v. 4 (year 2024)

Presentation of the course
FIELD AND SERVICE ROBOTICS

DIETI UNINA UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

DIPARTIMENTO DI INGEGNERIA ELETTRICA E TECNOLOGIE DELL'INFORMAZIONE

www.prisma.unina.it

- About
  - Field and Service Robotics (FSR)
    - This is a module of the Advanced Robotics course
  - 6 CFU
  - About 25 lessons (2h each)
  - Lessons
    - Monday 10:30 - 12:30 (NA-II-A8 + MS TEAMS)
    - Tuesday 10:30 - 12:30 (NA-II-A8 + MS TEAMS)
  - Course registration
    - Please, check the instructor's website (Ateneo docenti)
    - **It is important to register for organization purposes**

Textbooks

- Textbooks
  - Wheeled ground robots
    - B. Siciliano, L. Sciavicco, L. Villani, G. Oriolo, "*Robotics – Modelling, Planning, and Control*", Springer, London, 2009, ISBN 978-1-84628-641-4
  - Aerial robotic
    - "*Aerial Robotic Manipulation*", A. Ollero and B. Siciliano Eds., Springer Tracts in Advanced Robotics, 2019, ebook ISBN 978-3-030-12945-3

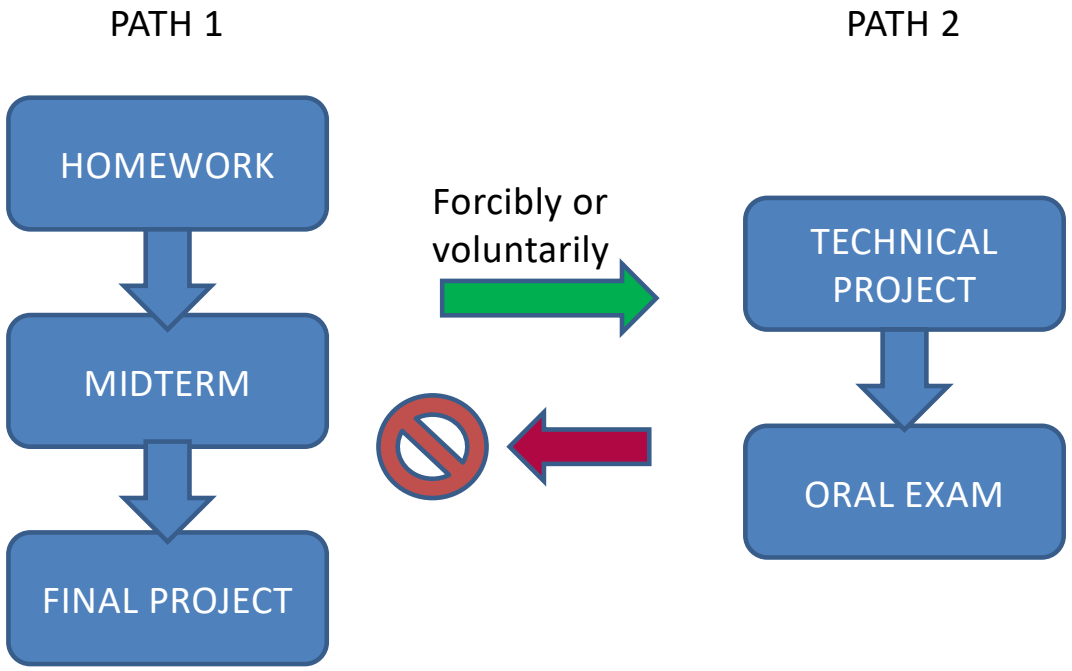
- Additional material
  - Introduction
    - K.M. Lynch, F.C. Park, "Modern Robotics. Mechanics, Planning, and Control", Cambridge University press, 2017, ISBN 9781107156302.
  - Underwater robotic
    - G. Antonelli, "Underwater robots", Springer Tracts in Advanced Robotics, 2014, ed. 3, ebook ISBN 978-3-319-02877-4
  - Provided by the instructor and available on the official channels

Instructor support – Prof. F. Ruggiero

- Contacts
  - Room 3.26, Building 3/A, Via Claudio 21
  - Phone: 081-76(83843)
  - Email: fabio.ruggiero@unina.it
  - Teacher website: www.docenti.unina.it/fabio.ruggiero
  - Students reception
    - Friday from 08.00am to 09.30am at instructor's office
  - TEAMS channel
    - Field and Service Robotics 2024 - LM Ing. Automazione e Robotica - Fabio Ruggiero | Generale | Microsoft Teams
  - Telegram group
    - https://t.me/+7wmxBIAiyhI1MTA8

Syllabus

- Syllabus
  - On the instructor's website
- Lessons register
  - On the instructor's website


PATH 1
PATH 2
HOMEWORK
MIDTERM
FINAL PROJECT
Forcibly or voluntarily
TECHNICAL PROJECT
ORAL EXAM

