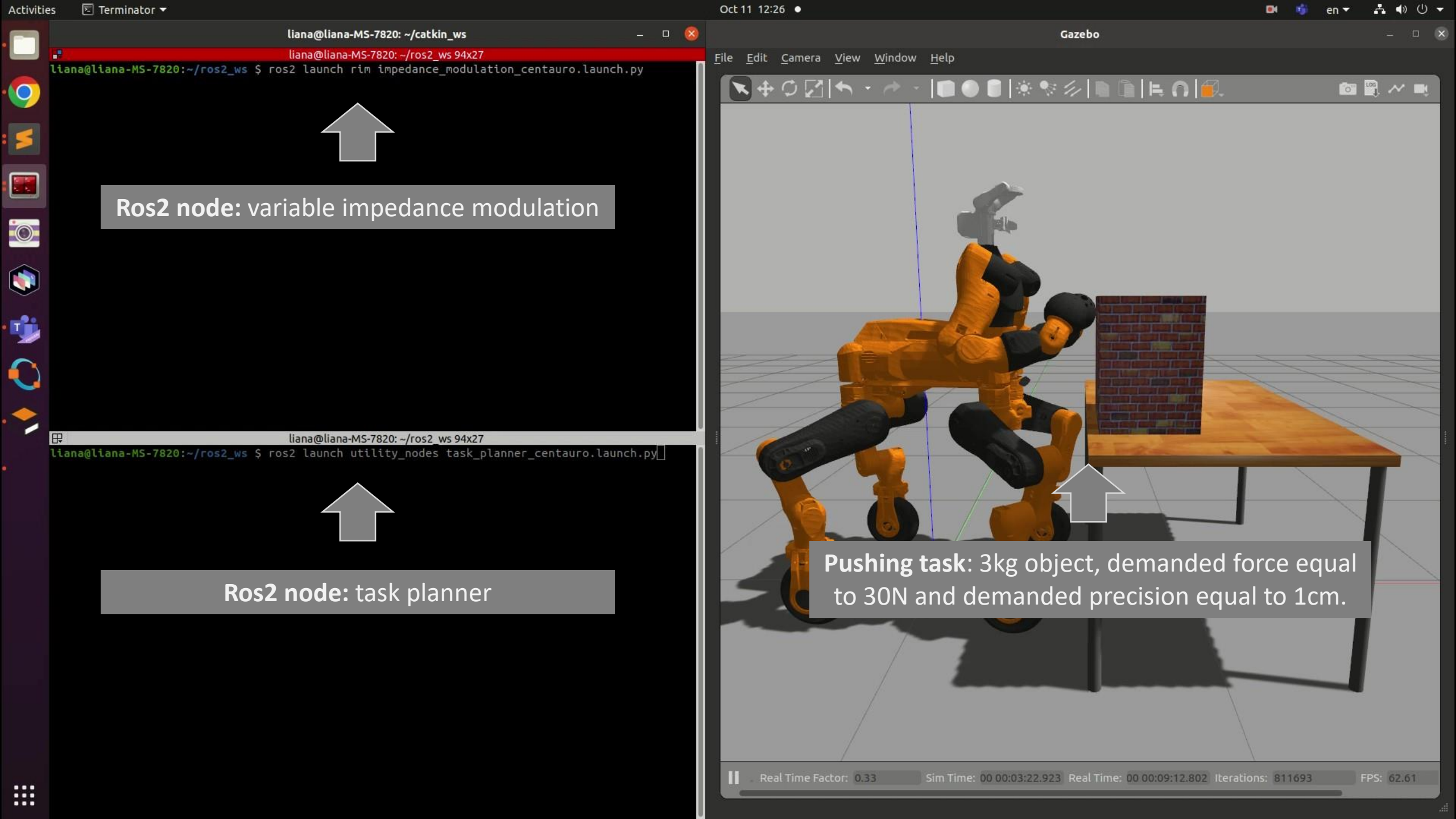
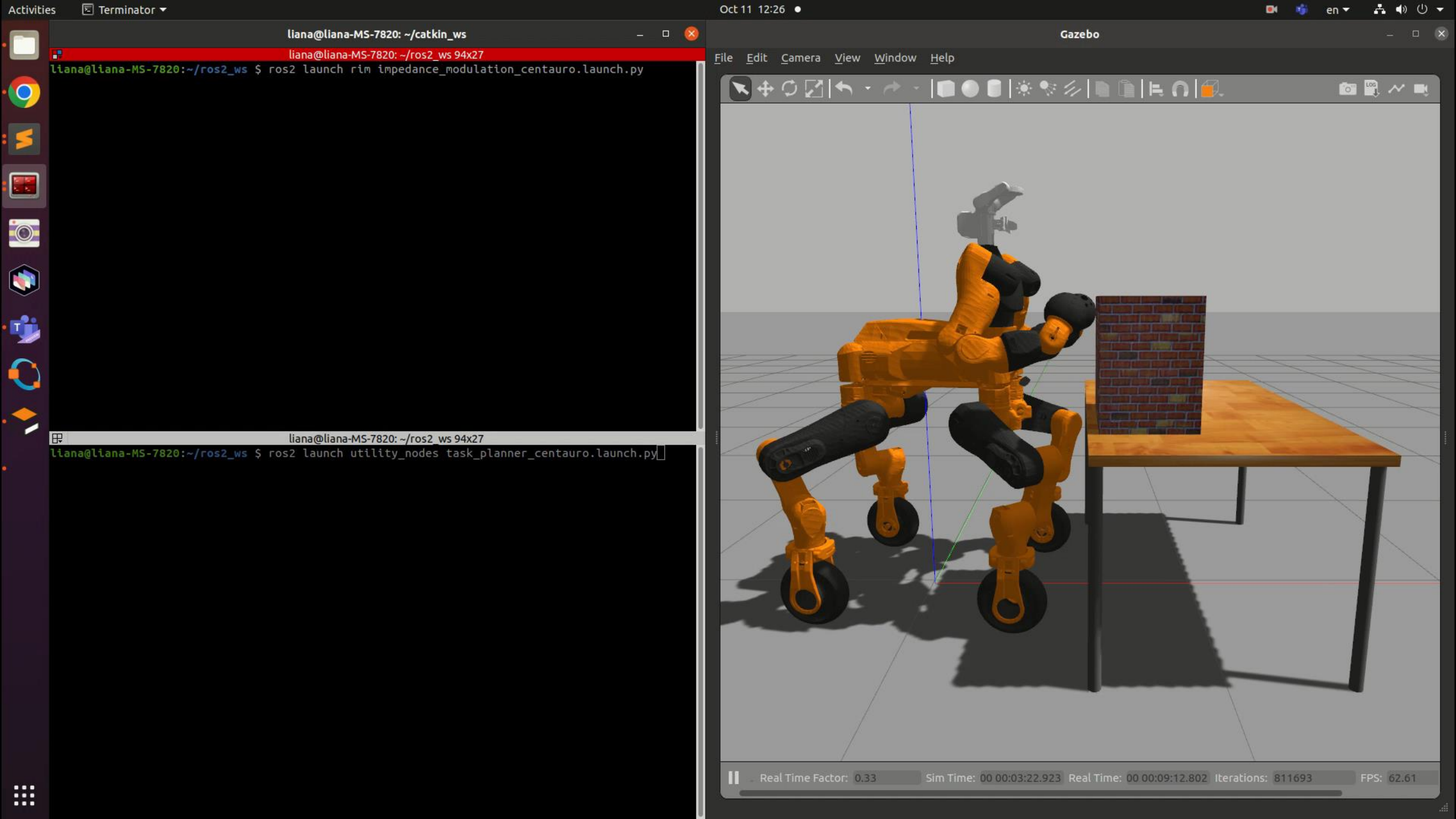
How the package works


