

EXPLOITING SEMANTIC INFORMATION IN INDOOR ENVIRONMENTS

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Federal University of Rio Grande do Sul
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November 27, 2021

FIRST YEARS OF MOBILE ROBOTICS

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

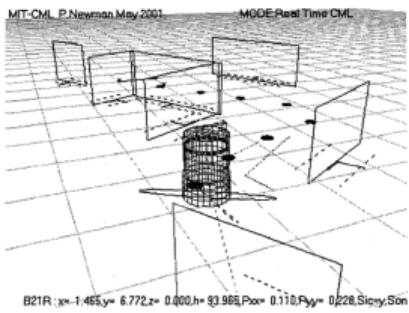
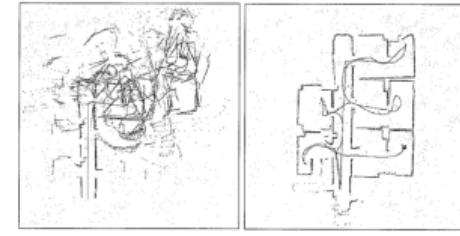
(A) Real Time CML¹(B) Online mapping²

FIGURE: Initial works on SLAM

¹ Newman, Paul, et al. "Explore and return: Experimental validation of real-time concurrent mapping and localization." ICRA, 2002

² Thrun, Sebastian. "An Online Mapping Algorithm for Teams of Mobile Robots". Carnegie-Mellon Univ Pittsburgh PA School of Computer Science 2000. [DOI](#) [PDF](#)

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 - ▶ **Introduction of the main probabilistic formulations for SLAM**
 - ▶ **Lidar and sonar sensors**

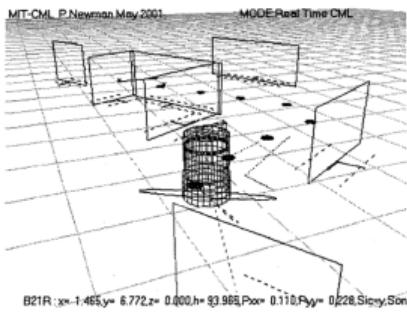
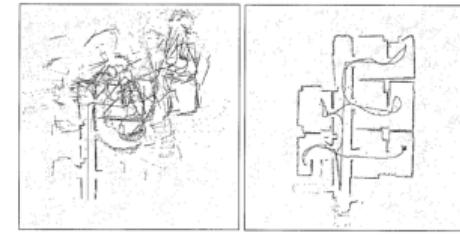
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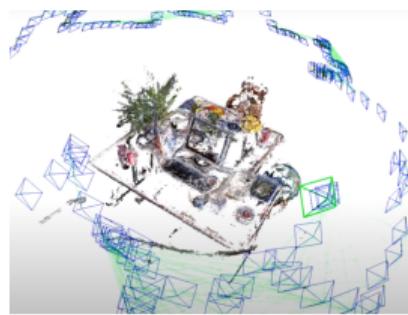
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FIGURE: Improved SLAM and Visual SLAM

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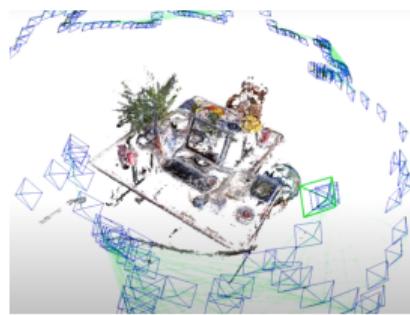
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 - **Geometric perception**

