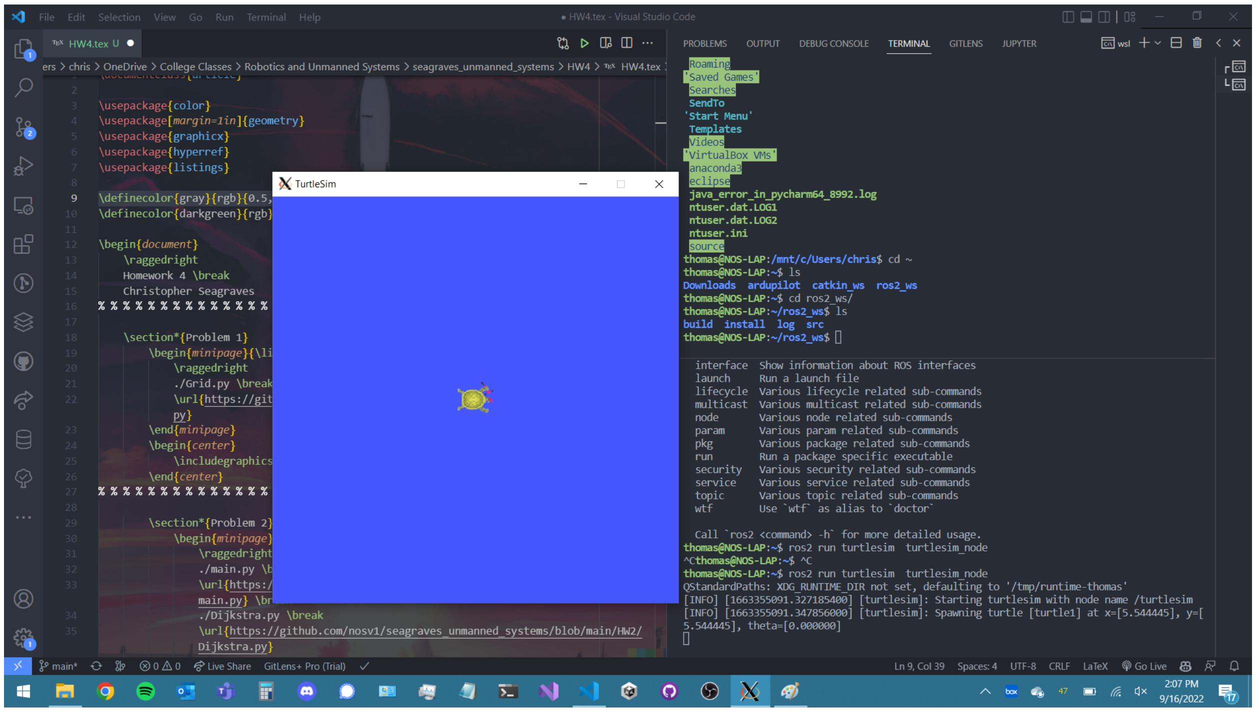
Homework 4
Christopher Seagraves

Problem 1

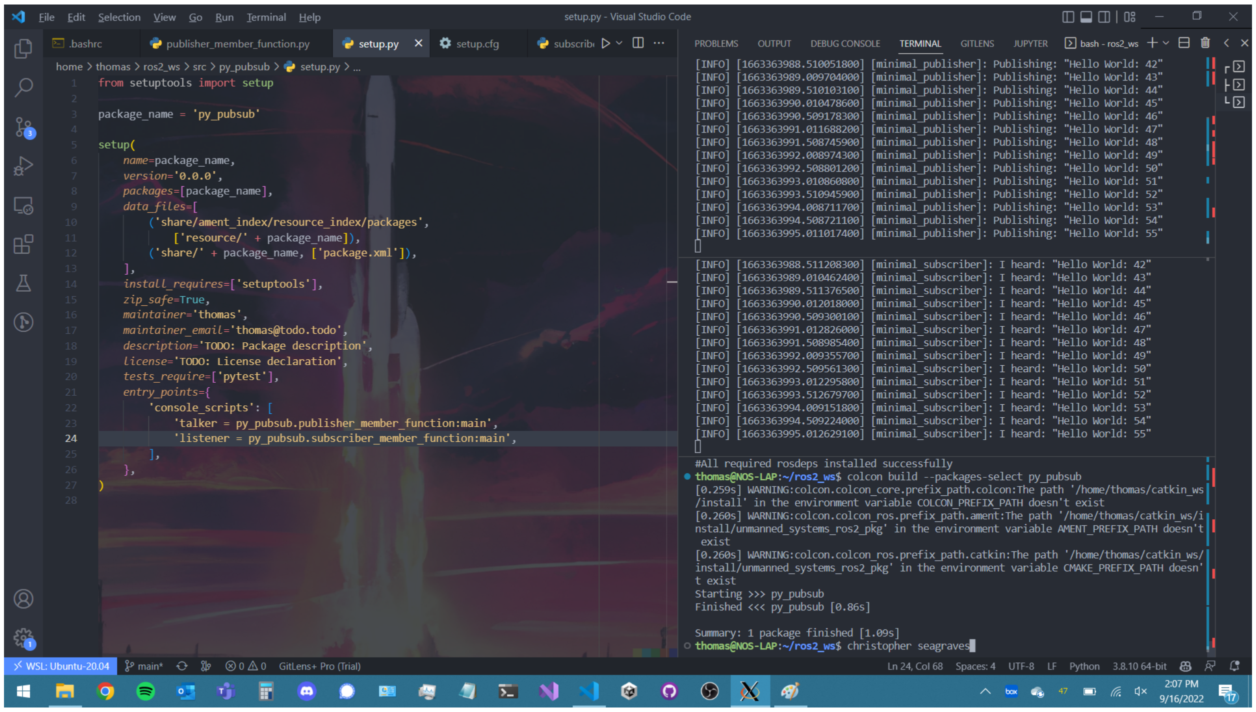

File Edit Selection View Go Run Terminal Help
● HW4.tex - Visual Studio Code
HW4.tex U
ers > chris > OneDrive > College Classes > Robotics and Unmanned Systems > seagraves_unmanned_systems > HW4 > HW4.tex
TurtleSim
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL GITLENS JUPYTER
wsl
main* ⊗ 0 ⚠ 0 Live Share GitLens+ Pro (Trial)
Ln 9, Col 39 Spaces: 4 UTF-8 CRLF LaTeX Go Live
2:07 PM 9/16/2022

```
\usepackage{color}
\usepackage[margin=1in]{geometry}
\usepackage{graphicx}
\usepackage{hyperref}
\usepackage{listings}

\definecolor{gray}{rgb}{0.5,
\definecolor{darkgreen}{rgb}

\begin{document}
    \raggedright
    Homework 4 \break
    Christopher Seagraves
% % % % % % % % % % % % % %

    \section*{Problem 1}
        \begin{minipage}{\li
            \raggedright
            ./Grid.py \break
            \url{https://git
            py}
        \end{minipage}
        \begin{center}
            \includegraphics
        \end{center}
% % % % % % % % % % % % % %

        \section*{Problem 2}
            \begin{minipage}
                \raggedright
                ./main.py \b
                \url{https:/
                main.py} \br
                ./Dijkstra.py \break
                \url{https://github.com/nosv1/seagraves_unmanned_systems/blob/main/HW2/
                Dijkstra.py}
```

```
 Roaming