Path 1 - Homework

- Homework
  - Small- or medium-size exercises
    - At home
    - Some coding parts
  - Deadlines for submission are fixed
    - Late submissions are not allowed
    - Missing a homework submission corresponds to F
  - Production
    - English report (PDF file), max 15 pages, regular font
    - If code is produced, create a unique ZIP file with code + report
    - Be careful! It is not simply necessary to write the correct answer. You should explain the answer's reasoning while staying in the page limits
  - Sumbission
    - MOODLE

N. HOMEWORK	RELEASED (MAX.DATE)	DEADLINE (NO EXTENSION)	RESULTS (FLEXIBLE)
1	19/03/24	29/03/24	12/04/24
2	16/04/24	26/04/24	10/05/24
3	07/05/24	17/05/24	31/05/24
4	28/05/24	07/06/24	21/06/24 (on demand)

GRADE	VOTE
A+	29-30
A	27-28
B	24-26
C	20-23
D	18-19
F	<18

Path 1 - Midterm

- Midterm
  - April 29, 2024
  - 1-hr test in classroom
    - Remote participation to the midterm is allowed following the procedure indicated by the university for the remote exams
    - It is allowed to consult class material
  - No collaboration with other students
  - Grades as for the homework
  - Do not show up at midterms corresponds to F

Path 1 – Final project

- Final project
  - Free to be chosen
    - Please, select the topic carefully! It is expected that this project will take you a maximum of 3-4 weeks of work
    - It is possible to start working on the project during the class
    - Developing novel algorithms/systems is okay, but reimplementing published work and/or applying a published algorithm to a model system from class is also great
    - You will be evaluated based on whether the project forced understanding new concepts, not based on the novelty of the approach
    - It is allowed to extend a project carried out in previous classes
      - Specify it in the report and highlight the novelty with respect to the previous report
    - **EXCEPTION**: You cannot choose unicycle/differential drive robot
  - Production
    - Detailed English report (PDF file), max 25 pages, normal font
      - Outline on the website
    - Code
    - Video
    - Presentation (max 15 minutes if alone, 10 minutes each student for collaborative projects)
  - Submission steps on the website
  - Ideas on the website
    - Discuss with us

Path 1 – Grading policy

- Grading
  - 30% homework
  - 30% midterm
  - 40% final project
- No final oral exam
- Regrading
  - If you are not satisfied with some grades, report to the instructor: you will receive some oral questions during the final project discussion
- Path 2 forced conditions
  - 3 or more F during homework

  OR
  - at least one F during homework and F at midterm

Path 1 – Collaboration policy

- Collaboration policy
  - homework must be done individually
  - the final project can be done individually or in a small team (max 2 people, no exception!)
- Collaboration is encouraged
  - You can talk with other students, the instructors, and the teaching assistants
  - The assignment is expected to be entirely on your own
  - You can discuss with other students, but you must understand the concepts and produce them by your own assignment reports
  - The solution must be written by yourself
  - You must not see anyone else answer before writing yours
- Generative AI
  - It is a tool: free to use it
  - Cite it!
- Anti-plagiarism software is used to detect plagiarism among all the received documents
  - Detected or suspected plagiarism, copying from other colleagues, copying from past years' assignments, and all similar actions will be penalized with an F grade or prevent taking the final examination with this path

- Technical project
  - The assigned topic must be solved individually
    - Plagiarism check
  - Production
    - Detailed English report (PDF file), max 25 pages, normal fonts
    - Code
    - Video
- Projects
  - Surnames A-C: Project 1
  - Surnames D-G: Project 2
  - Surnames H-N: Project 3
  - Surnames O-Z: Project 4
  - You can ask changing the assigned project BEFORE the end of the course
- No restrictions on the programming languages and simulation environments
  - This does not hold for Project 4 where ROS and Gazebo is mandatory, but the code is already provided, and you must only add piece of it
  - There is instead a restriction on the employed libraries/commands: it is forbidden to use libraries/commands automatically solving the specific problems indicated within the description of the assigned technical project
- The oral discussion is made by technical report presentation + three questions randomly covering all the topics of the syllabus

