

Robot Programming

Project and Exam Rules (2023-24)

Giorgio Grisetti

About Exam

- The evaluation is binary (pass/no pass)
- At each session we will establish some discussion dates. You will reserve a slot in these dates through a web system
- The exam consists in the presentation of the project

Project

- Done in C++
- Done on a private repo (gitlab/github) shared with **all** the teachers of the course
 - grisetti@diag.uniroma1.it
 - giacomini@diag.uniroma1.it
 - s.ferrari@diag.uniroma1.it
- **Each individual commit must be tagged.**
- A project can be done in small groups (max 2). The blocks of code written by each member should be tagged in the source as comments with the member initial (e.g. //gg: <your comment>)
- A project should be accompanied by a small report (1 page) stating:
 - how to compile
 - How to run
 - How to test

Project Guidelines

- Written in C++
- Builds with catkin on noetic or melodic
OR
- Builds with ament on ROS2
- Can be integrated in other subjects (e.g. Robotics/ AI/ DL and so on)

Project Examples

2D Multi Robot ROS simulator [1 ppl]

Write a C++ configurable multi robot simulator supporting

- Grid maps
- Unicycle like mobile robots
- Laser Scanners

The system should read the configuration from a text file specifying the layout of the simulation environment:

- For each device : the frame_id, and the topics. If a device is mounted on another device, the position in w.r.t the parent device.
- For a lidar the number of beams and the max/min range
- For a robot the maximum velocities

The output should be integrated in ROS and work with the navigation stack.

Project Examples

DMAP based localization [1ppt]

- Write a program that listens a Grid-Map from a map server, extracts the obstacles (occupied cells), and populates a Distance Map with the world coordinates of these points.
- The program should output a transform between the map and odom, similar to what a localizer should do.
- The program works by computing the transform between the current scan and the map, using ICP.
- It subscribes to a topic `/initialpose` to set the initial position from rviz
- Each time a new scan is received the program performs a new registration, starting from an initial guess. This initial guess is obtained by applying the odometry **displacement** to the estimate of the previous time instant.

Project Examples

Simple RVIZ [1ppt]

- Write a program to control a mobile robot in ROS and display simple systems(rviz simple clone).
- The program is able to show
 - a map (received from the map server),
 - Laser scans
 - mobile bases (as a circle)All items are displayed according to their transform
- particles of localization
- The program is able to issue
 - issue /initialpose message, to initialize the localizer
 - and /move_base/goal messages to set a planner destination

Project Examples

Simple Planner[1ppl]

- Write a program that computes the path to a user selected goal from the current location of the robot, received as the transform map->base_link.
- The program listens to a grid_map (similar to what localizer does), extracts the obstacles and the traversable surface (cells “brighter” than a value).
- The cost of being in a location depends on the distance to a closest obstacle (the smaller, the higher)
- Using this cost function, the program computes the path (if existing) to the goal by using your favorite search algorithm.
- The goal pose is received from the /move_base/goal message.

Project Evaluation

- During the discussion we will ask you to do small modifications of your work on the fly. Not succeeding in doing so means you did not understand what you wrote and raises questions on the project's authorship.
- If the above happens, your project will be changed, and you will come back at the next round.