'Saved Games'
 Searches
 SendTo
'Start Menu'
 Templates
 Videos
'VirtualBox VMs'
 anaconda3
 eclipse
 java_error_in_pycharm64_8992.log
 ntuser.dat.LOG1
 ntuser.dat.LOG2
 ntuser.ini
 source
thomas@NOS-LAP:/mnt/c/Users/chris$ cd ~
thomas@NOS-LAP:~$ ls
Downloads  ardupilot  catkin_ws  ros2_ws
thomas@NOS-LAP:~$ cd ros2_ws/
thomas@NOS-LAP:~/ros2_ws$ ls
build  install  log  src
thomas@NOS-LAP:~/ros2_ws$ 
```

```
  interface  Show information about ROS interfaces
  launch     Run a launch file
  lifecycle  Various lifecycle related sub-commands
  multicast  Various multicast related sub-commands
  node       Various node related sub-commands
  param      Various param related sub-commands
  pkg        Various package related sub-commands
  run        Run a package specific executable
  security   Various security related sub-commands
  service    Various service related sub-commands
  topic      Various topic related sub-commands
  wtf        Use `wtf` as alias to `doctor`

  Call `ros2 <command> -h` for more detailed usage.
thomas@NOS-LAP:~$ ros2 run turtlesim  turtlesim_node
^Cthomas@NOS-LAP:~$ ^C
thomas@NOS-LAP:~$ ros2 run turtlesim  turtlesim_node
QStandardPaths: XDG_RUNTIME_DIR not set, defaulting to '/tmp/runtime-thomas'
[INFO] [1663355091.327185400] [turtlesim]: Starting turtlesim with node name /turtlesim
[INFO] [1663355091.347856000] [turtlesim]: Spawning turtle [turtle1] at x=[5.544445], y=[
5.544445], theta=[0.000000]
```

