A graphical interface for motions planning. Guaranteed motion planners.

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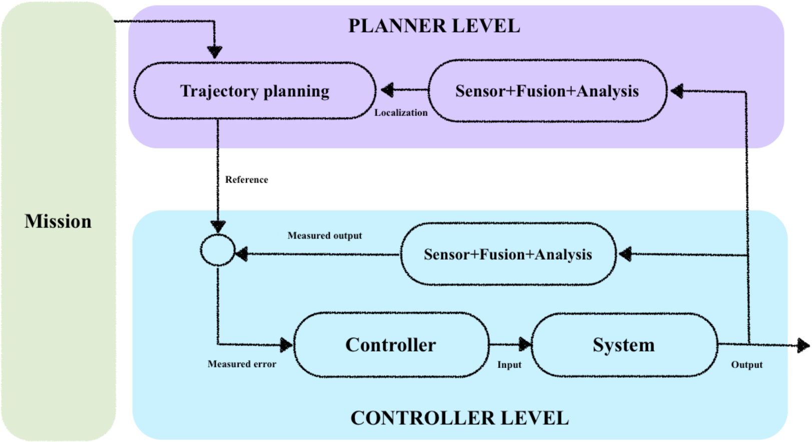
Motivation

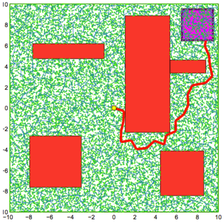

PLANNER LEVEL
Trajectory planning
Sensor+Fusion+Analysis
Localization
Reference
Mission
Measured output
Sensor+Fusion+Analysis
Controller
System
Measured error
Input
Output
CONTROLLER LEVEL

Motion planning algorithms

(1) Focus on sampling-based **motion planning algorithms** :

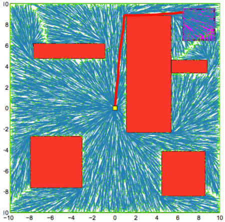
- *Rapidly-exploring Random Trees*[1] (**RRT**s)
- *Optimal Rapidly-exploring Random Trees*[2] (**RRT***)

RRT :
does not converge to the optimal path



Source : Karaman and Frazzoli

RRT* :
converge to the optimal path



Source : Karaman and Frazzoli

1. S. M. LaValle. Rapidly-exploring random trees : a new tool for path planning. Technical report, Iowa State University, 1998.
2. S. Karaman and E. Frazzoli. Optimal kinodynamic motion planning using incremental sampling-based methods. In Conference on Decision and Control 2010, pages 7681-7687.

BoxRRT, BoxRRT* : Guaranteed motion planning algorithms

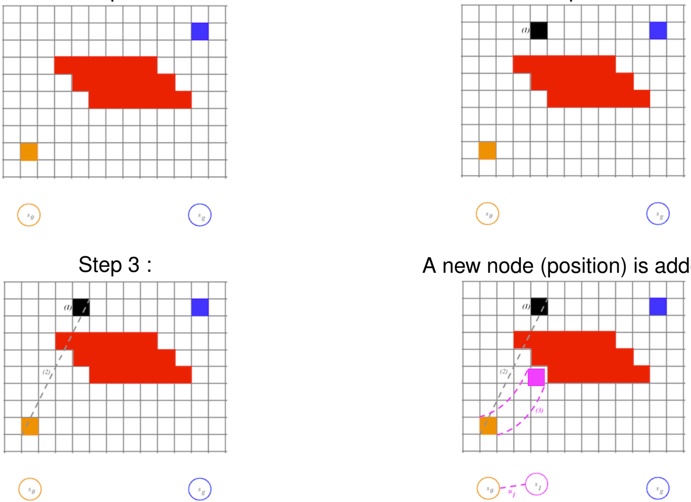
Idea behind RRT motion planning :

Step 1 :

Step 2 :

Step 3 :

A new node (position) is added :



Guaranteed motion planning algorithms

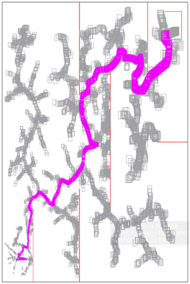
Consider a system (mobile robot) whose evolution is given by :

$$\dot{\mathbf{s}}(t) = \mathbf{f}(\mathbf{s}(t), \mathbf{u}(t)) \qquad (1)$$

$\mathbf{s} \in \mathbb{S} \subset \mathbb{R}^n$ the measurable state of the system ;
$\mathbf{u} \in \mathbb{U}_{[\mathbf{u}]}^{\Delta t}$ the control input (piecewise-constant bounded function).

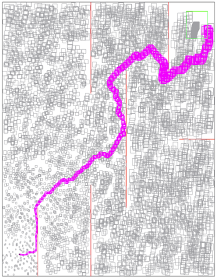
BoxRRT
random u :

- cost : 137.14
- CPU : 95 sec



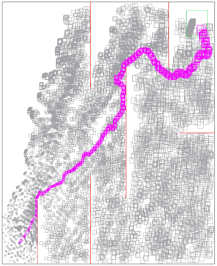
BoxRRT
with control u :

- cost : 123.42
- CPU : 129 sec



BoxRRT*
with control u :

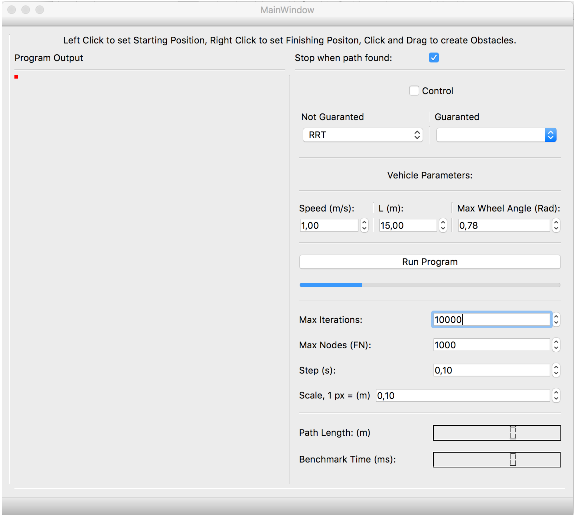
- cost : 109.84
- CPU : 349 sec



Graphical interface for motion planning algorithms

With Marco Biroli (bachelor student, now 2nd year at Ecole polytechnique, summer internship)

Until now 7 algorithms based on RRT.



Conclusions. Work in progress. Future work.

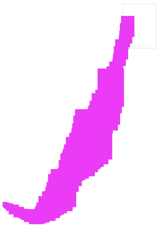
Conclusions

- Understood the Planner level and proposed different guaranteed motion planners.
- Validated the BoxRRT* on a mobile robot.

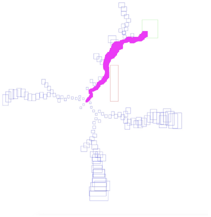
Work in progress

- Improve the proposed motion planners.

Scenario 1 :



Scenario 1 :



- Propose guaranteed motion planner and controller for the autonomous schema.

Thank you！