Final Submission :

I) Components:

ars_remote_controller_test

ars_remote_controller

ars_obstacle_avoidance_reative

ars_msf_state_estimator

ars_motion_controller_pid

ars_path_follower

ars_path_planner

II) Details about each component:

0_ars_remote_controller_test

Idea: I created and adapted an interface to control the drone.

How to run: # ars_remote_controller_test

roscore

roslaunch ars_sim_robot ars_sim_robot.launch

roslaunch ars_robot_models robot_urdf.launch

rosrun rviz rviz -d $(rospack find ars_config)/config/rviz_config/rviz_conf_sim.rviz

roslaunch ars_launchers robot_trajectory.launch

roslaunch ars_launchers robot_remote_controller_test.launch

OPTIONAL rosbag record -a

OPTIONAL rqt_plot /robot_pose/pose/position/:x:y:z

OPTIONAL rosrun ars_remote_controller_test graphical_interface.py

OPTIONAL rosrun ars_remote_controller_test twistStampedtotwist.py

OPTIONAL go to path

cd ~/workspace/catkin_ws/src/ars_project/packages/robot_intelligence_student/ars_remote_controller_test/source

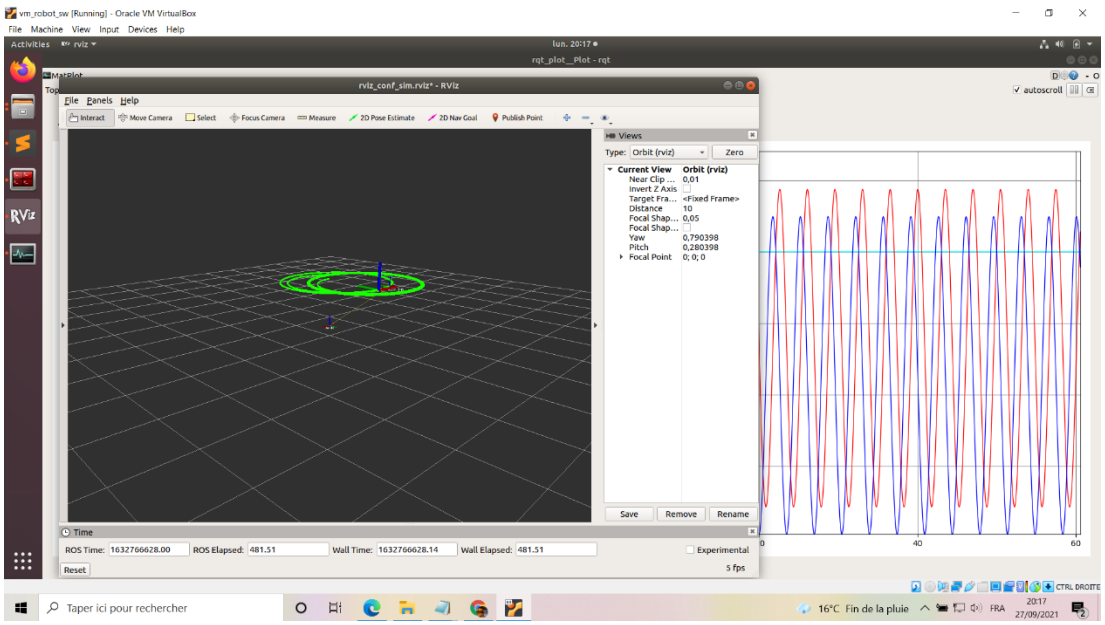
OPTIONAL and run:

"bash go_in_cirle.sh"

OPTIONAL rostopic echo /robot_cmd_ctr_stamped

OPTIONAL refresh and run: rosbag play name.bag

Results :



1_ars_remote_controller

roscore

roslaunch ars_sim_robot ars_sim_robot.launch

roslaunch ars_robot_models robot_urdf.launch

rosrun rviz rviz -d $(rospack find ars_config)/config/rviz_config/rviz_conf_sim.rviz

roslaunch ars_launchers robot_trajectory.launch

roslaunch ars_launchers robot_remote_controller.launch

OPTIONAL rosbag record -a

OPTIONAL rqt_plot /robot_pose/pose/position/:x:y:z

OPTIONAL rosrun ars_remote_controller graphical_interface.py

OPTIONAL rosrun ars_remote_controller twistStampedtotwist.py

OPTIONAL go to path

cd ~/workspace/catkin_ws/src/ars_project/packages/robot_intelligence_student/ars_remote_controller/source

