SORBONNE UNIVERSITÉ

Master's Department of Engineering Sciences

MASTERS Sdi Sciences de l'ingénieur

Name of the unit: ROS and experimental robotics

Lecturer: S. Argentieri, F. Vérité (sylvain.argentieri@sorbonne-universite.fr)
Course code: UM4RBR21
Student workload: 12h of lectures, h of tutorial sessions, 20h of lab sessions@
Credits: 6 ECTS

Specialization tracks:	- **E3A** :	☐ CIMES	☐ Syscom	☐ IPS
	- **AR** :	☐ ROBOT	☐ SI	☐ MeDH
	- **MECA** :	☐ MS2	☐ MF2A	☐ CompMech
		☐ ACOU	☐ EE	☐ EE APP

Semester offered: ☐ S1 ☒ S2 ☐ S3 ☐ S4
Language of instruction: ☐ French ☐ English
Targeted audience: ☐ Engineering Sciences students ☐ Other (specify):
Localization : ☒ PMC Campus ☐ Other (specify):

Course Overview

This teaching unit aims at mastering the ROS2 software in order to (i) build a realistic simulation of a simple two wheels robot or a serial manipulator endowed with sensorimotor capabilities in a dedicated simulator (gazebo), and (ii) to exploit the resulting code to interface with a real robot (Turtlebot 3 Burger or Niryo Ned2) in some realistic robotic scenario.
Keywords: ROS2, Gazebo simulation, autonomous navigation, robotic manipulation, cooperation tasks

Prerequisites

Students should have previously acquired the following prerequisites to follow this course:

- Python programming
- Basic signal/image processing algorithms
- Notions in automatic control

Intended Learning Outcomes

By the end of this course, students will be able to:

1. To master all the root concepts of the ROS2 software (nodes, messages, topics, services, etc.) and its tools (rviz, gazebo, etc.)
2. To write a standard subscriber and publisher node in Python
3. To understand and exploit a simulated robot description (written in URDF) in a physical simulator
4. To extract relevant information from raw sensory data, coming either from simulation or from a real robot
5. To control the actuators of the simulated or real robot
6. To interact with both motor and sensory data to achieve a reactive task in a simulated or real environment
7. To interface with a real robot, and to adapt all the code written for simulation to the real world
8. To define a comprehensive specification document targeting a proposed robotic task
9. To develop hardware and/or software solutions to meet the defined requirements

10. To assess against set criteria how the list of specifications is validated for the targeted robotic task

Indicative Teaching Sequence and Methods

Week	C/TD/TP*	Content	Preparation	Learn. outc.
S1	C1 + C2	Introduction to the teaching unit (1h) + introduction to ROS2 (2h)	ROS2 tutorials	AAV1
S2	C3	Linux systems and networks (2h)	ROS2 tutorials	AAV1
S3	C4	Recalls about event-driven programming (2h)	ROS2 tutorials	AAV1
S4	TP1	Hands-on approach to ROS2 (1/3, 4h)	C1+2+3	AAV1, AAV2
S5	TP2	Hands-on approach to ROS2 (2/3, 4h)		AAV1, AAV2
S6	TP3	Hands-on approach to ROS2 (3/3, 4h)		AAV1, AAV2
S7	C5	Flipped classroom: nodes, messages, topics, services and feebacks on the first practical sessions (1h30)	ROS2 tutorial	AAV1, AAV2
S8	Practical exam		TP1+2+3 + ROS2 tutorials	
S9	TP4	Simulated/real robot hands-on, URDF description (1/2, 4h)	C1+2+3	AAV1, AAV3, AAV7
S10	TP5	Data extraction and processing from simulated/real robot (2/2, 4h)		AAV1, AAV4, AAV7
S11	C6	Flipped classroom: URDF, simulation, sensorimotor closed-loop implementation (1h30)		AAV8, AAV9, AAV10
S12	Project	Realize a robotic task in simulation and with real robots (1/3, 8h)	TP1-5	AAV8, AAV9, AAV10
S13	Project	Realize a robotic task in simulation and with real robots (2/3, 8h)		AAV8, AAV9, AAV10
S14	Project	Realize a robotic task in simulation and with real robots (3/3, 8h)		AAV8, AAV9, AAV10
S15	Project evaluation	In group, oral and practical evaluation		AAV1-10

* C/TD/TP respectively corresponds to lectures, tutorials and lab sessions.

Sequence of the unit:
1st phase: C1-2-3-4, TP1-2-3 = ROS fundamentals, quiz + lab exam
2nd phase: Quiz2, TP4-5, C5 = ROS (advanced), quiz
3rd phase: project

Indicative Assessment of Intended Learning Outcomes (1st session)

Week	Individ./group	In-person/remote	Type of exam	Evaluated outcomes	Scale %
S2	Individual	In-person	Quiz	AAV1	12 %
S7	Individual	In-person	Labs	AAV2	25 %
S8	Individual	In-person	Quiz	AAV1, AAV3	12 %
S15	Collective	In-person	Other	AAV8-9-10	50 %

2nde session of exam

Session	Individ./group	In-person/remote	Type of exam	Evaluated outcomes	Scale %
2	Individual	In-person	Labs	All	50 %
1	Collective	In-person	Other	AAV8-9-10	50 %

Bibliographic references

- Robot Operating System, an Introduction, O. Stasse

Date of generation of this unit description: January 14, 2026