复习PPT

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1. Describe how odometry errors on a mobile robot might occur and explain two methods

how they could be corrected.

Error type: Deterministic Non-deterministic

method: Calibration, 方法二没找到

2、IR和sonar或laser

【没找到答案,自己组织的】

当探查远距离的人时,使用红外比声纳更好,因为用声纳容易超出探测距离,且人可以释放红外辐射。

当需要成本低廉的近距离探测时,使用声纳更好,因为声纳价格低廉

When detecting people at a long distance, using IR is better because using sonar may exceed the detection distance and people can emit infrared radiation.

When low-cost close range detection is needed, it is better to use sonar because it is inexpensive 【声纳存在的问题:声音是锥形散开,柔性表面会吸收声能,且由于其他表面的反射可能造成测量误差】

3. Name 4 sensors discussed in this course that can resolve the range of objects? For each sensor named briefly explain how it works.

【不确定range of object怎么理解】

红外: 红外传感器通过测量物体反射回机器人的红外光量来确定与物体的距离

激光线传感器:通过测量光束返射回传感器所花费的时间来确定距离。

超声波传感器:发射脉冲并接收回声,统计往返时间来计算路径

Stereo vision传感器:立体视觉系统通过三角测量 (triangulation) 提供深度和完整的位置信息

4. Briefly explain the levels 1 to 4 of automation attributed to autonomous vehicles.

What is an Autonomous Vehicles

Level 0 (No automation)

Human is in complete and sole control of safety-critical functions (brake, throttle, steering) at all times.

Level 1 (Function-specific automation)

Human has complete authority, but cedes limited control to the vehicle in certain normal driving or crash imminent situations. Example: electronic stability control.

Level 2 (Combined function automation)

Automation of at least two control functions designed to work in harmony (e.g., adaptive cruise control and lane centering) in certain driving situations. Enables hands-off-wheel and foot-off-pedal operation. But driver still responsible for monitoring and safe operation and expected to resume control of the vehicle. Example: adaptive cruise control in conjunction with lane centering.

Level 3 (Limited self-driving)

Smart Driving Cars

Vehicle controls all safety functions under certain traffic and environmental conditions. Human can cede monitoring authority to vehicle, which must alert driver if conditions require transition to driver control.

Driver expected to be available for occasional control. Example: Google car

Level 4 (Full self-driving automation)

Vehicle controls all safety functions and monitors conditions for the entire trip. The human provides destination or navigation input but is not expected to be available for control during the trip. **Vehicle may operate while unoccupied**. Responsibility for safe operation rests solely on the automated system

6. Two methods for acquiring a map of the environment using odometry are outline segments and an occupancy grid. Explain these mapping methods.

【没找到outline segments,我理解为Continues Line-based representation,下面也是自己理解整理的】

Outline segments: represent things with set of lines of vector

Occupancy grid: split space into several areas and use a grid to represent an area to convert the 3D space to a 2D plane.

7. State one advantage an outdoor mobile robot has over an indoor mobile robot when navigating the environment? State one disadvantage an outdoor mobile robot has over an indoor mobile robot when navigating the environment?

【没找到,自己整理的,从室内室外环境进行分析,再结合第七章中的deliberate和react架构的优缺点】

室外机器人对突发情况的响应及时,能够响应各种非预设的情况,适合动态和非结构化的世界。室外机器人没有internal mode,无法随着时间的推移进行plan、learn and adapt

8. Briefly explain how a robot pool cleaner might go about navigating its environment.

【自己整理,思路 location and map,描述探测器】

- 1、首先使用sonar定位自己的位置,根据陀螺仪等确定当前自身状态。
- 2、如果原先没有internal model,则使用sonar分析环境,标记landmark,使用图像识别感知器,识别environment中需要clean的位置,标记为goal
- 3、如果有internal model则基于原有的model,识别landmark并进行相应的更新和导航
- 4、清理完成则识别并制定下一个goal
- 5、重复上述步骤直到清理完成

分区 CSCI944 的第 2 页

基于地图定位的步骤

- 1. 根据先前的估计和里程表进行预测。
- 2. 内置传感器(on-board sensors)观察。
- 3. 基于预测和地图的测量预测(measurement prediction)。
- 4. 将观测和地图进行匹配(matching)。
- 5. 估算 -> 位置更新 (后验位置)
- 9. Explain the difference between a mobile robot control systems that reacts to the environment and one that works by planning a path through the environment. List one advantage and one disadvantage of each of these controllers.

【参考第七章,deliberative 和 react方式】

deliberative是通过推理其动作的结果来计划任务的解决方案,然后再执行。控制过程包括 sensing, model updating, planning steps。

反应式控制的感觉输入与执行器紧密耦合(tightly coupled), 没有其他推理行为干预(no intervening reasoning)。

deliberative的优缺点:

优点

- 能进行关于突发情况(contingencies)的推理
- 计算给定任务的解决方案
- 目标导向(goal-directed)的策略
- 抗噪声和动态的稳健性。(robustness to noise and dynamics)

缺点

- 在存在不确定性的情况下,解决方案可能很脆弱(fragile)。
- · 需要频繁的重新计划。(requires frequent re-planning)
- 对变化和意外情况(unexpected situations)的反应相对缓慢。
- · 机器人并不是纯粹协商性(purely deliberative)的。

react方式的优缺点:

优点

- 反应式控制非常适合动态和非结构化的世界。因为在这些世界中,访问世界模型是一个不现实的选择。
- 最少的计算意味着反应性系统快速,稳键且适合用于最少的硬件平台(minimal hardware platform)。
- 能够及时响应快速变化的环境。
- 能够在非结构化环境中对可以事先确定的任务执行最佳性能。

缺点

- 反应型控制权衡了快速响应时间(fast reaction time)和推理复杂性(complexity of reasoning)。
- 不适合需要内部模型, 内存和学习的任务。
- 无法存储高级环境信息 high-level environment information (如地图),因此无法随着时间的推移进行规划plan,学习learn和适应 adapt。
- 10. In terms of sensing and control, explain how a bookmobile robot could navigate the

inside of a library building.

【和第8题类似,主要考虑区别在于,目标多变但相对固定,可以考虑对landmark进行拓扑分解,此外行人较多考虑避障,这里简写,详细参考8】

【感觉思路错了,怀疑需要考虑hybrid control架构,暂时无思路】 【定位、识别状态,识别外部环境,输入到hybrid control的planning层进行规划,遇到行人等特殊情况,输入到reactive层进行处理】

11、没找到piano mover,无思路