OPTIONAL and run:

"bash go_in_cirle.sh"

OPTIONAL rostopic echo /robot_cmd_ctr_stamped

OPTIONAL refresh and run: rosbag play name.bag

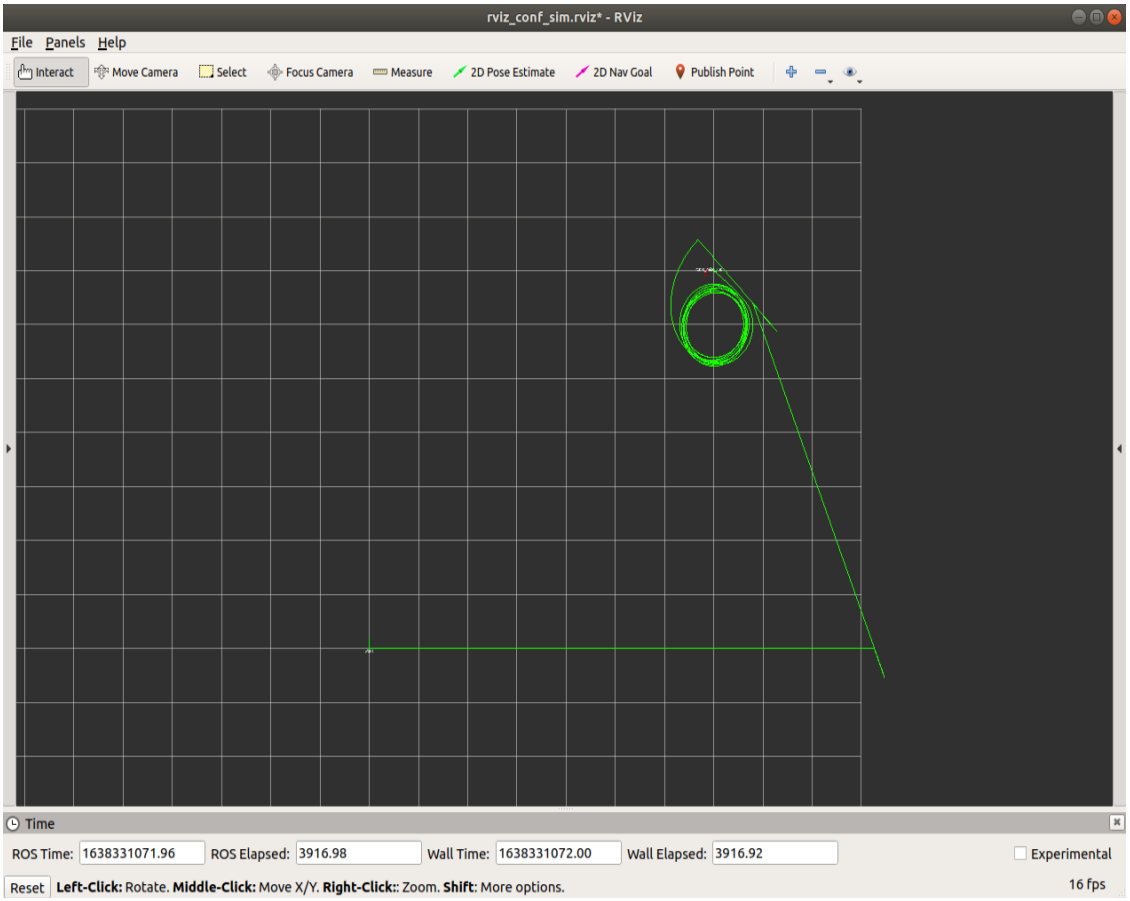
Credit:

