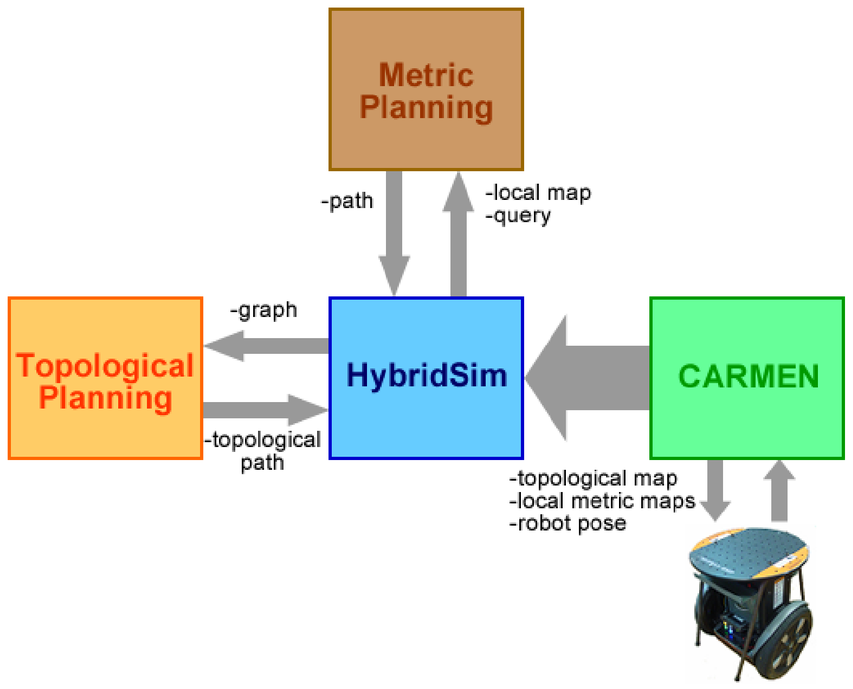
Trajectory Planning and Execution for Navigation on Hybrid Hierarchical Maps



Márcio Henriques (M. Sc. student)
Rui Rocha (supervisor)

Introduction:

The mapping of large spaces has known some developments recently, with the emergence of hybrid representations. The IRPS (Intelligent Robotic Porter System) project has been using this technique to perform mapping. In this work we present an hybrid simulator that uses the IRPS hybrid topological/metric maps to obtain paths.

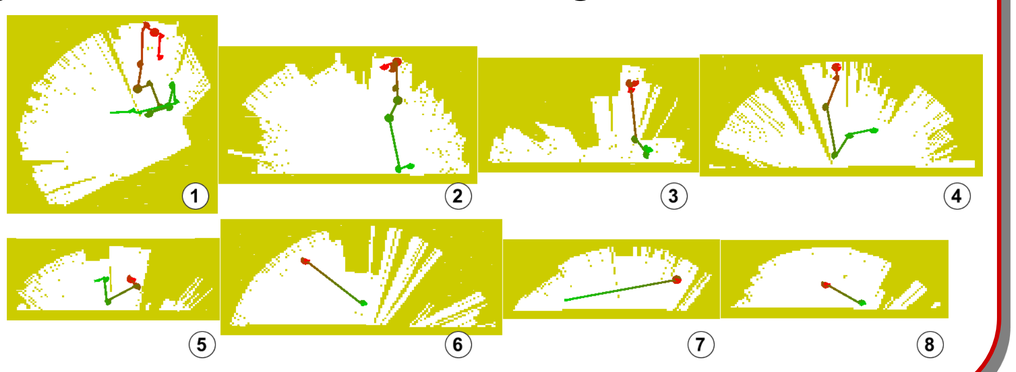
Objectives:

- development of an hybrid planner to generate trajectories.
- execute trajectories with the mobile robot.

Metric Planning

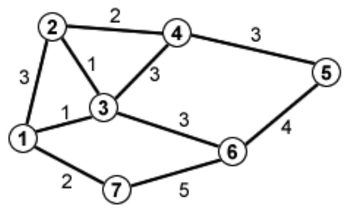
OOPSMP – Object Oriented Programming System for Motion Planning

- OOPSMP is a package for motion planning that is easy to extend, robust and efficient. It can be used for motion planning research or as teaching tool.
- For local metric planning we take advantage of the motion planning components implemented on OOPSMP, that allows us test and analyse several diferent methods, such as RRT, PRM and others.
- **Lines or Columns** algorithm was developed to obtain geometric maps used with OOPSMP from occupancy grids.