FAQs

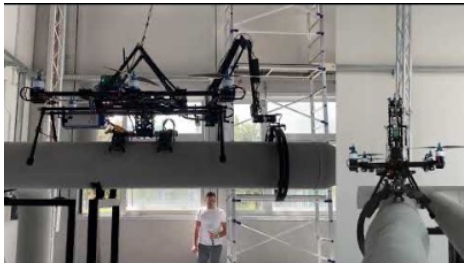
Exams

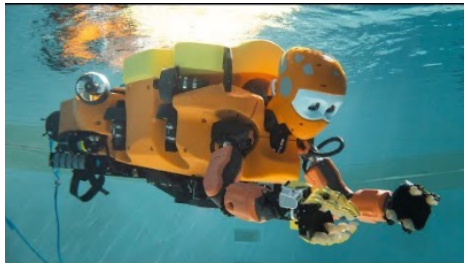
- Do I have to communicate the chosen path?
  - NO. It is quite obvious that if you do not submit homework, you have chosen Path 2.
- Can I switch from Path 1 to Path 2 and vice versa?
  - You can switch from Path 1 to Path 2 at any moment without communication. You cannot switch from Path 2 to Path 1 for obvious reasons (if you do not participate to homework you get F, and after three F's or more you cannot follow Path 1).
- I attended the FSR course during the previous years. Can I choose Path 1?
  - YES. However, you must follow all the deadlines and you have to follow this year syllabus. Besides, if you already delivered some homework/midterm previously and you deliver a new homework/midterm, your history is erased!
- I attended the FSR course during the previous years. Can I choose Path 2?
  - YES. However, if you follow Path 2 with the projects given this years, the oral examination will be done on this year's syllabus.
- I attended the FSR course during the previous years. Should I choose among Path 1 and Path 2 only?
  - NO. You can stay with the given project and the syllabus of the year when you attended the FSR course.

- Stats (February 2024)
  - Examined students: 103 (103) (+17 this year)
  - Average grade: 28.92 (-0.15 this year)

Course objectives

FROM HERE → TO HERE





Course objectives

FOUNDATION OF ROBOTICS

- Bolted robots
- Fully actuated (or redundant) systems
- Feedback-linearization approach works
- Trajectory planning in a free-obstacle workspace

FIELD AND SERVICE ROBOTICS

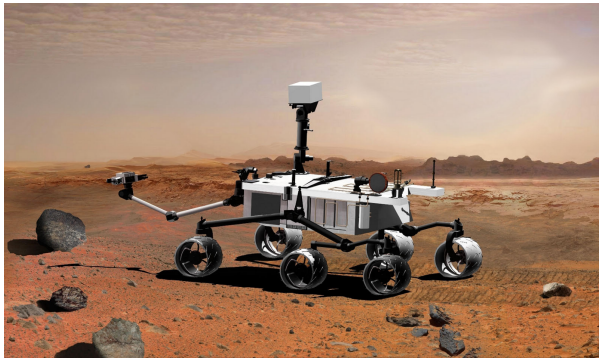
- Robots free to move inside the environment (they can run, swim, fly, …)
- Underactuated systems
- Feedback-linearization approach DOES NOT work
- Motion and trajectory planning in a workspace with obstacles

…covered by other robotic courses

- High-level motion planning
- Visual servoing
- Odometry
- Interaction with the environment
- Manipulation
- Flexible/soft robots

Course objectives

- The course aims to provide an overview of the tools employed in modeling, planning, and control mobile robots

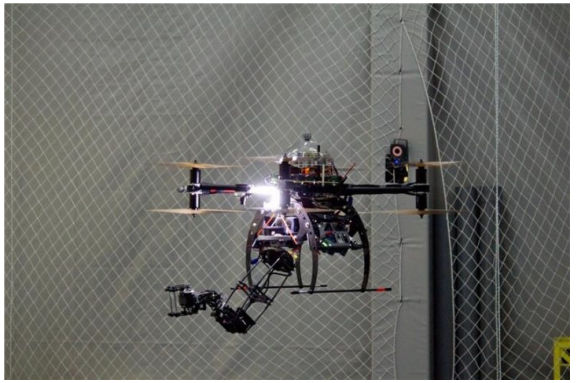


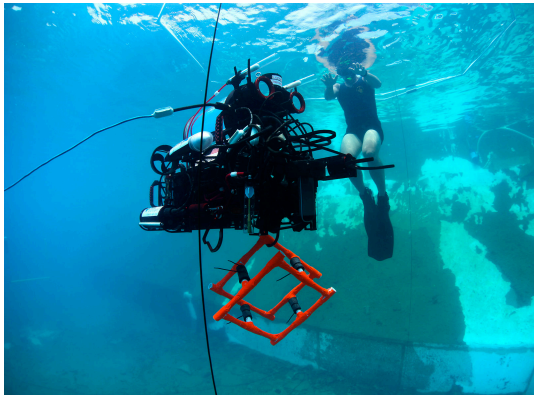
WHEELED GROUND ROBOTS

- Nonholonomic constraints
- Kinematic and dynamic model
- Planning and motion control
- Odometry

AERIAL ROBOTS

- Dynamic model
- Sensors
- Actuators
- Aerodynamic effects
- Aerial manipulation





UNDERWATER ROBOTS

- Dynamic model
- Sensors
- Actuators
- Hydrodynamics effects

LEGGED ROBOTS

- Taxonomy
- Centroidal dynamics
- Zero-moment point
- Gait planner
- Control of quadruped robots