Problem 2


File Edit Selection View Go Run Terminal Help
setup.py - Visual Studio Code
.bashrc publisher_member_function.py setup.py setup.cfg subscrib
home > thomas > ros2_ws > src > py_pubsub > setup.py > ...
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL GITLENS JUPYTER
bash - ros2_ws
WSL: Ubuntu-20.04 main* ⊗ 0 ⚠ 0 GitLens+ Pro (Trial)
Ln 24, Col 68 Spaces: 4 UTF-8 LF Python 3.8.10 64-bit
2:07 PM 9/16/2022

```python
from setuptools import setup

package_name = 'py_pubsub'

setup(
    name=package_name,
    version='0.0.0',
    packages=[package_name],
    data_files=[
        ('share/ament_index/resource_index/packages',
            ['resource/' + package_name]),
        ('share/' + package_name, ['package.xml']),
    ],
    install_requires=['setuptools'],
    zip_safe=True,
    maintainer='thomas',
    maintainer_email='thomas@todo.todo',
    description='TODO: Package description',
    license='TODO: License declaration',
    tests_require=['pytest'],
    entry_points={
        'console_scripts': [
            'talker = py_pubsub.publisher_member_function:main',
            'listener = py_pubsub.subscriber_member_function:main',
        ],
    },
)
```

