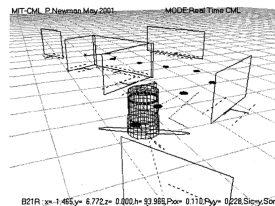# EXPLOITING SEMANTIC INFORMATION IN INDOOR ENVIRONMENTS

Mathias Fassini Mantelli

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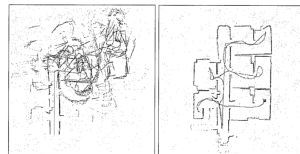Postgraduate Program in Computing

November 28, 2021

FIRST YEARS OF MOBILE ROBOTICS

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

(A) Real Time CML[1]

(B) Online mapping[2]

FIGURE: Initial works on SLAM

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

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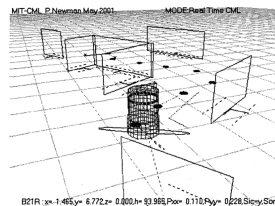   - ▶ **Lidar** and **sonar** sensors

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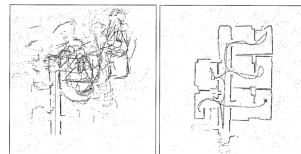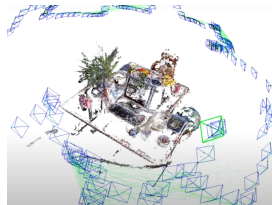   - **Lidar** and **sonar** sensors
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FIGURE: Improved SLAM and Visual SLAM

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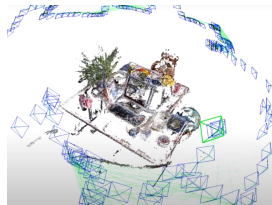   - **Visual** sensors

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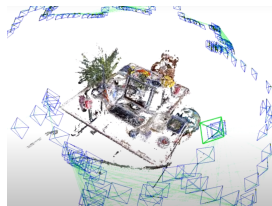 - **Geometric perception**

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GEOMETRIC PERCEPTION
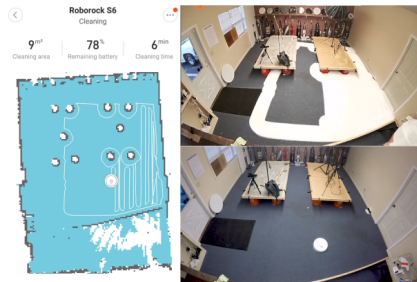
- Useful for many **robotic tasks**

FIGURE: Vacuum cleaner robot in operation.[5]

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

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- Useful for many **robotic tasks**
- Efficient for **building maps** and **state estimation**