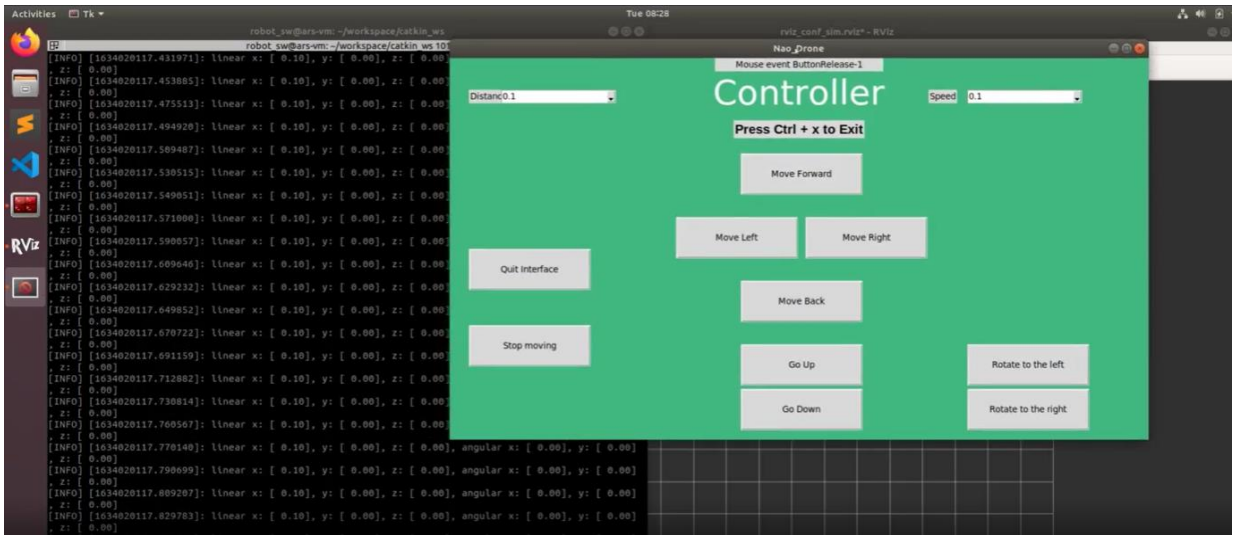
[1] https://github.com/Tanguyvans/bebop_code "Original source code"

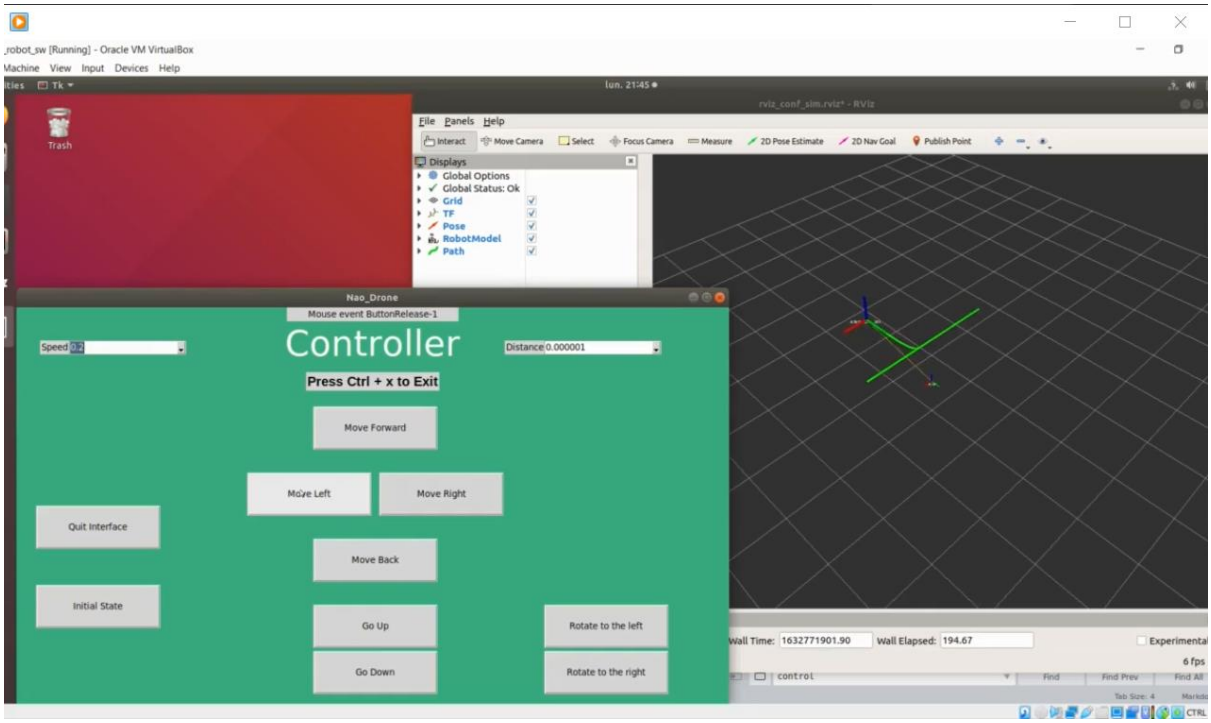
[2] https://sceweb.sce.uhcl.edu/harman/CENG_all/TurtleBotGuide2_19_2016a.pdf "Turtle Bot Guide"