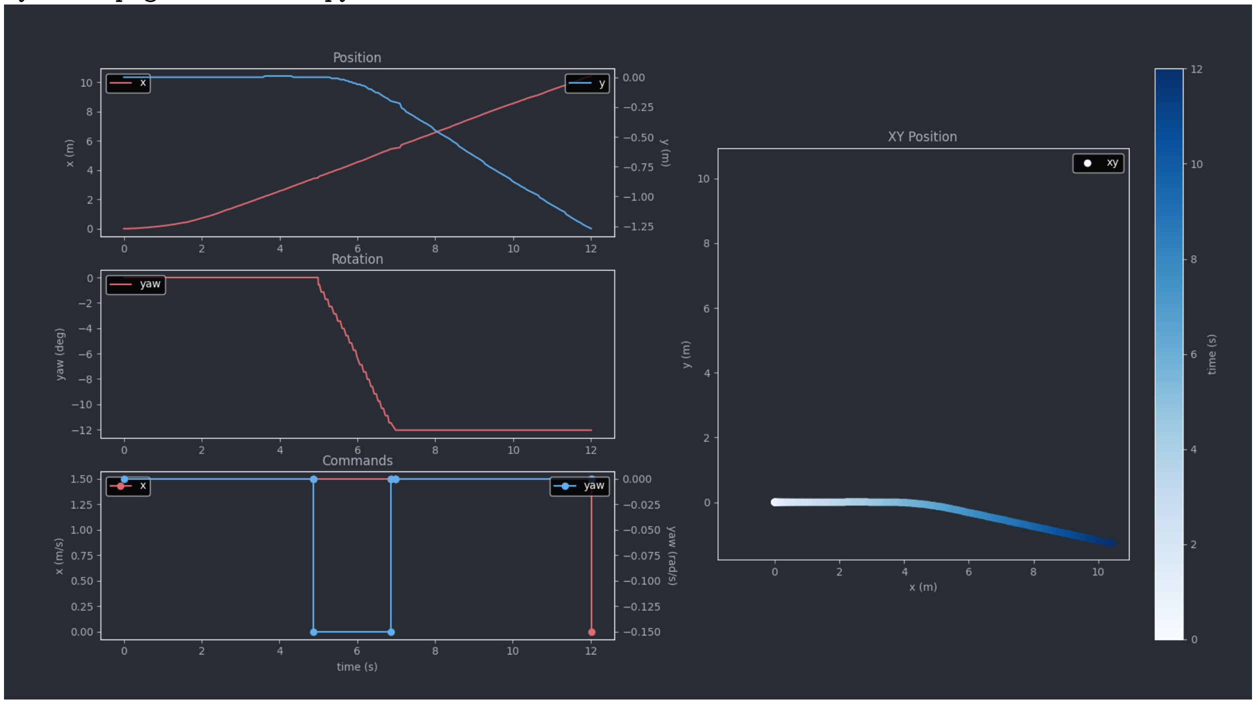
```
[INFO] [1663363988.510051800] [minimal_publisher]: Publishing: "Hello World: 42"
[INFO] [1663363989.009704000] [minimal_publisher]: Publishing: "Hello World: 43"
[INFO] [1663363989.510103100] [minimal_publisher]: Publishing: "Hello World: 44"
[INFO] [1663363990.010478600] [minimal_publisher]: Publishing: "Hello World: 45"
[INFO] [1663363990.509178300] [minimal_publisher]: Publishing: "Hello World: 46"
[INFO] [1663363991.011688200] [minimal_publisher]: Publishing: "Hello World: 47"
[INFO] [1663363991.508745900] [minimal_publisher]: Publishing: "Hello World: 48"
[INFO] [1663363992.008974300] [minimal_publisher]: Publishing: "Hello World: 49"
[INFO] [1663363992.508801200] [minimal_publisher]: Publishing: "Hello World: 50"
[INFO] [1663363993.010860800] [minimal_publisher]: Publishing: "Hello World: 51"
[INFO] [1663363993.510945900] [minimal_publisher]: Publishing: "Hello World: 52"
[INFO] [1663363994.008711700] [minimal_publisher]: Publishing: "Hello World: 53"
[INFO] [1663363994.508721100] [minimal_publisher]: Publishing: "Hello World: 54"
[INFO] [1663363995.011017400] [minimal_publisher]: Publishing: "Hello World: 55"
```

```
[INFO] [1663363988.511208300] [minimal_subscriber]: I heard: "Hello World: 42"
[INFO] [1663363989.010462400] [minimal_subscriber]: I heard: "Hello World: 43"
[INFO] [1663363989.511376500] [minimal_subscriber]: I heard: "Hello World: 44"
[INFO] [1663363990.012018000] [minimal_subscriber]: I heard: "Hello World: 45"
[INFO] [1663363990.509300100] [minimal_subscriber]: I heard: "Hello World: 46"
[INFO] [1663363991.012826000] [minimal_subscriber]: I heard: "Hello World: 47"
[INFO] [1663363991.508985400] [minimal_subscriber]: I heard: "Hello World: 48"
[INFO] [1663363992.009355700] [minimal_subscriber]: I heard: "Hello World: 49"
[INFO] [1663363992.509561300] [minimal_subscriber]: I heard: "Hello World: 50"
[INFO] [1663363993.012295800] [minimal_subscriber]: I heard: "Hello World: 51"
[INFO] [1663363993.512679700] [minimal_subscriber]: I heard: "Hello World: 52"
[INFO] [1663363994.009151800] [minimal_subscriber]: I heard: "Hello World: 53"
[INFO] [1663363994.509224000] [minimal_subscriber]: I heard: "Hello World: 54"
[INFO] [1663363995.012629100] [minimal_subscriber]: I heard: "Hello World: 55"
```

```
#All required rosdeps installed successfully
thomas@NOS-LAP:~/ros2_ws$ colcon build --packages-select py_pubsub
[0.259s] WARNING:colcon.colcon_core.prefix_path.colcon:The path '/home/thomas/catkin_ws
/install' in the environment variable COLCON_PREFIX_PATH doesn't exist
[0.260s] WARNING:colcon.colcon_ros.prefix_path.ament:The path '/home/thomas/catkin_ws/i
nstall/unmanned_systems_ros2_pkg' in the environment variable AMENT_PREFIX_PATH doesn't
 exist
[0.260s] WARNING:colcon.colcon_ros.prefix_path.catkin:The path '/home/thomas/catkin_ws/
install/unmanned_systems_ros2_pkg' in the environment variable CMAKE_PREFIX_PATH doesn'
t exist
Starting >>> py_pubsub
Finished <<< py_pubsub [0.86s]

Summary: 1 package finished [1.09s]
thomas@NOS-LAP:~/ros2_ws$ christopher seagraves
```