Topological Planning

Dijkstra's Alghoritm



Costs table for root node=1

node	cost	previous node
3	1	1
2	2	3
7	2	1
4	4	3
6	4	3
5	7	4

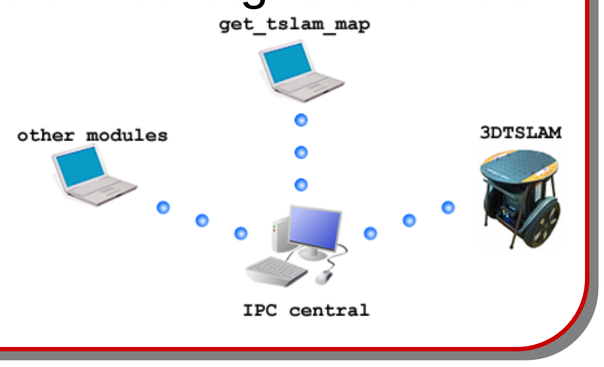
- Topological path is obtained with Dijkstra's algorithm.

Solution path from root to node 5 is:
1→3→4→5

CARMEN

CARMEN – Robot Navigation Toolkit

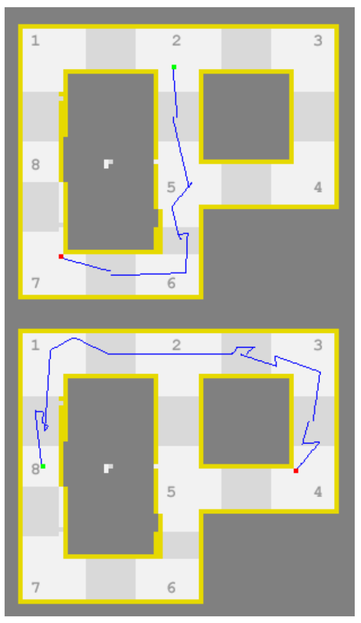
- **get_tslam_map** CARMEN module was built to receive hybrid maps directly from the mobile robot.



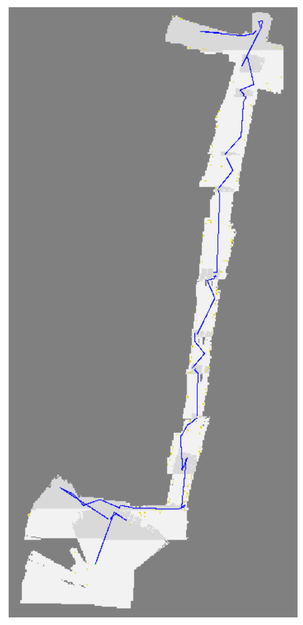
HybridSim

Faro airport mapping.

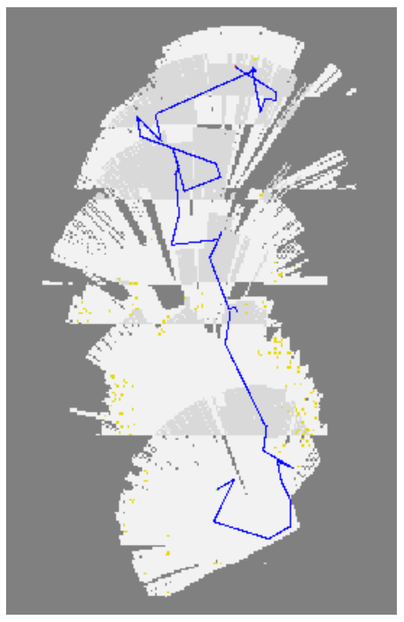
- The developed simulator combines metric and topological planning to get a path through the hybrid map.
- To make the transition between two local maps it finds a change point inside the common area between them.
- The OOPSMP toolbox allows to test diferent planning methods in local maps without making any changes to the simulator.
- The Dijkstra's algorithm can easily be replaced by other graph search alghoritms.



Hybrid map used for testing.



ISR corridor map.



Faro airport 's garage map.

Conclusions:

- The developed simulator successfuly obtains paths in both testing and real maps.
- A method to make the transition between local maps was presented.
- The OOPSMP toolbox adds to the simulator the capacity of extension to new planning methods.
- The OOPSMP toolbox allows to analyse in detail the planning in local maps.
- CARMEN modules allow direct communication with a wide variety of mobile robots.

Contact Person:
Márcio Henriques
marciohenriques84@gmail.com
Rui Rocha
rprocha@deec.uc.pt

DEEC DEPARTAMENTO DE ENGENHARIA ELECTROTÉCNICA E DE COMPUTADORES · U C · FCTUC FACULDADE DE CIÊNCIAS E TECNOLOGIA UNIVERSIDADE DE COIMBRA

Mobile Robotics Laboratory
Institute of Systems and Robotics
ISR – Coimbra