Activities
Terminator
Oct 11 12:26
en
liana@liana-MS-7820: ~/catkin_ws
liana@liana-MS-7820: ~/ros2_ws 94x27
liana@liana-MS-7820:~/ros2_ws $ ros2 launch rim impedance_modulation_centauro.launch.py
Ros2 node: variable impedance modulation
liana@liana-MS-7820: ~/ros2_ws 94x27
liana@liana-MS-7820:~/ros2_ws $ ros2 launch utility_nodes task_planner_centauro.launch.py
Ros2 node: task planner
Gazebo
File Edit Camera View Window Help
Pushing task: 3kg object, demanded force equal to 30N and demanded precision equal to 1cm.
Real Time Factor: 0.33
Sim Time: 00 00:03:22.923
Real Time: 00 00:09:12.802
Iterations: 811693
FPS: 62.61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Gazebo
File
Edit
Camera
View
Window
Help
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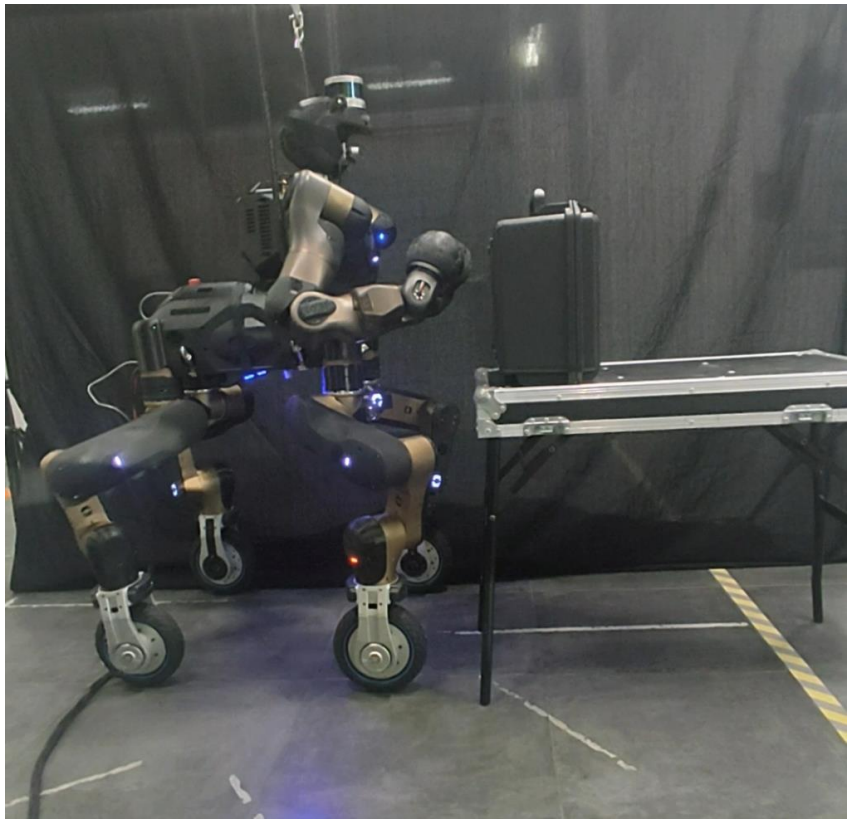
Centauro