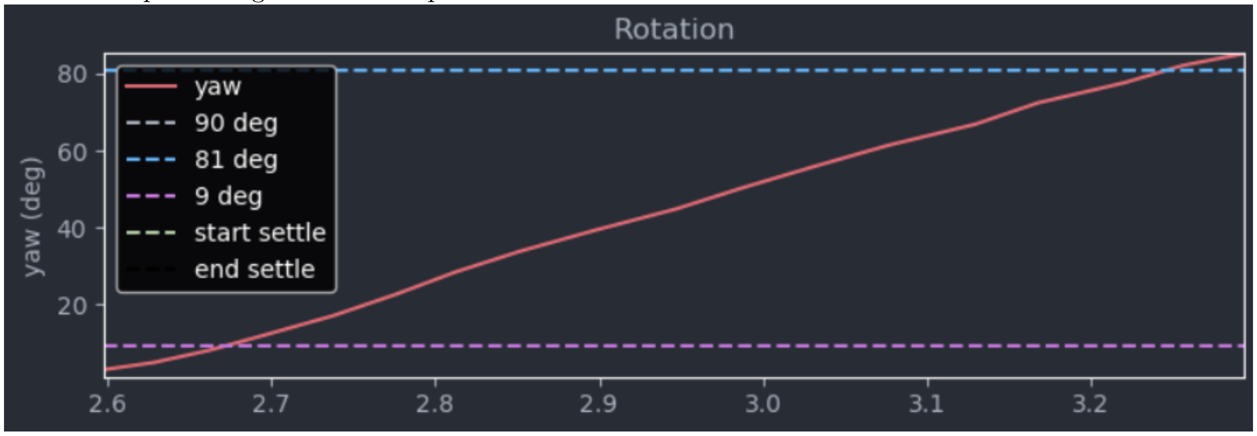
Problem 3

controller.py
`https://github.com/nosv1/seagraves_unmanned_systems_pkg/blob/master/seagraves_unmanned_systems_pkg/controller.py`

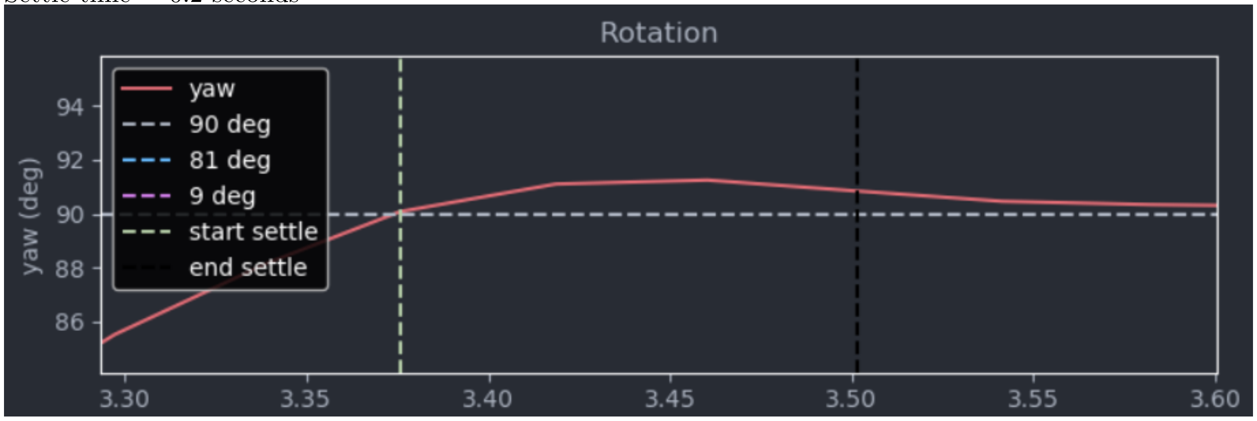


Problem 4

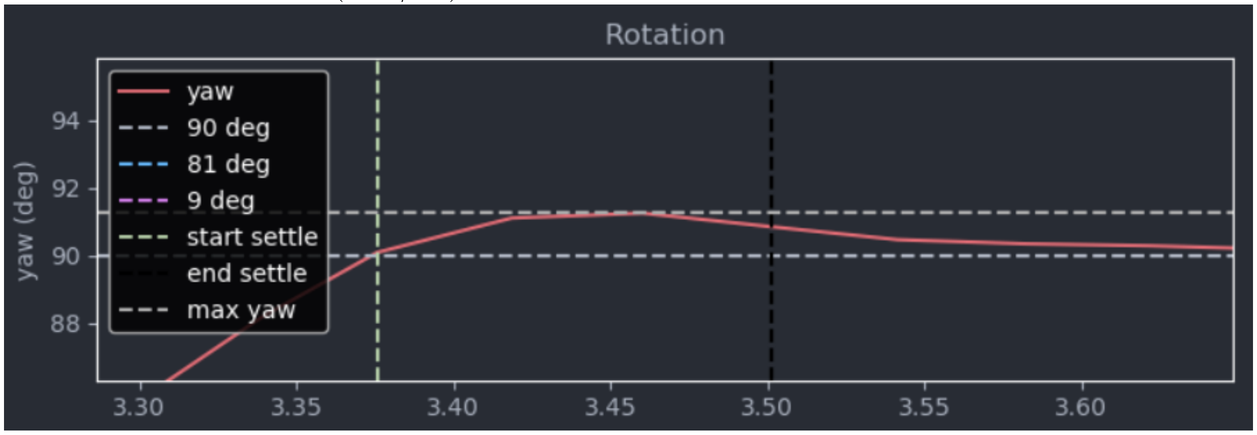
Kp = 6.5, Ki = 0.0, Kd = 0.0
Rise time = 0.6 seconds
Given Burger can turn at 2.84 rad/s (162.4 deg/s), it can complete a 90 degree turn in 0.55 seconds - about .05 seconds per 10 degrees - so the optimal rise time would be about 0.44 seconds.

