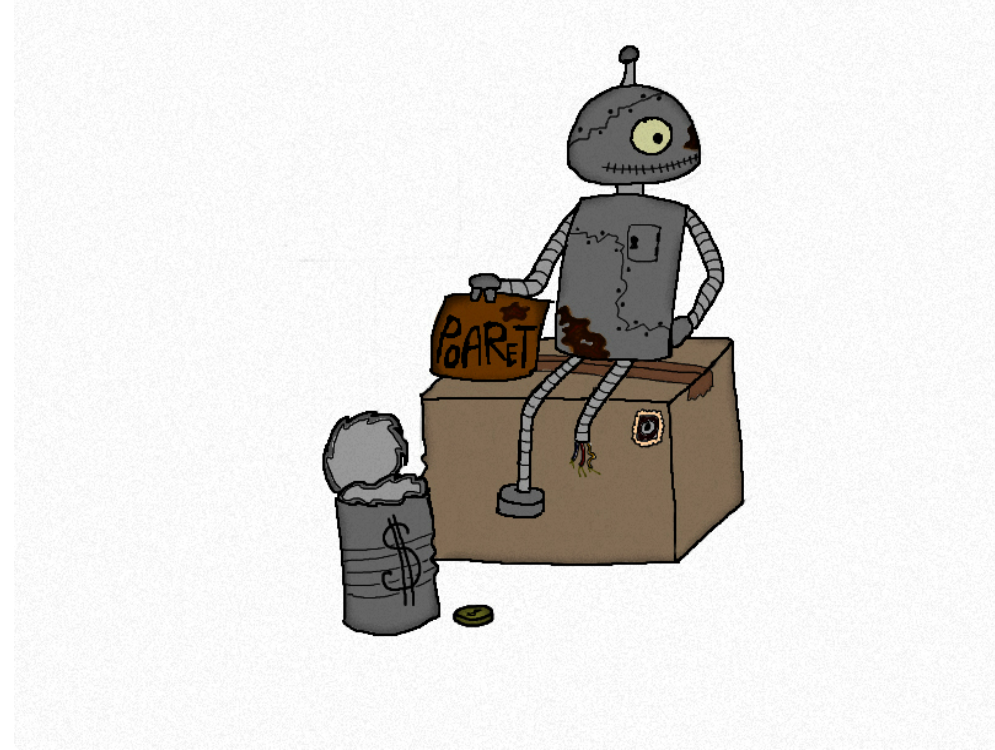




PoAReT

Rescue Simulation League

Politecnico di Milano

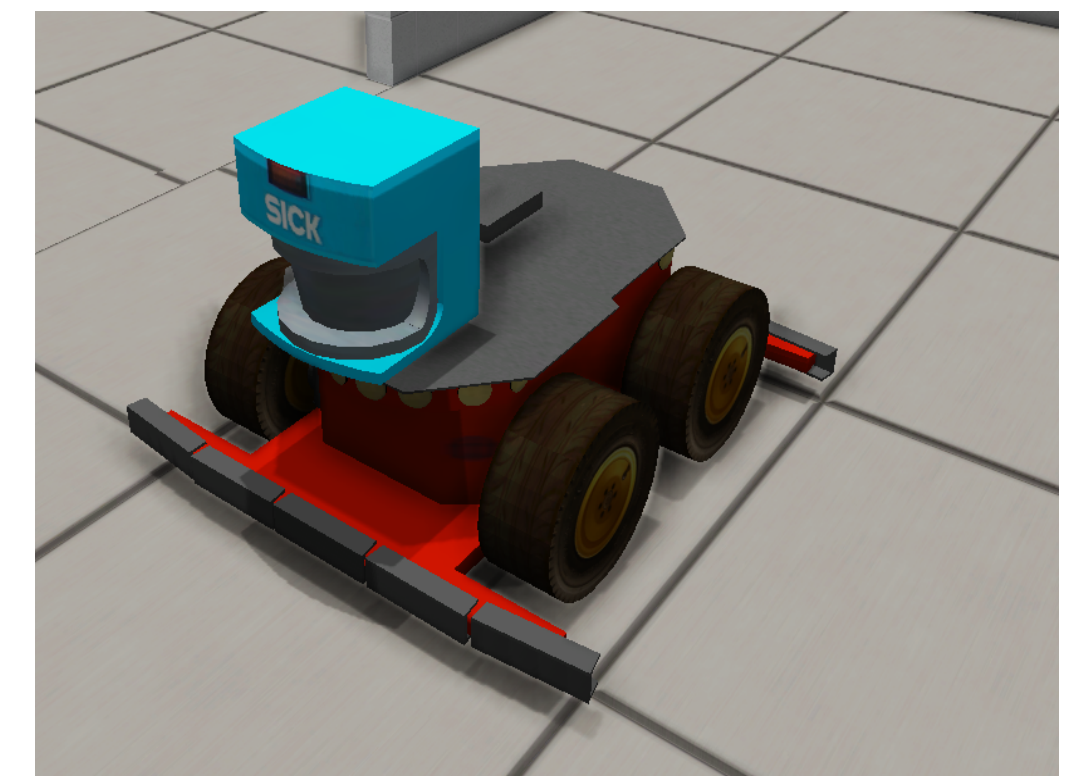
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RoboCup
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Introduction

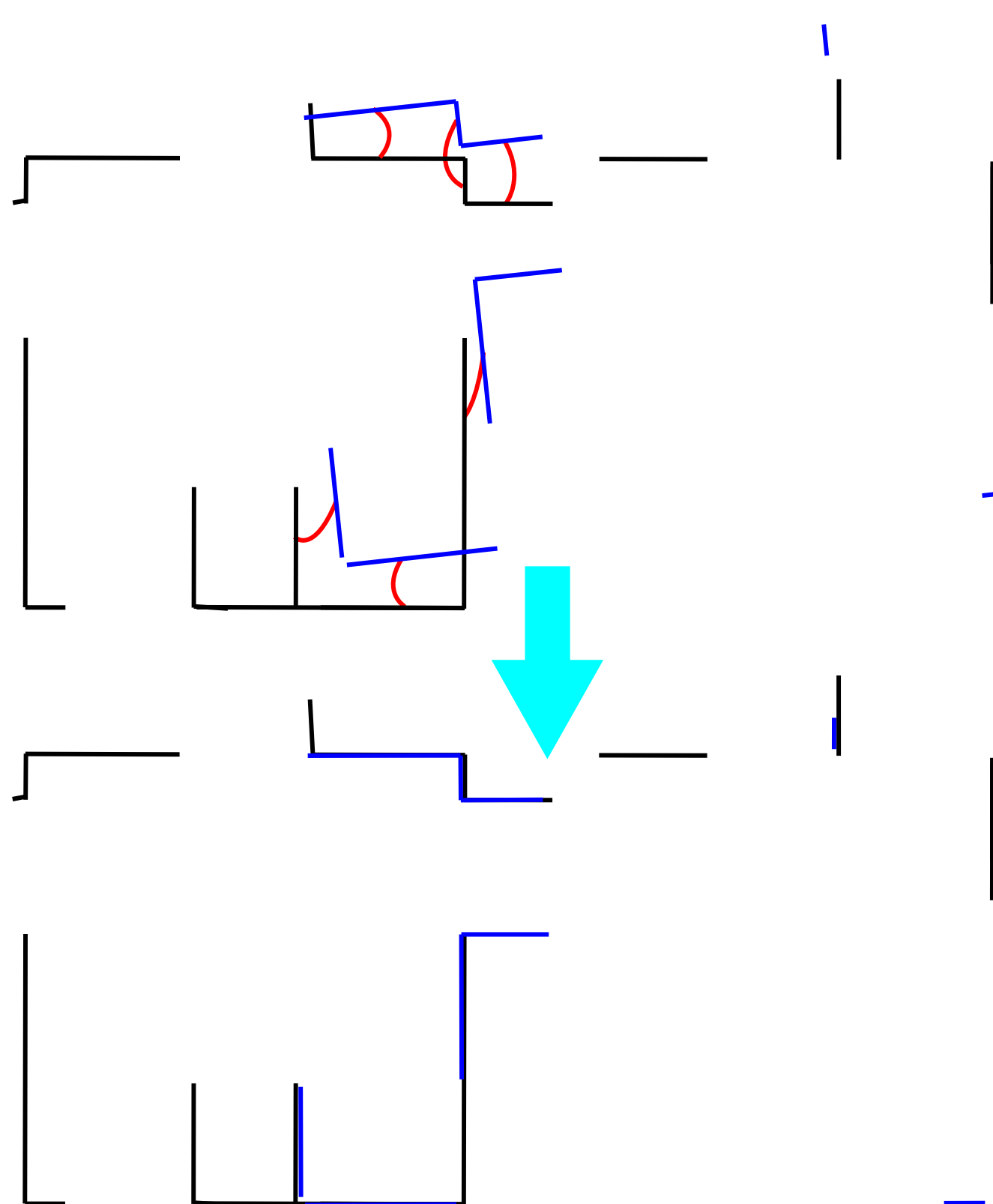
In developing PoAReT (Politecnico di Milano Autonomous Robotic Rescue Team), we tried to push along the *autonomy* axis and, this year, also to improve the *robustness*. The PoAReT system is basically composed of P3AT or Kenaf mobile platforms, equipped with laser range finders, sonars, and cameras. Laser range finders are used to build a geometrical map of the environment that is represented with two sets of line segments, representing (the edges of) perceived *obstacles* and the *frontiers*, namely the boundaries between the known and unknown portions of the environment. The system is also able to control AirRobots.