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GEOMETRIC PERCEPTION

- Useful for many **robotic tasks**

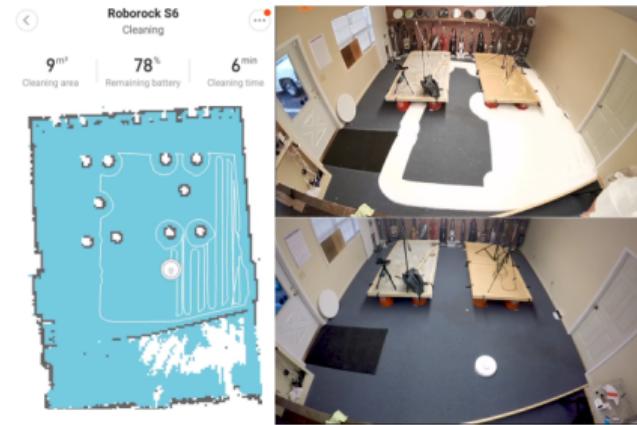


FIGURE: Vacuum cleaner robot in operation.⁵

⁵Extracted from youtube.com/watch?v=5O8VmDiab3w

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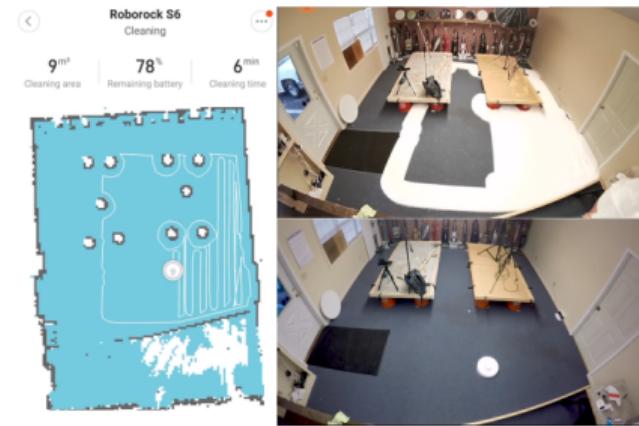


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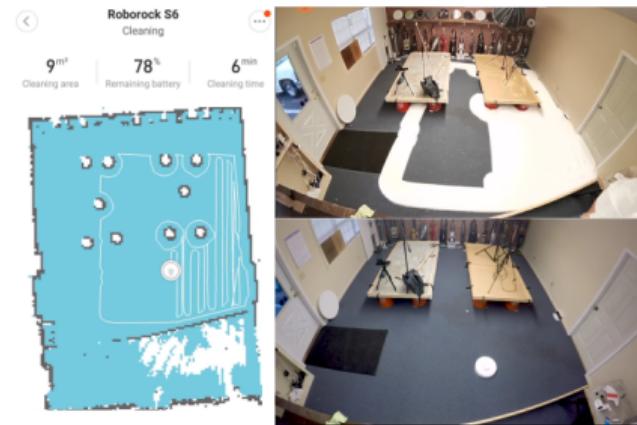


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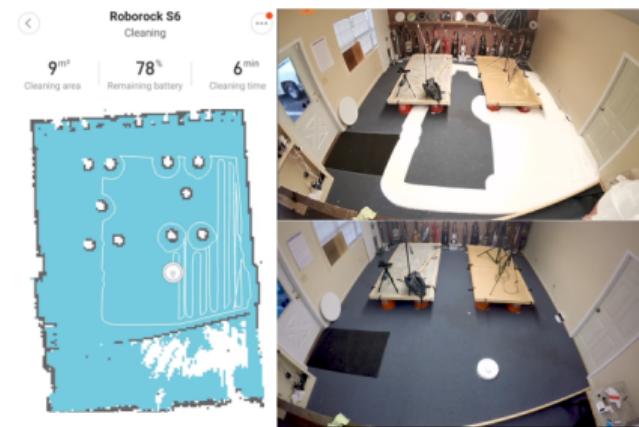


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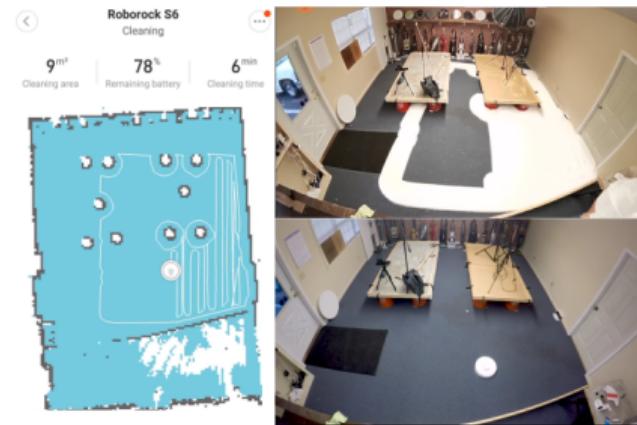


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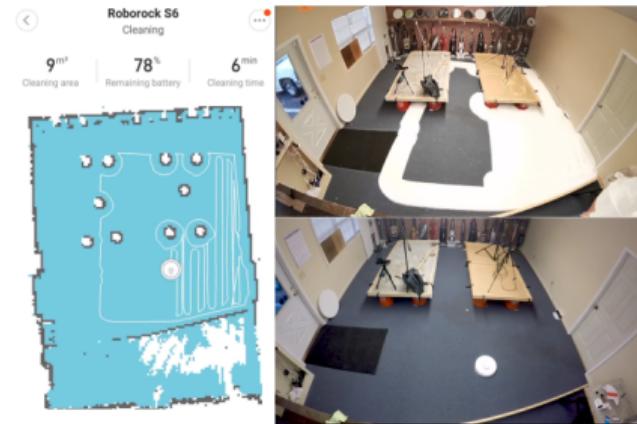


