Introduction to Robotics CSCI/ARTI 4530/6530

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Announcements

- Mid-term exam will be on Thursday (Oct 4)

Agenda

- A quick solutions overview on Assignment 1
- For today
  - Robot simulations with Gazebo in ROS

Assignment 1

1. Inferring the results of a medical test:

Bayes Rule:

$p(Infl|+) = p(+|Infl).p(Infl)/p(+)$

$P(+) = p(+|Infl).p(Infl) + p(+|\sim Infl).p(\sim Infl)$

Answer = 16%

Assignment 1

4. Recursive Bayesian update

$$P(x \mid z_1, \ldots, z_n) = \frac{P(z_n \mid x)\, P(x \mid z_1, \ldots, z_{n-1})}{P(z_n \mid z_1, \ldots, z_{n-1})}$$

$$= \eta\, P(z_n \mid x)\, P(x \mid z_1, \ldots, z_{n-1})$$

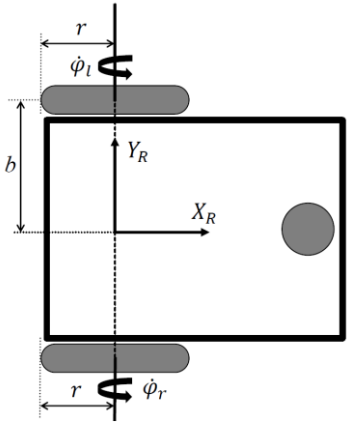
$$= \eta_{1\ldots n} \prod_{i=1\ldots n} P(z_i \mid x)\, P(x)$$

P(faulty) = p = 0.01, (sensing<1m) = 1/3

P(faulty|n-sensing<1m) = $\frac{p}{p + \frac{1}{3^n}(1-p)}$

Assignment 1

5. Differential drive kinematics



Forward kinematics solution

$$\begin{bmatrix}\dot{x}\\ \dot{y}\\ \dot{\theta}\end{bmatrix} = \begin{bmatrix} r/2 & r/2 \\ 0 & 0 \\ r/2b & -r/2b \end{bmatrix} \begin{bmatrix}\dot{\varphi}_r\\ \dot{\varphi}_l\end{bmatrix}$$

Forward velocity: $\dot{x} = r\frac{(\dot{\varphi}_r+\dot{\varphi}_l)}{2}$

No-sliding: $\dot{y} = 0$

Angular velocity: $\dot{\theta} = r\frac{(\dot{\varphi}_r-\dot{\varphi}_l)}{2b}$

Degree of Maneuverability

$\delta_m = 2, \quad \delta_s = 0, \quad \delta_M = 2$

Forward differential kinematics

$$\begin{bmatrix}\dot{x}\\ \dot{y}\\ \dot{\theta}\end{bmatrix} = \begin{bmatrix} r/2 & r/2 \\ 0 & 0 \\ r/2b & -r/2b \end{bmatrix} \begin{bmatrix}\dot{\varphi}_r\\ \dot{\varphi}_l\end{bmatrix}$$

Inverse differential kinematics

$$\begin{bmatrix}\dot{\varphi}_r\\ \dot{\varphi}_l\end{bmatrix} = \begin{bmatrix} 1/r & 0 & b/r \\ 1/r & 0 & -b/r \end{bmatrix} \begin{bmatrix}\dot{x}\\ \dot{y}\\ \dot{\theta}\end{bmatrix}$$

Assignment 1

5. Ackerman-steer kinematics

References:

http://www.fieldrobotics.org/users/alonzo/pubs/reports/WMR_Kinematics.pdf (pages 14-16)

http://correll.cs.colorado.edu/?p=1869

Today – Gazebo in ROS

Follow the below tutorial from Purdue.

https://github.com/SMARTlab-Purdue/ros-tutorial-gazebo-simulation

Today – Gazebo in ROS

For controlling the Husky robot in Gazebo with the Keyboard teleop node from Turtlesim, create a launch file (e.g., husky_teleop.launch) as shown below and place it in any of your ros package' launch folder.

```
<launch>
  <node pkg="turtlesim" type="turtle_teleop_key" name="teleop">
    <remap from="turtle1/cmd_vel" to="husky_velocity_controller/cmd_vel"/>
  </node>
</launch>
```