

EXPLOITING SEMANTIC INFORMATION IN INDOOR ENVIRONMENTS

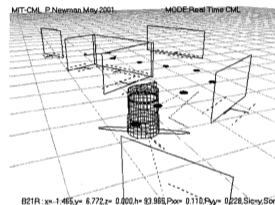
Mathias Fassini Mantelli

Federal University of Rio Grande do Sul
Institute of Informatics
Postgraduate Program in Computing

November 29, 2021

FIRST YEARS OF MOBILE ROBOTICS

- Ages of mobile robotics:
 - Classical age (1986-2004)



(A) Real Time CML¹



(B) Online mapping²

FIGURE: Initial works on SLAM

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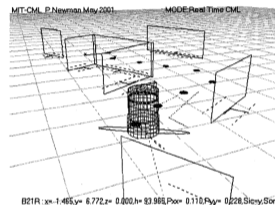
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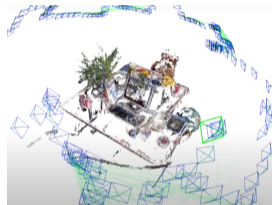
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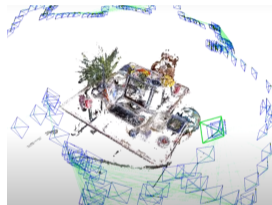
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 - Geometric perception

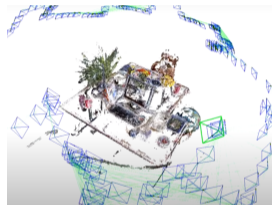
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GEOMETRIC PERCEPTION

- Useful for many **robotic tasks**

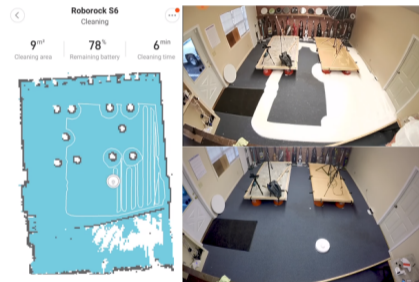


FIGURE: Vacuum cleaner robot in operation.⁵

⁵Extracted from [youtube.com/watch?v=5O8VmDiab3w](https://www.youtube.com/watch?v=5O8VmDiab3w)

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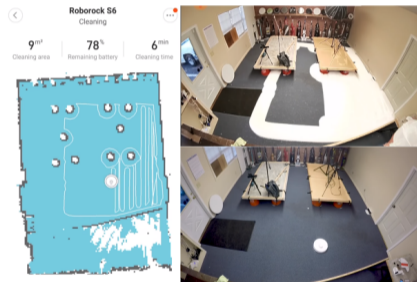


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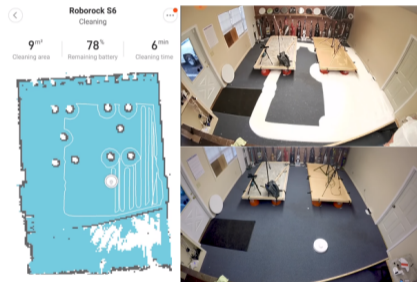


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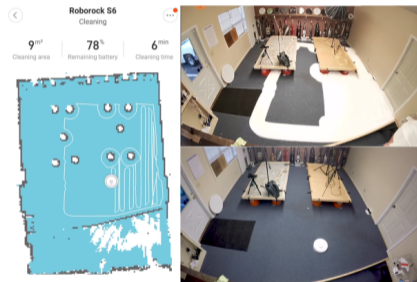


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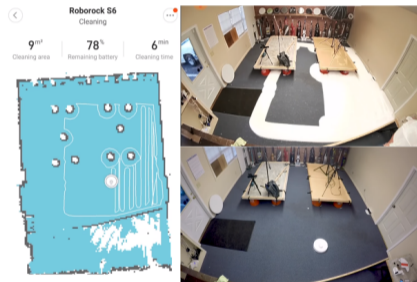


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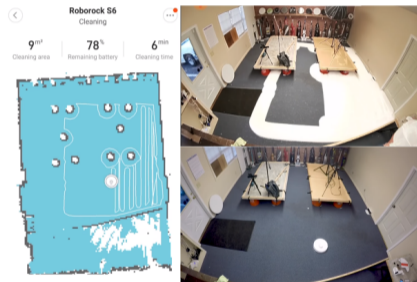


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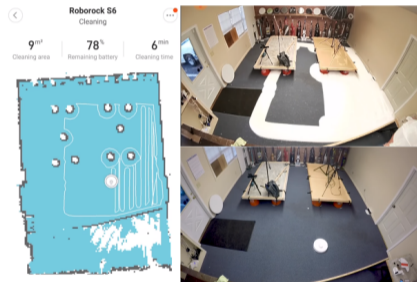


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- How to **overcome** these **limitations**?