Overview

The main activities of the PoAReT system are: (a) building a geometrical map of the environment (SLAM), (b) selecting the most convenient frontiers to reach (exploration), (c) coordinating the allocation of robots to the frontiers, (d) maintaining a semantic map of the environment, (e) performing the detection of victims, and (f) managing the interaction with the human operator.

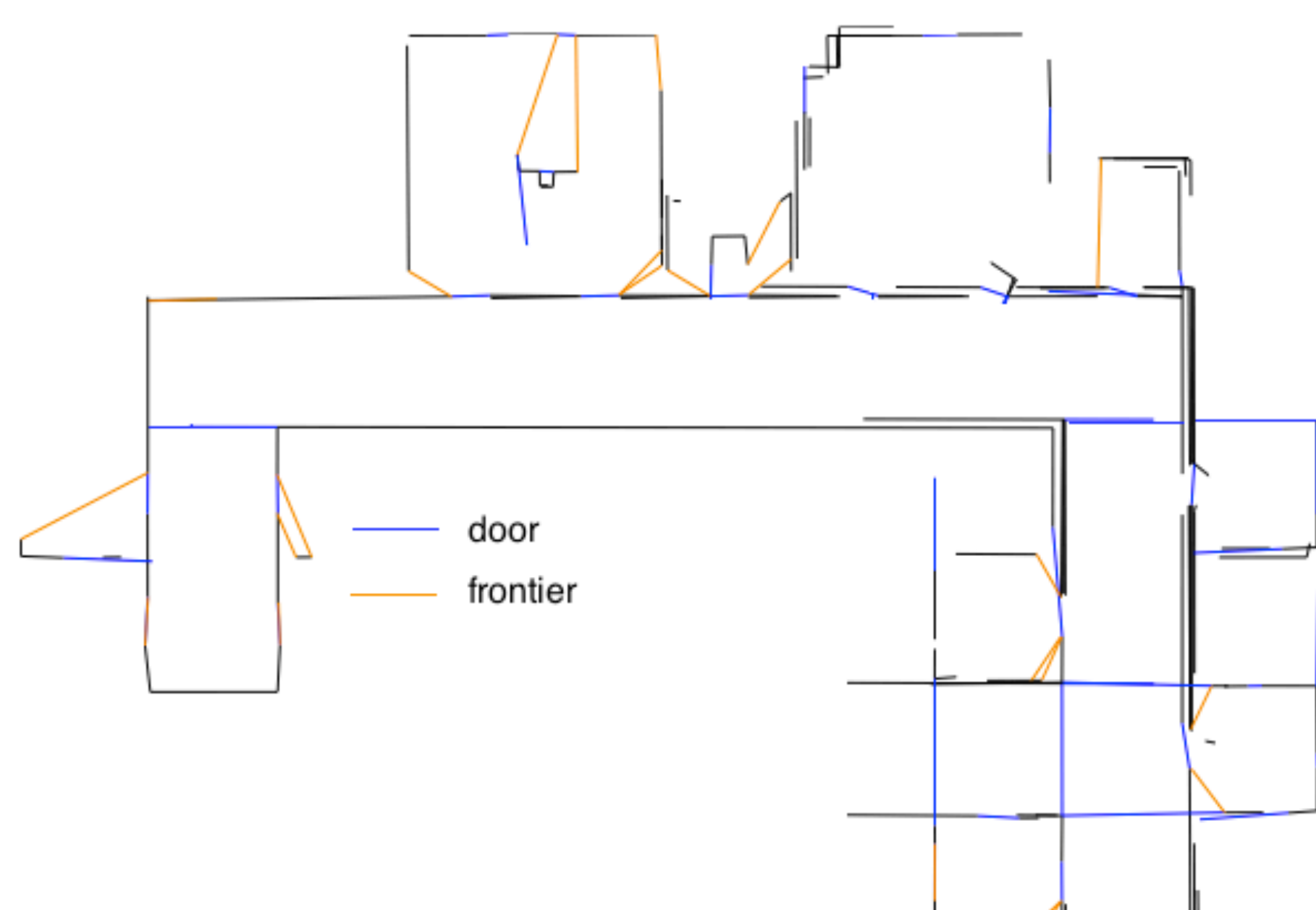
SLAM



- Novel iterative closest line (ICL) scan matching based on new definitions of distance between line segments.
- Singular geometries like corridors yield gross uncertainty along the tangential axis, but can be handled with a probabilistic framework.

Semantic Mapping

- Identification of doorways (and rooms) using geometrical features.
- Support to path planning.
- Introduction of new frontiers.



Communication

- Distance vector protocol allows communication in noisy environments and extends the operative range of robots.

Behavior-Based Control

- When a robot is stuck, a behavior-based approach is activated to incrementally reach close locations, until the path planner is able to successfully compute a path.

Exploration

- Frontiers are evaluated using the MCDM theoretical framework.
- Evaluation is based on several criteria, including information gain, distance of the frontier from the robot, battery consumption, probability of successful communication between robots and base station.

Coordination

- Market-based approach: auctions with minimum increment threshold to improve stability of assignments.

	Owned frontier	Minimum evaluation for interesting frontier	Frontier1	Frontier2	Frontier3	Frontier4	Frontier5
Robot1	31	34,1	21	23	63	11	55
Robot2	41	45,1	57	14	67	31	44
Robot3	15	16,5	88	27	54	22	7

Robot1-Frontier5, Robot2-Frontier3, Robot3-Frontier1.

Victim Detection

- Victim detection with a cascade classifier.
- HSV skin detection and subsequent skin blobs classification based on their shape and size.



User Interface

- Four levels of interaction: full autonomy, high-level commands, waypoint commands, and tele-operation.
- Fully customizable modular GUI with message filtering.
- Controllable video parameters (contrast and brightness).