pushing

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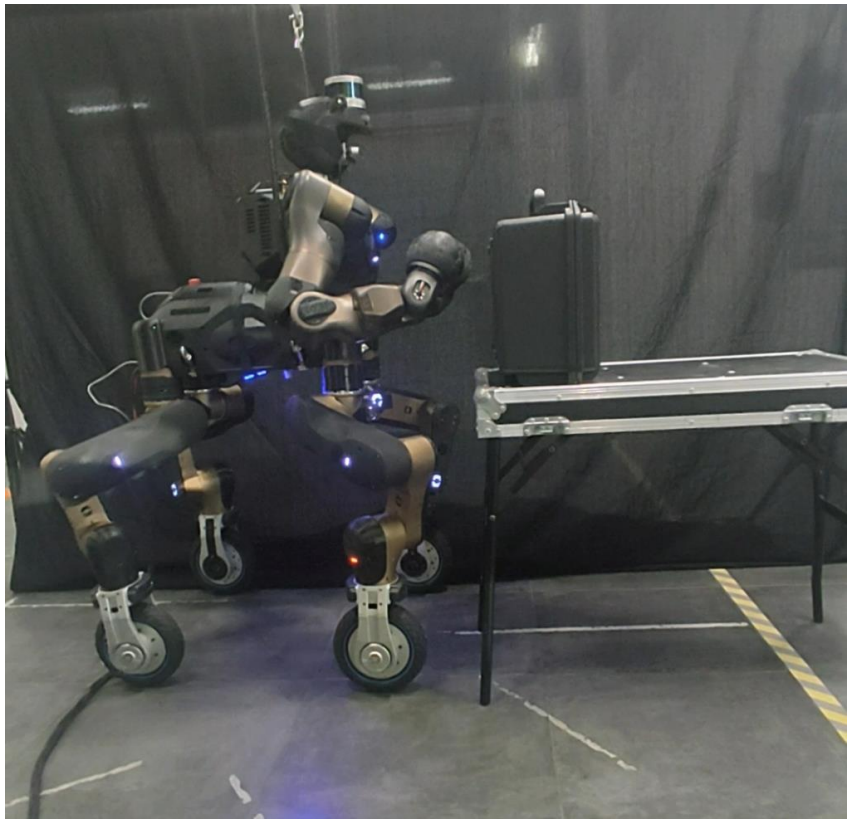
Centauro



