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
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**.
Principle behind
Drilling Task

Robot impedance is **online** modulated based on

- task trajectory
- task force
- task precision
Task to Execute

- Task trajectory
- Task force
- Task precision

drilling
pushing
assistance
Task to Execute

- ROS2 Package Inputs
  - Task trajectory
  - Task force
  - Task precision

ROS2 Package Outputs
- Stiffness
- Damping

Robot Control

Variable Impedance Modulation

- Desired Cartesian Stiffness
- Desired Joints Stiffness
- Joints Damping

Task to Execute assistance

Robot Control

ROSCon 19th Oct. 2023, New Orleans LA, USA
How to use the package
By using ROS2 topics!
0. Configuration

Variable Impedance Modulation

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

ROS2

 Params
0. Configuration

Variable Impedance Modulation

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Params

ROS2
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Params
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Variable

Impedance Modulation

Params
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0. Configuration

Variable Impedance Modulation

![Diagram of Variable Impedance Modulation]

 ROS2

Params
1. Publish inputs

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

2. Subscribe outputs

- float64[] robot_stiffness
- float64[] robot_damping
- float64[] robot_feedforward_torque

Variable Impedance Modulation

Every Iteration!
How the package works
Pushing task: 3kg object, demanded force equal to 30N and demanded precision equal to 1cm.

Ros2 node: variable impedance modulation

Ros2 node: task planner
Centauro

pushing
• **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**

  “An Assistive Human-Robot Bi-Manual Co-Manipulation System for Subjects with Upper Limb Motion Deficiencies” (ICRA submitted)
THANK YOU FOR YOUR ATTENTION!
ANY QUESTIONS?

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