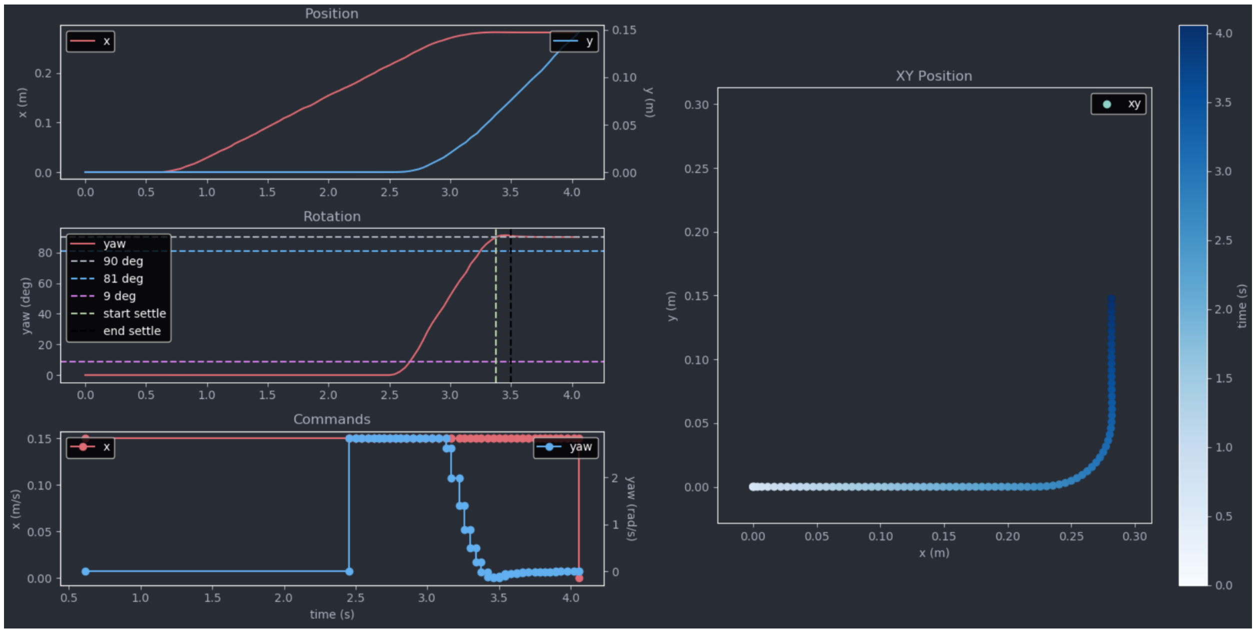


Settle time = 0.2 seconds

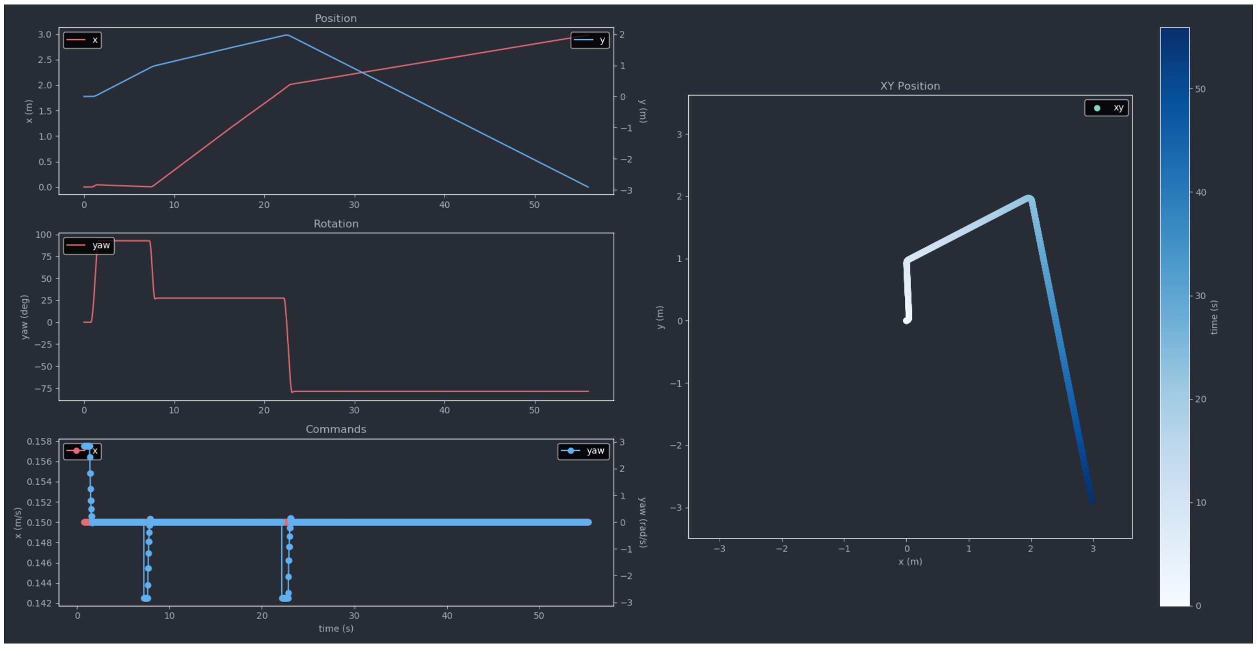


Percent overshoot = 1% 1 - (91.2 / 90)





Problem 5


Position
x
y
x (m)
y (m)
Rotation
yaw
yaw (deg)
Commands
x
yaw
x (m/s)
yaw (rad/s)
time (s)
XY Position
xy
x (m)
y (m)
time (s)