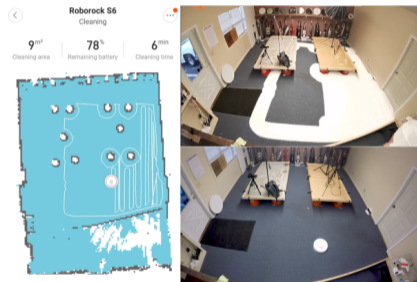


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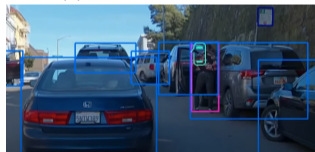
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EXPAND THE GEOMETRIC PERCEPTION

- **Understand** the **concepts** of parts of the **environment** (Semantic information)



(A) The siren of the fire truck



(B) The car door

FIGURE: Self-Driving System of an autonomous driving car.⁶

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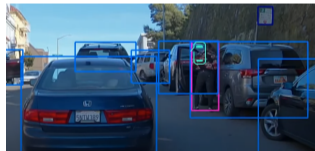
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- Essential for **high-level reasoning**



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HYPOTHESIS

Semantic information *associated with the* **spatial and temporal organization** *of the environment help mobile robotics to* **overcome the limitations to deal with high-level tasks**

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- **How** to perform the **inference/estimation** of the semantic information?
- **How** to **use** the **semantic information** to improve the **robot's performance**?
- We **investigate** this questions in the context of a **high-level task: object search (OS)**

OBJECT SEARCH (OS) TASK

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 - Semi-dynamic obstacles

PROBLEMS INVOLVED IN THIS WORK

- **Mobile robotics problems:**
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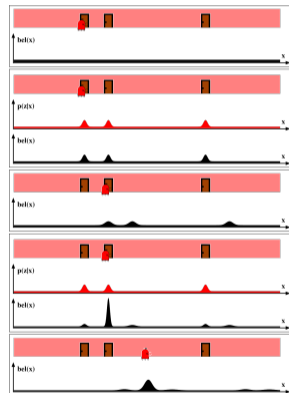


FIGURE: Illustration of the Markov localization algorithm.⁷

⁷Thrun, Sebastian. "Probabilistic robotics." Communications of the ACM 45.3 (2002): 52-57.

PROBLEMS INVOLVED IN THIS WORK

- **Mobile robotics** problems:
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FIGURE: Mapping with position indexed by odometry.⁸

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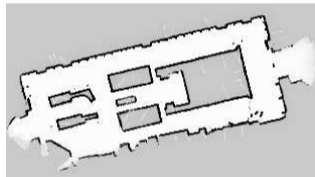


FIGURE: Occupancy grid map.⁹

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Text *as source of semantic information* for visual **object search in large and **unknown environments****

INTRODUCTION

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- Semantic information may be useful: search cues
- Level of abstraction of the environment

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- Semantic OS system for indoor environment

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- The novelties of this work:
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 - Textual information and organization of the environment
 - Analysis that highlights the advantages of the use of semantic information

SYSTEM OVERVIEW

- Our system is composed by:

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- An abstraction of the 2D grid map for grouping the detected door signs

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- The recognized numbers are associated to the map segments

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 - Distance

GROWING DIRECTION

- The

PARITY

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DOOR AND ROBOT ORIENTATIONS

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EXPERIMENTS AND RESULTS

- Simulated experiment setup

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- KTH map

EXPERIMENTS AND RESULTS

- Human participants in OS task

EXPERIMENTS AND RESULTS

- Physical Robot

CONCLUSIONS

- t

FUNDAMENTAÇÃO TEÓRICA

- Nós utilizamos essa abordagem
- Assim assim
- Assado

FUNDAMENTAÇÃO TEÓRICA

Nesta **abordagem** nós fizemos bla bla bla

- Exemplo de item
- Exemplo de item

THEOREM (MASS-ENERGY EQUIVALENCE)

$$E = mc^2$$

METODOLOGIA

Passos da metodologia

- 1 Statement
- 2 Explanation
- 3 Example

Explicando alguma coisa ... lorem ipsum dolor sit amet, consectetur adipiscing elit. Integer lectus nisl, ultricies in feugiat rutrum, porttitor sit amet augue. Aliquam ut tortor mauris. Sed volutpat ante purus, quis accumsan dolor.

RESULTADOS

Treatments	Response 1	Response 2
Treatment 1	0.0003262	0.562
Treatment 2	0.0015681	0.910
Treatment 3	0.0009271	0.296

TABLE: Table caption

RESULTADOS



CONCLUSÃO

- more work
- more responsibility
- more satisfaction

AGRADECIMENTOS

Agradeço a fulano, ciclano e beltrano que apoiaram o desenvolvimento dessa pesquisa.

REFERÊNCIAS I



Shuntaro Takahashi, Hiroyuki Furusawa, Takuya Ueda, and Yoshio Okahata.
Translation enhancer improves the ribosome liberation from translation initiation.
Journal of the American Chemical Society, 135(35):13096–13106, 2013.

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