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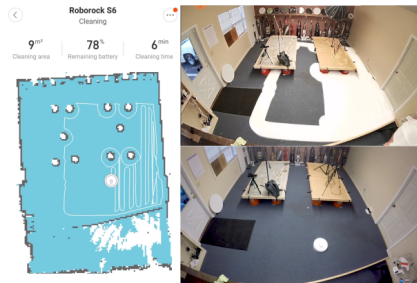- Efficient for **building maps** and **state estimation**
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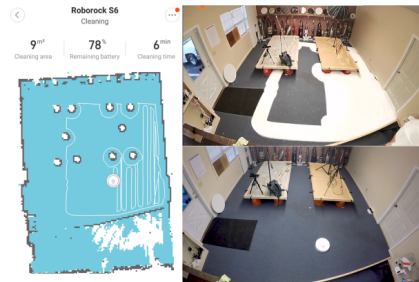- Suitable for **path-planning** and **obstacle avoidance**
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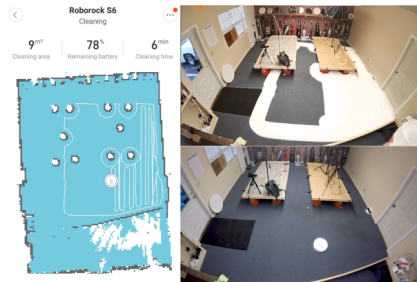- Suitable for **path-planning** and **obstacle avoidance**
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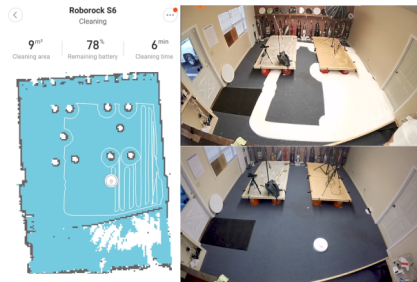- **Limitations**:
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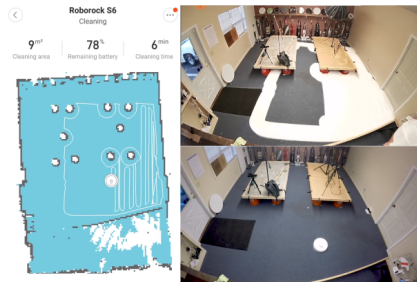 - Type of maps (free, occupied, unknown)
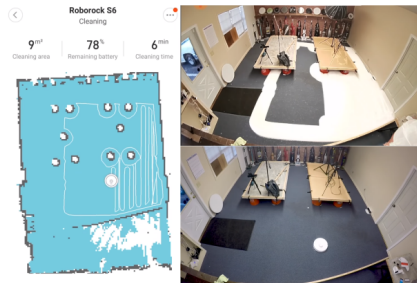 - Does not distinguish obstacles
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- How to **overcome** these **limitations**?
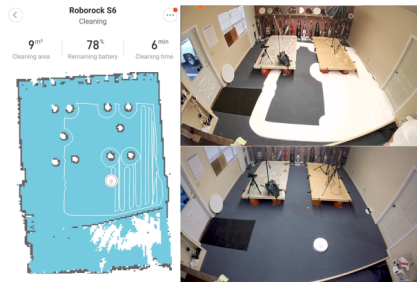
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EXPAND THE GEOMETRIC PERCEPTION

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

(A) The sire of the fire truck
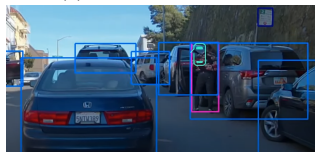
(B) The car door

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

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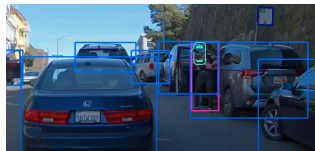
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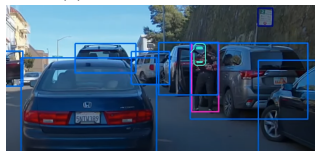
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Expand the geometric perception

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- **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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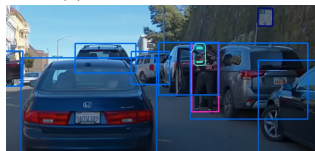
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HYPOTHESIS

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**

SEMANTIC INFORMATION WITHIN MOBILE ROBOTICS

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

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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**?
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- **How** to **use** the **semantic information** to improve the **robot's performance**?

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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- The robot **searches** for a **target object** in an **unknown environment**

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  - Texts
  - Semi-dynamic obstacles

PROBLEMS INVOLVED IN THIS WORK

- **Mobile robotics** problems:
  - **Localization**

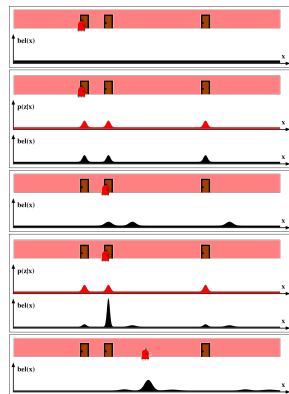FIGURE: Illustration of the Markov localization algorithm.[7]

---

[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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  - **Mapping**

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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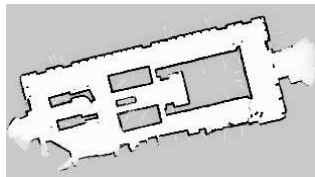 - Simultaneous localization and mapping (**SLAM**)
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Objetivos

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

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

Figure: Aqui temos a imagem de onde...

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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