# Assignment-2

Due date: November 10, 2016 at 11:59PM

**Notes:**

- This assignment is a group assignment. The group SHOULD be same group as course project.
- Make sure you installed ROS and configured your workspace as explained in the second tutorial.
- Get CatBot ROS package from SPC418 GitHub Repo: https://github.com/mahmoudabdulazim/src
- Anything handed in after the due date will be penalized by 50% for each 24 hours of lateness.

**What to submit**: a report that contains:

- A short assignment report reporting your observations and screenshots of the implemented code, typed or neatly handwritten.
- ROS-compatible code for all the included programming exercises.
- Zip the assignment report and the source code (including a README file) and name it "**Assignment2-Your Project#.zip**".
- Send this file to the course TA, Eng. Ahmed El-Sadek.

1. Write a node that subscribes to */catbot/joint_states* and extracts information about odometry from wheel joint velocities, and then re-publishes them as *nav_msgs/Odometry* message on a topic named */catbot/odom*. Add visualization for Odometry on rviz to visualize the odometry published on */catbot/odom*. **[2 Marks]**

2. Write a node that subscribes to *LaserScan* data, finds the maximum in the array of *LaserScan* data and publishes that on a separate topic as Float64. **[2 Marks]**

3. Write a node that subscribes to IMU data, and integrates it with time to get the velocity and position and publishes those on a separate topic as a custom defined message. **[2 Marks]**

4. Kinematics is the most basic study of how mechanical systems behave. In mobile robotics, we need to understand the mechanical behavior of the robot both in order to design appropriate autonomous vehicle for different tasks and to understand how to create control software for an instance of autonomous vehicle hardware. Suppose that a differential drive robot (Fig. 1) is rotating around the point ICC with an angular velocity $\omega(t)$. $D$ is the wheel separation. During the infinite short time $dt$ the robot will travel the distance from the point $P(t)$ to $P(t+dt)$ with a linear velocity $V(t)$. $V(t)$ has two perpendicular components, one along the $X$ axis - $V_x(t)$, and the other along the $Y$ axis - $V_y(t)$. For infinite short time we can assume that the robot is moving along a straight line tangent in the point $P(t)$ to the real trajectory of the robot.

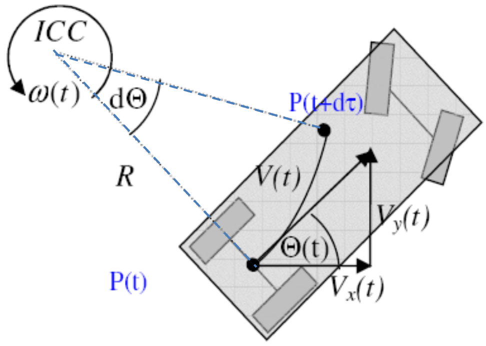


Fig. 1 Differential Drive

Assume the following:

- $x(k)$, $y(k)$, $\theta(k)$ are the components of the pose at the *k* step of the movement.
- $\Delta t$ is the interval (e.g. sampling period) between two sampling times.
- *D* is the wheel separation
- $d_L(k)$ and $d_R(k)$ are the distances traveled by left and right wheel respectively in last sampling period.

Using the kinematics equations of differential drive explained in Lecture 4, implement using ROS a *kinematic* node for CatBot that calculates and updates the position and orientation of the robot $x(k)$, $y(k)$, $\theta(k)$ given the distances traveled by left and right wheel respectively in last sampling period $d_L(k)$, $d_R(k)$. Next is use rviz to animate the motion of the robot that is generated from the Kinematic node. **[4 Marks]**