[3] https://www.youtube.com/watch?v=eJ4QPrYqMlw "Youtube video"

[4] https://femexrobotica.org/eir2015/wp-content/uploads/2015/01/Navegaci%C3%B3nDeRobotsM%C3%B3viles.pdf "Lecture notes"


rviz_conf_sim.rviz* - RViz
File Panels Help
Interact
Move Camera
Select
Focus Camera
Measure
2D Pose Estimate
2D Nav Goal
Publish Point
Time
ROS Time: 1638331071.96
ROS Elapsed: 3916.98
Wall Time: 1638331072.00
Wall Elapsed: 3916.92
Experimental
Reset
Left-Click: Rotate. Middle-Click: Move X/Y. Right-Click:: Zoom. Shift: More options.
16 fps


Activities
Tue 08:28
Nao_Drone
Mouse event ButtonRelease-1
Controller
Distance 0.1
Speed 0.1
Press Ctrl + x to Exit
Move Forward
Move Left
Move Right
Quit Interface
Move Back
Stop moving
Go Up
Go Down
Rotate to the left
Rotate to the right



2_ars_obstacle_avoidance_reative

source $ARS_CATKIN_WORKSPACE/devel/setup.bash

rospack profile

roscore

roslaunch ars_launchers robot_simulator.launch

roslaunch ars_robot_models robot_urdf.launch

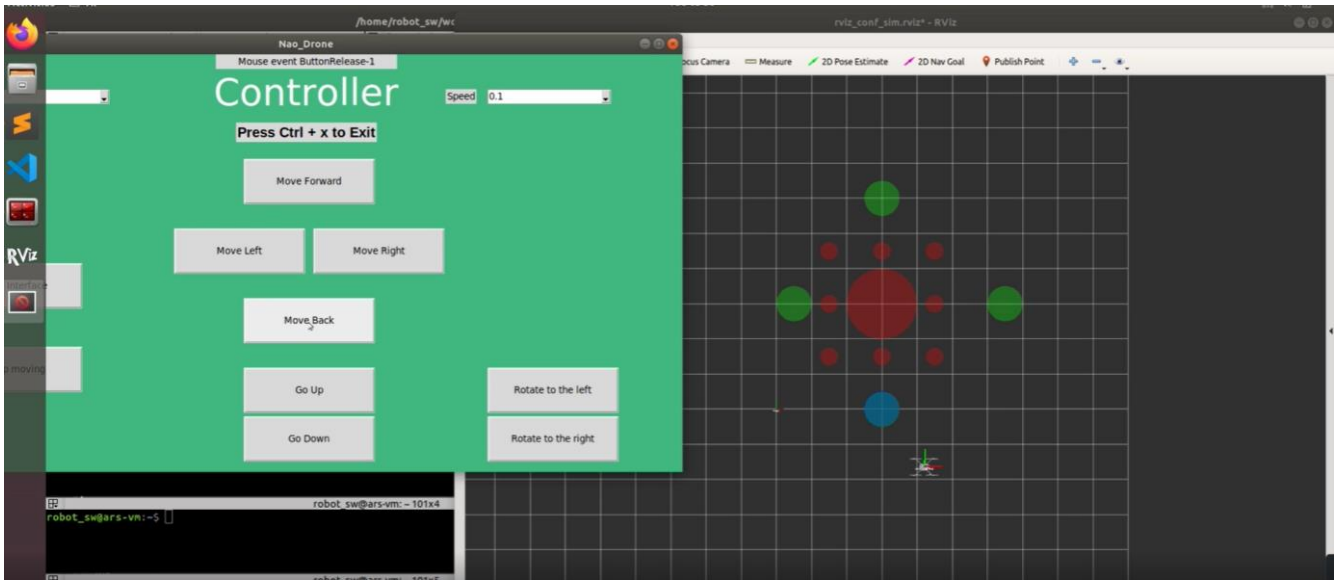
rosrun rviz rviz -d $(rospack find ars_config)/config/rviz_config/rviz_conf_sim.rviz

