

# SE498 Introduction to Autonomous Vehicle System

## Laboratory Assignment 2: Turtlesim Robot Simulation

### Goals for this Lab Assignment:

1. Learn turtlesim structure.
2. Learn how to drive turtlesim robot around.
3. Learn how to get states of turtlesim robot and drive it to a desired orientation and location (P controller).

### Exercise 1 - Learn turtlesim

Open terminal 1

```
$ roscore
```

Open terminal 2

```
$ rosrun turtlesim turtlesim_node
```

Open terminal 3

```
$ rostopic list
```

/turtle1/pose – get turtle state's info

/turtle1/cmd\_vel – drive turtle to move around

Open terminal 4

```
$ rostopic type /turtle1/pose
```

```
$ rostopic type /turtle1/pose | rosmmsg show
```

```
$ rostopic type /turtle1/cmd_vel
```

```
$ rostopic type /turtle1/cmd_vel | rosmmsg show
```

Reference: <http://wiki.ros.org/turtlesim>

### Exercise 2 - Learn how to create ROS package to control turtlesim

Download se498\_lab2 package from website extract it and put it under ~/catkin\_NETID/src/

website: <http://coecsl.ece.illinois.edu/se498/>

Open terminal 1

```
$ cd ~/catkin_NETID
```

```
$ catkin_make
```

```
$ source devel/setup.bash
```

```
$ roscore
```

Open terminal 2

```
$ cd ~/catkin_NETID
```

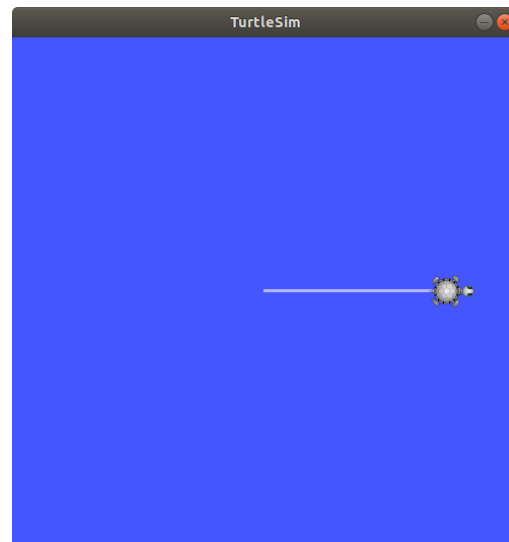
```
$ source devel/setup.bash
```

```
$ rosrun turtlesim turtlesim_node
```

```
3$ cd ~/catkin_NETID
$ cd ~/catkin_NETID
$ source devel/setup.bash
$ rosrn se498_lab2 lab2_node
```

```
Enter speed: 1
Enter distance: 4
Move forward? (1 or 0): 1
```

Ctrl+c to exit

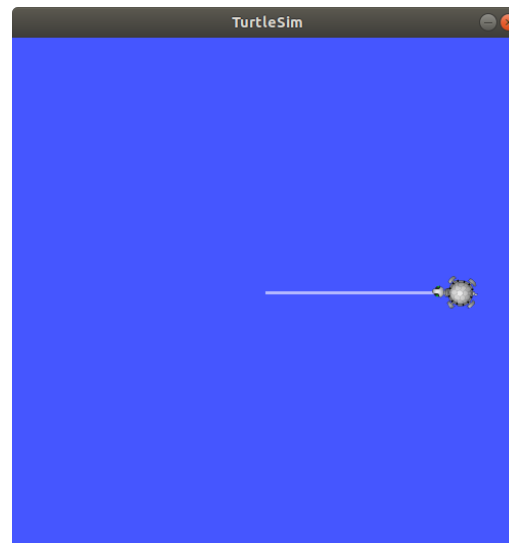


Open terminal

In Exercise 2, you need to finish the void rotate() function, so that the robot can rotate around its z-axis at a given speed by a given angle and direction. The only file you need to modify is lab2.cpp

```
Enter angular_speed (degree/s): 30
Enter angle (degrees): 180
Clockwise? (1 or 0): 1
```

Ctrl+c to exit



Reference: <http://wiki.ros.org/turtlesim>

### Exercise 3 - Learn how to get states of turtlesim robot and drive it to a desired orientation and location

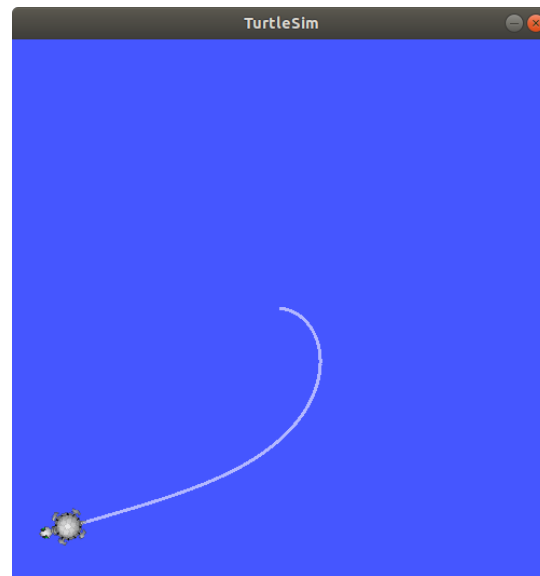
- (1) Finish poseCallback function which subscribes topic /turtle1/pose.
- (2) Finish moveGoal function so that turtlesim robot can be drive to a desired orientation and location.

```
Open terminal 1
$ cd ~/catkin_NETID
$ catkin_make
$ source devel/setup.bash
$ roscore
```

Open terminal 2\$ cd ~/catkin\_NETID  
\$ cd ~/catkin\_NETID  
\$ source devel/setup.bash  
\$ rosrn turtlesim turtlesim\_node

Open terminal 3  
\$ cd ~/catkin\_NETID  
\$ source devel/setup.bash  
\$ rosrn se498\_lab2 lab2\_node

Desired location: (1, 1)



### Moving to a Point $(x^*, y^*)$ in the 2D plane

■ Linear velocity  $v^* = K_v \sqrt{(x^* - x)^2 + (y^* - y)^2}$

■ Steering Angle  $\theta^* = \tan^{-1} \frac{y^* - y}{x^* - x}$

■ Proportional Controller  $\gamma = K_h(\theta^* \ominus \theta)$ ,  $K_h > 0$

■ turns the steering wheel toward the target