pushing

Concert

drilling

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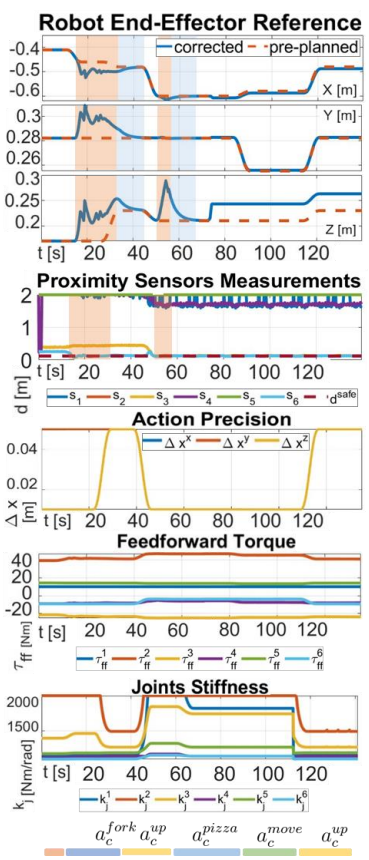
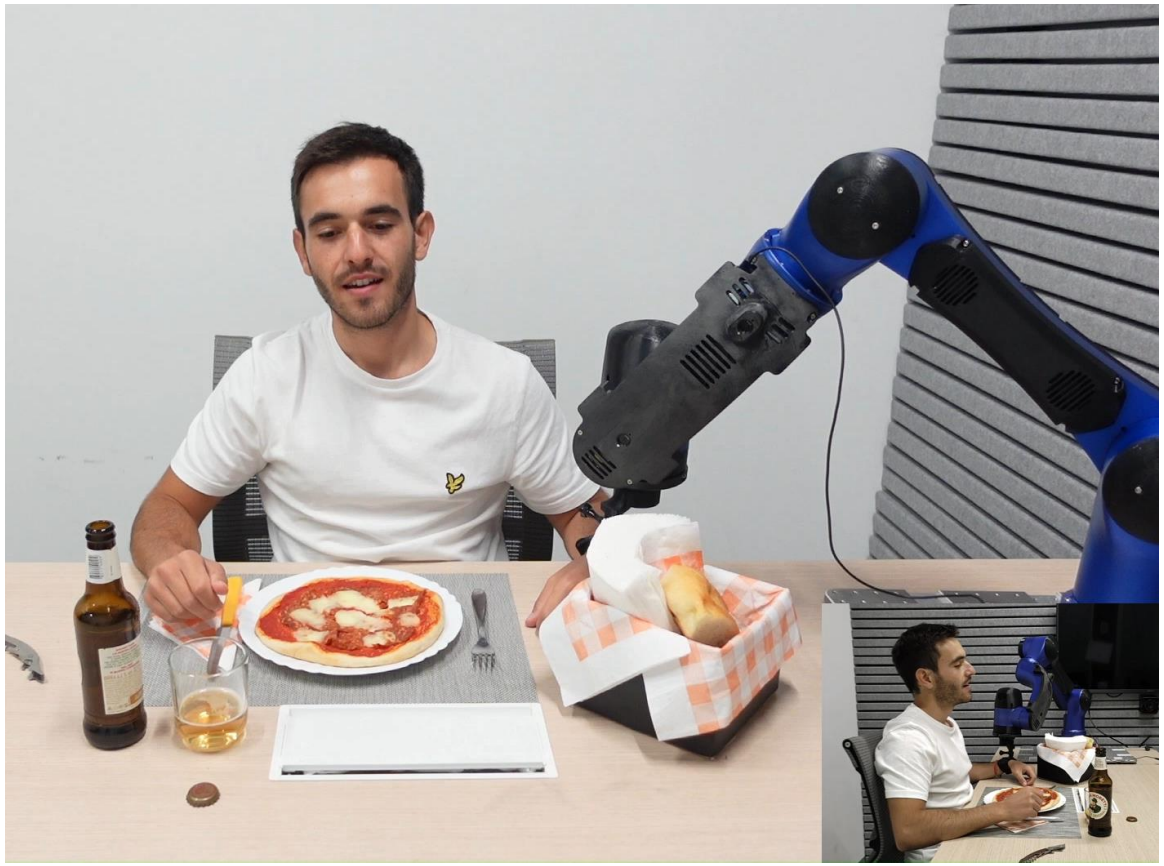
Inail 2 arm





assistance

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- **Source code**
  https://github.com/ADVRHumanoids/RobotImpedanceModulation

- **Documentation/Instructions**
  https://github.com/ADVRHumanoids/RobotImpedanceModulation

- **Projects**

  CONCERT: https://concertproject.eu/

  HARIA: http://haria-project.eu/

- **Publications**

  “Bertoni, Liana, et al. "Task Driven Online Impedance Modulation." *2022 IEEE-RAS 21st International Conference on Humanoid Robots (Humanoids)*. IEEE,2022” https://ieeexplore.ieee.org/abstract/document/10000215

  “An Assistive Human-Robot Bi-Manual Co-Manipulation System for Subjects with Upper Limb Motion Deficiencies” (ICRA submitted)

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THANK YOU FOR YOUR ATTENTION!

ANY QUESTIONS?

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