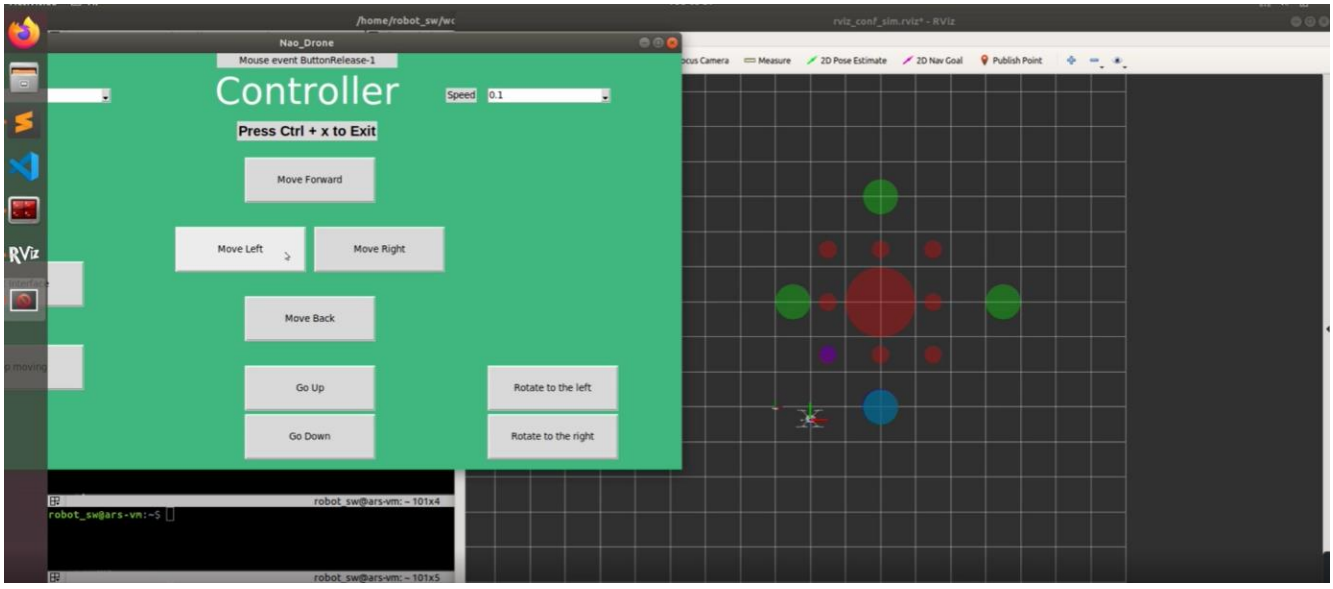
roslaunch ars_launchers environment_simulator.launch environment_description_yaml_file:="$(rospack find ars_config)/config/environment/obstacles_env_02.yaml"

