Autonomous Construction by a Mobile Robot in Unknown Environments with Scarce Resources

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LSRO
http://mobots.epfl.ch

Context
Autonomous construction by mobile robots would be useful in various situations, such as in outer space, in hazardous environments, but also for the building industry.

Related work

Applications demand

• flat environments
• readily available resources
• simples structures
• single structure type

• complex, 3D environments
• remote resources
• multi-layers structures
• various structures types

Hardware

magnetic gripper

proximity sensors

odometry

gyroscope

camera

Software architecture

user command

HTN planning

fused map / path planning

resources map

SLAM obstacle map

holes map

camera, proximity

scanner, gyro, odo.

ground, gripper

cameras, proximity

wheels, gripper

sensors

mapping

reasoning

acting

actuators

Symbol grounding

• probabilistic maps
• morphological operations
• fusion using by-pixel op.
• map regions labelization

Execution

• plan using symbols only
• ref. to geometrical data
• state machine for actions
• low-level through ASEBA

Target experiment

Initial situation:

area 1

area 2

gap

Goal:

• build a structure in area 1
• not enough res. at area 1
• must harvest from area 2
• must fill the gap first

current status: no camera, no sensing of remote resources

Preliminary result: gap passing

Preliminary result: structure building

Conclusion
We achieved autonomous construction, with reliability:
• gap passing: ~80%
• structure building: ~50%
Imperfect score due to imprecisions in positionning

Outlook
• cam. for remote resources
• quantitative results
• continual planning
• multiple robots
• complex structures
• raw building blocks

Contact and probe further
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Affordable SLAM through the Co-Design of Hardware, Software, and Methodology. Stéphane Magnenat, Valentin Longchamp, Michael Bonani, Philippe Ré tromaz, Paolo Germano, and Francesco Mondada. Accepted in ICRA 2010.