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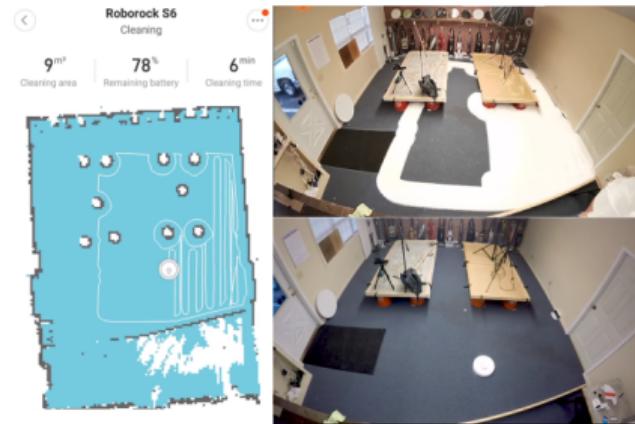


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- How to **overcome** these **limitations?**

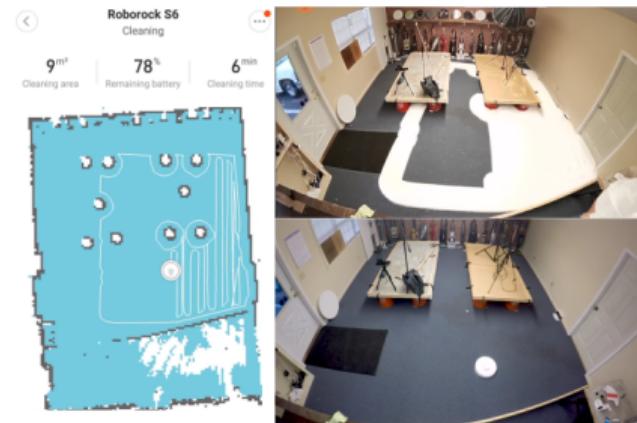


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EXPAND THE GEOMETRIC PERCEPTION

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



(A) The sire of the fire truck



(B) The car door

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

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EXPAND THE GEOMETRIC PERCEPTION

- **Understand the concepts** of parts of the **environment** (Semantic information)
- **Associate them** to the parts of the **map** (Semantic mapping)



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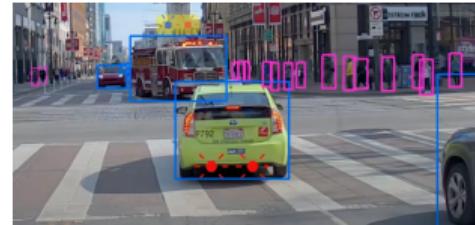
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EXPAND THE GEOMETRIC PERCEPTION

- **Understand the concepts** of parts of the **environment** (Semantic information)
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- Enhance robot's autonomy and robustness, **facilitate** more **complex tasks**



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- **Understand the concepts of parts of the environment** (Semantic information)
- **Associate them to the parts of the map** (Semantic mapping)
- Enhance robot's autonomy and robustness, **facilitate** more **complex tasks**
- 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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- **Which** type of **semantic information** is **relevant** to the **task**?

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SEMANTIC INFORMATION WITHIN MOBILE ROBOTICS

- **Which** type of **semantic information** is **relevant** to the **task**?
- **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

- Challenging and unsolved task for robots

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 - Texts
 - Semi-dynamic obstacles

PROBLEMS INVOLVED IN THIS WORK

- Mobile robotics problems:
 - Localization

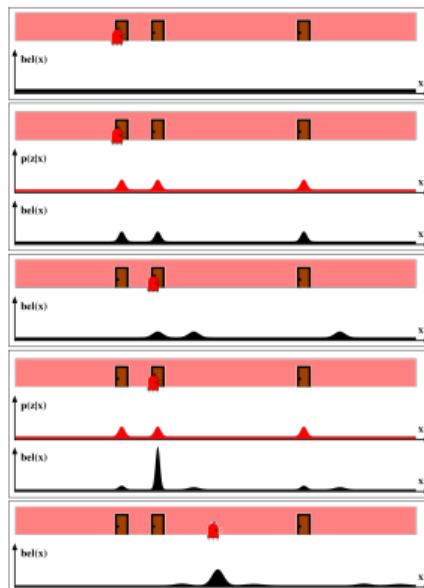


FIGURE: Illustration of the Markov localization algorithm.⁷

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

PROBLEMS INVOLVED IN THIS WORK

- **Mobile robotics** problems:
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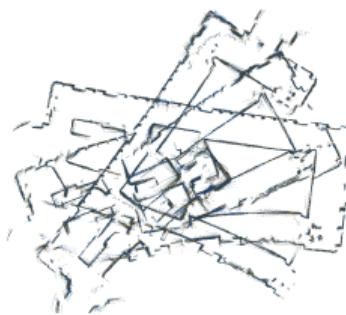