roslaunch ars_launchers obstacles_detector_simulator.launch

roslaunch ars_launchers robot_remote_controller.launch

roslaunch ars_launchers robot_obstacle_avoidance_react.launch



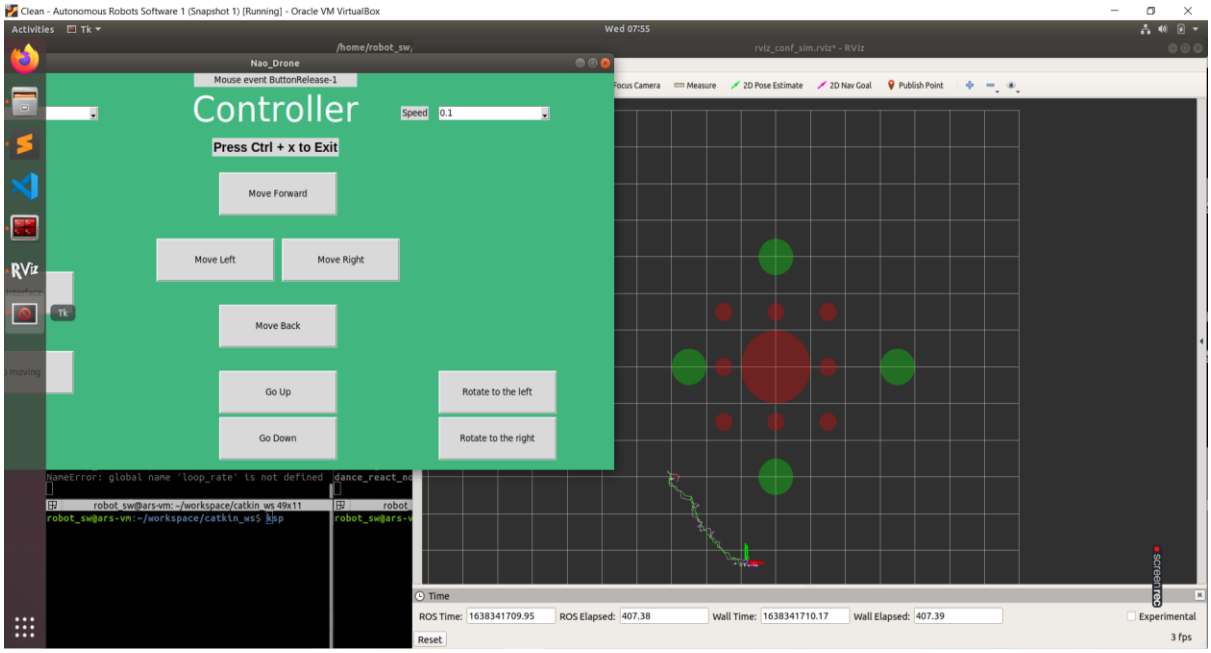


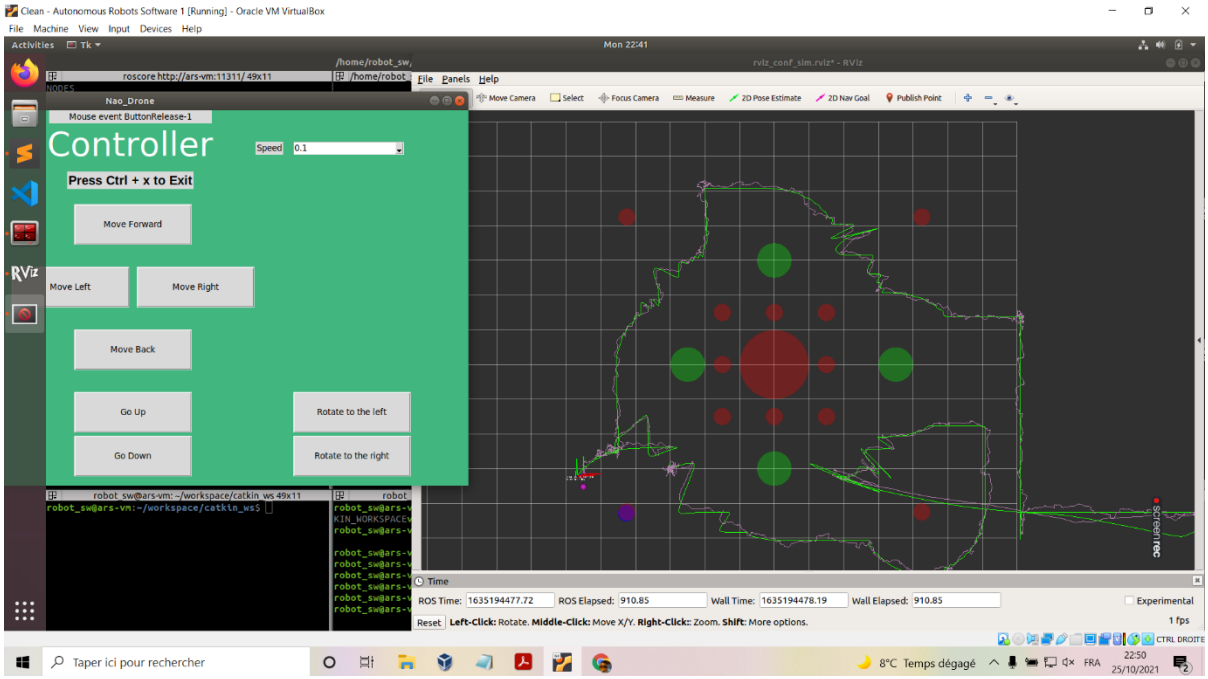
3_ars_msf_state_estimator

```
cd $ARS_CATKIN_WORKSPACE

catkin clean

catkin build

roscore


roslaunch ars_launchers robot_simulator.launch


roslaunch ars_robot_models robot_urdf.launch


rosrun rviz rviz -d $(rospack find
ars_config)/config/rviz_config/rviz_conf_sim.rviz


roslaunch ars_launchers robot_trajectory.launch


roslaunch ars_launchers environment_simulator.launch
environment_description_yaml_file:="$(rospack find
ars_config)/config/environment/obstacles_env_01.yaml"


roslaunch ars_launchers obstacles_detector_simulator.launch


roslaunch ars_launchers robot_simulator_sensors_robot.launch


roslaunch ars_launchers robot_remote_controller.launch

roslaunch ars_launchers robot_obstacle_avoidance_react.launch
```