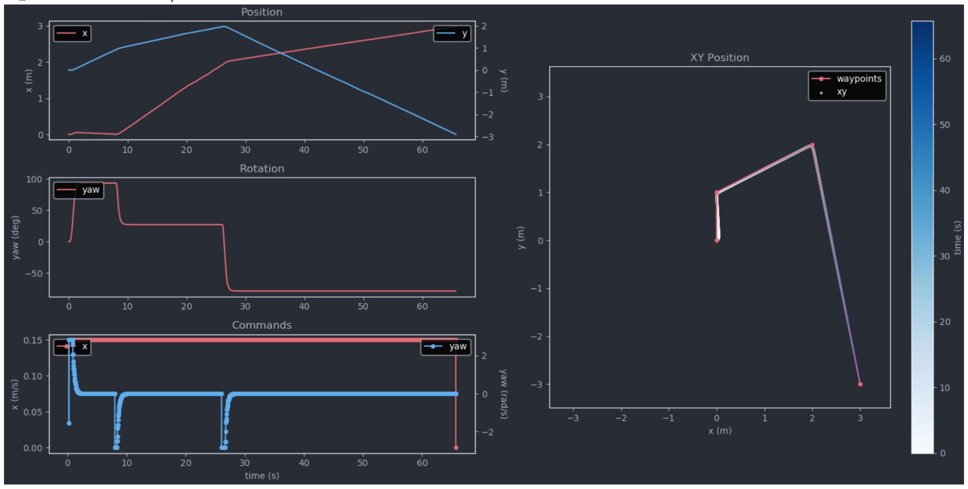
Problem 6

All runs below use the PID: kp=4.5, ki=0, kd=0.25

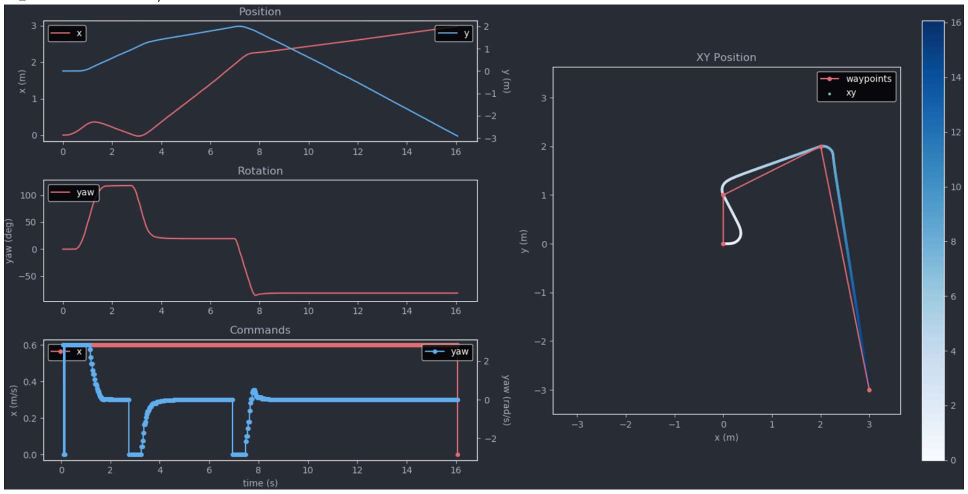
Clearly, as the speed increases, the PID controller is put under more stress; at 1.5m/s, this PID controller fails completley. Anything over 1 m/s and your pushing your luck, in my opinion.

