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
1. Inferring the results of a medical test:

Bayes Rule:

\[ p(\text{Infl}|+) = \frac{p(+|\text{Infl}).p(\text{Infl})}{p(+)} \]

\[ P(+) = p(+|\text{Infl}).p(\text{Infl}) + p(+|\sim\text{Infl}).p(\sim\text{Infl}) \]

Answer = 16%
Assignment 1

4. Recursive Bayesian update

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

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

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

\[P(\text{faulty}) = p = 0.01, \ (\text{sensing} < 1\text{m}) = 1/3\]

\[P(\text{faulty} \mid n\text{-sensing} < 1\text{m}) = \frac{p}{p + \frac{1}{3^n}(1 - p)}\]
5. Differential drive kinematics

Forward kinematics solution

\[
\begin{bmatrix}
\dot{x} \\
\dot{y} \\
\dot{\theta}
\end{bmatrix} = \begin{bmatrix}
r/2 & r/2 & \phi_r \\
0 & 0 & \phi_l \\
r/2b & -r/2b & 0
\end{bmatrix} \begin{bmatrix}
\phi_r \\
\phi_l
\end{bmatrix}
\]

Forward velocity: \( \dot{x} = r \frac{\phi_r + \phi_l}{2} \)

No-sliding: \( \dot{y} = 0 \)

Angular velocity: \( \dot{\theta} = r \frac{\phi_r - \phi_l}{2b} \)

Degree of Maneuverability

\( \delta_m = 2, \quad \delta_s = 0, \quad \delta_M = 2 \)

Forward differential kinematics

\[
\begin{bmatrix}
\dot{x} \\
\dot{y} \\
\dot{\theta}
\end{bmatrix} = \begin{bmatrix}
r/2 & r/2 & \phi_r \\
0 & 0 & \phi_l \\
r/2b & -r/2b & 0
\end{bmatrix} \begin{bmatrix}
\phi_r \\
\phi_l
\end{bmatrix}
\]

Inverse differential kinematics

\[
\begin{bmatrix}
\phi_r \\
\phi_l
\end{bmatrix} = \begin{bmatrix}
1/r & 0 & b/r \\
1/r & 0 & -b/r
\end{bmatrix} \begin{bmatrix}
\dot{x} \\
\dot{y} \\
\dot{\theta}
\end{bmatrix}
\]
Assignment 1

5. Ackerman-steer kinematics

References:


http://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
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>
```