roslaunch ars_launchers robot_trajectory_estim.launch

roslaunch ars_launchers robot_msf_state_estimator.launch





4_ars_motion_controller_pid

cd $ARS_CATKIN_WORKSPACE

catkin clean

catkin build

cd $ARS_CATKIN_WORKSPACE

source $ARS_CATKIN_WORKSPACE/devel/setup.bash

rospack profile

roscore

roslaunch ars_launchers robot_simulator.launch

rosrun rviz rviz -d $(rospack find ars_config)/config/rviz_config/rviz_conf_sim.rviz

roslaunch ars_launchers environment_simulator.launch environment_description_yaml_file:="$(rospack find ars_config)/config/environment/obstacles_env_01.yaml"

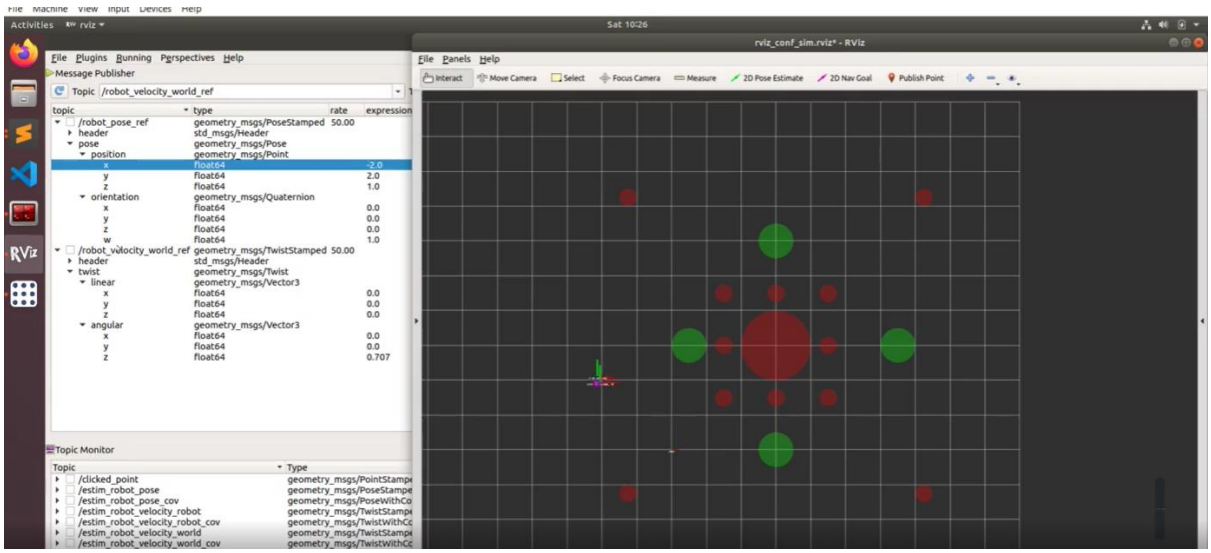
roslaunch ars_launchers obstacles_detector_simulator.launch