It would be cool to have a PID controller for throttle that also takes into consideration the heading error so it could maybe slow down if it detected error and pedal to the medal otherwise... but this still wouldn't solve the overshoot problem compeltley; you would need a method to know how fast you could turn and slow down for the next 'big step' in optimality.

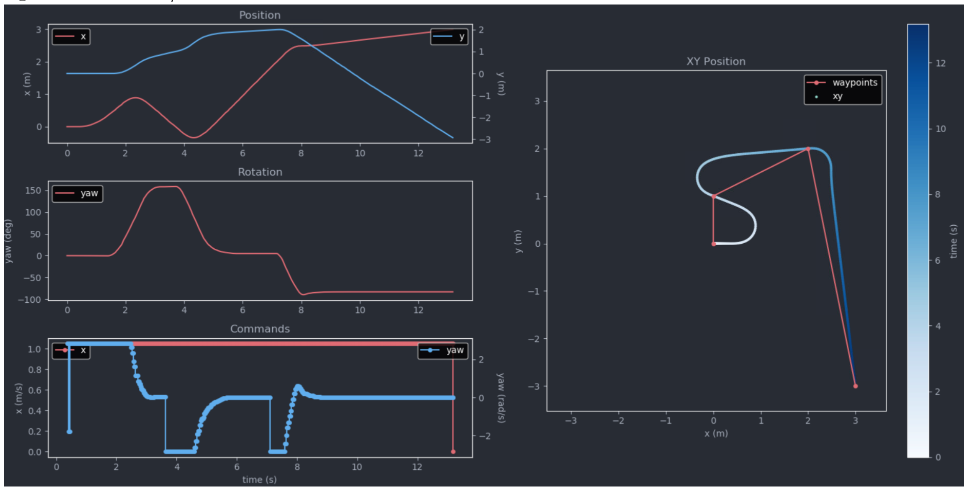
Speed: 0.15 m/s



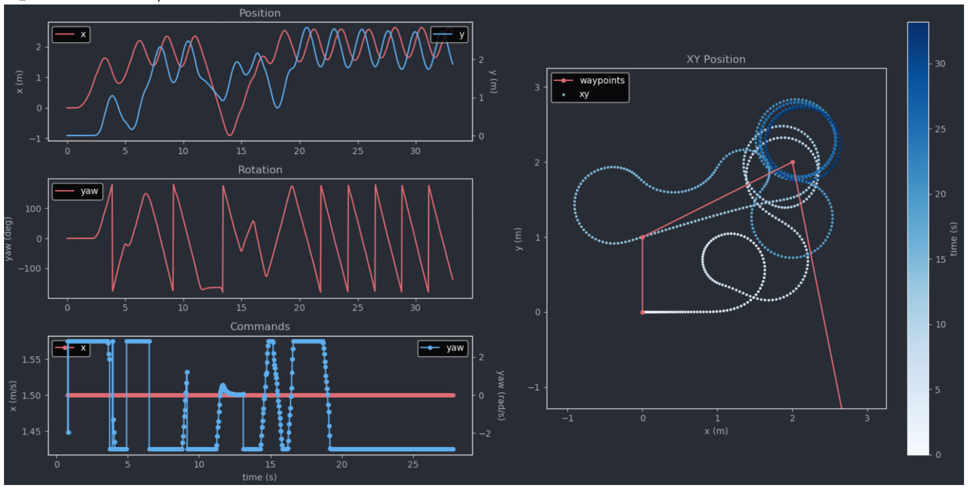
Speed: 0.6 m/s



Speed: 1.05 m/s



Speed: 1.5 m/s



Notes

Personal imports can be found in the 'support_module' directory
Log plotter can be found in 'extra' directory

You may notice the additional package directory, 'turtlebot3_gazebo'. Mainly used in the 'Rapid Simulations' branch (working on GA stuff for fun), I edited the oringal worlds to run in headless mode and/or speed up simulations, had to edit /worlds/empty_worlds/burger.model and /launch/empty_world_no_x_launch.py