FIGURE: Mapping with position indexed by odometry.⁸

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PROBLEMS INVOLVED IN THIS WORK

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 - Simultaneous localization and mapping
(SLAM)

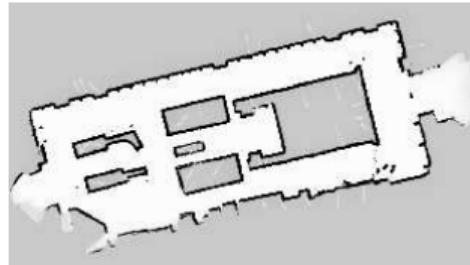


FIGURE: Occupancy grid map.⁹

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- **Mobile robotics** problems:
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- Types of OS problems:
 - The **map** and the **probability distribution** are **known**

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OBJETIVOS

OBJETIVO GERAL

O objetivo geral é fazer um algoritmo para calcular expressão gênica a partir de uma parte da sequência de RNA

OBJETIVOS ESPECÍFICOS

- Objetivo específico 1
- Objetivo específico 2
- Objetivo específico 3
- Objetivo específico 4

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

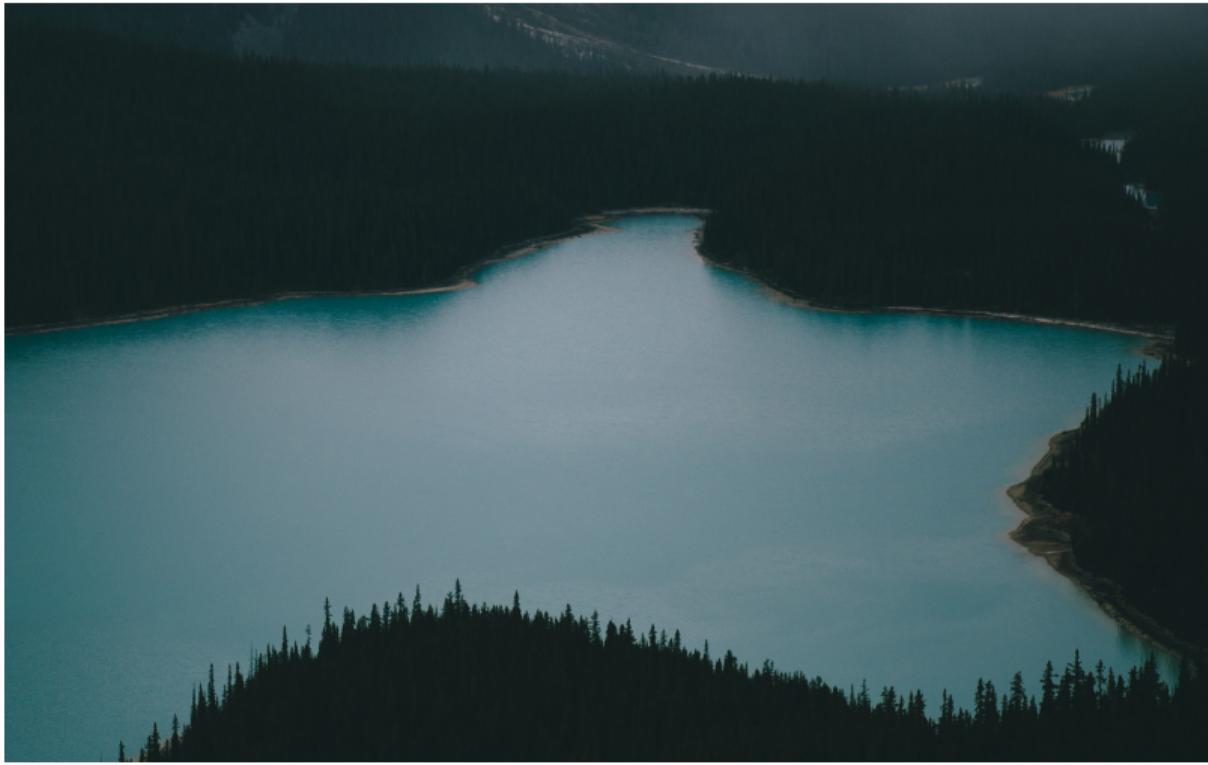
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RESULTADOS

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

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Translation enhancer improves the ribosome liberation from translation initiation.
Journal of the American Chemical Society, 135(35):13096–13106, 2013.

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