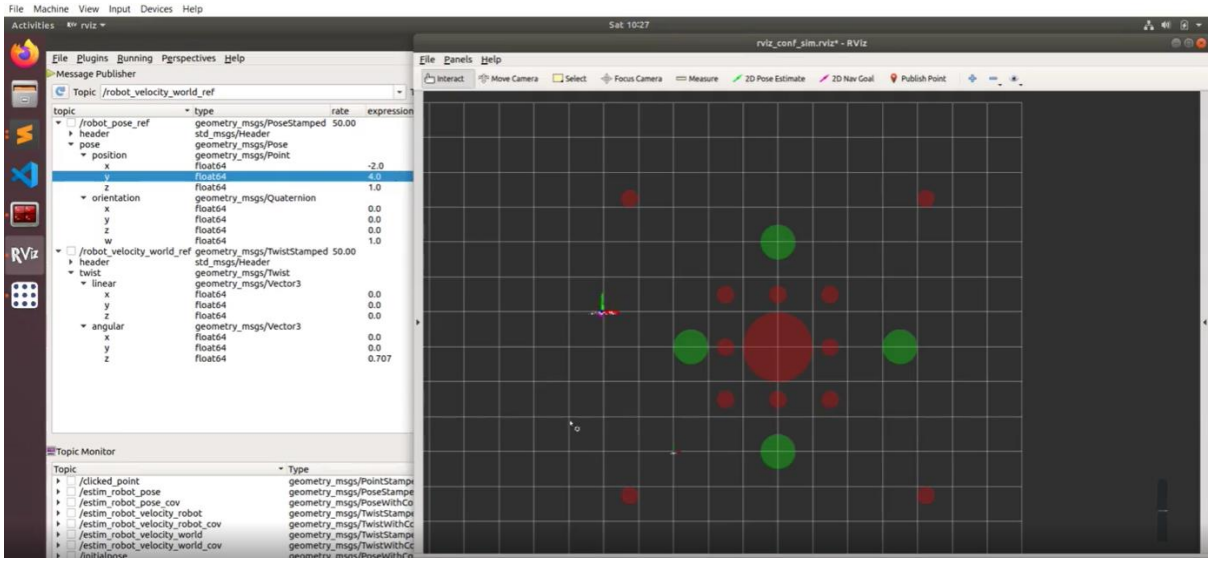
roslaunch ars_launchers robot_simulator_sensors_robot.launch

roslaunch ars_launchers robot_obstacle_avoidance_react.launch

roslaunch ars_launchers robot_msf_state_estimator.launch

roslaunch ars_launchers robot_motion_controller_pid.launch robot_cmd_ctr_stamped:=/robot_cmd_ctr_stamped robot_cmd_ctr:=/robot_cmd_ctr flag_use_state_estim:=True





5_ars_path_follower

cd $ARS_CATKIN_WORKSPACE

source $ARS_CATKIN_WORKSPACE/devel/setup.bash

rospack profile

roscore

roslaunch ars_launchers robot_simulator.launch

rosrun rviz rviz -d $(rospack find ars_config)/config/rviz_config/rviz_conf_sim.rviz

roslaunch ars_launchers robot_trajectory.launch

roslaunch ars_launchers environment_simulator.launch environment_description_yaml_file:="$(rospack find ars_config)/config/environment/obstacles_env_01.yaml"

#rostopic pub -1 /simulator/sim_environment/flag_dynamic_obstacles std_msgs/Bool "data: true"

roslaunch ars_launchers obstacles_detector_simulator.launch

roslaunch ars_launchers robot_simulator_sensors_robot.launch

roslaunch ars_launchers robot_obstacle_avoidance_react.launch

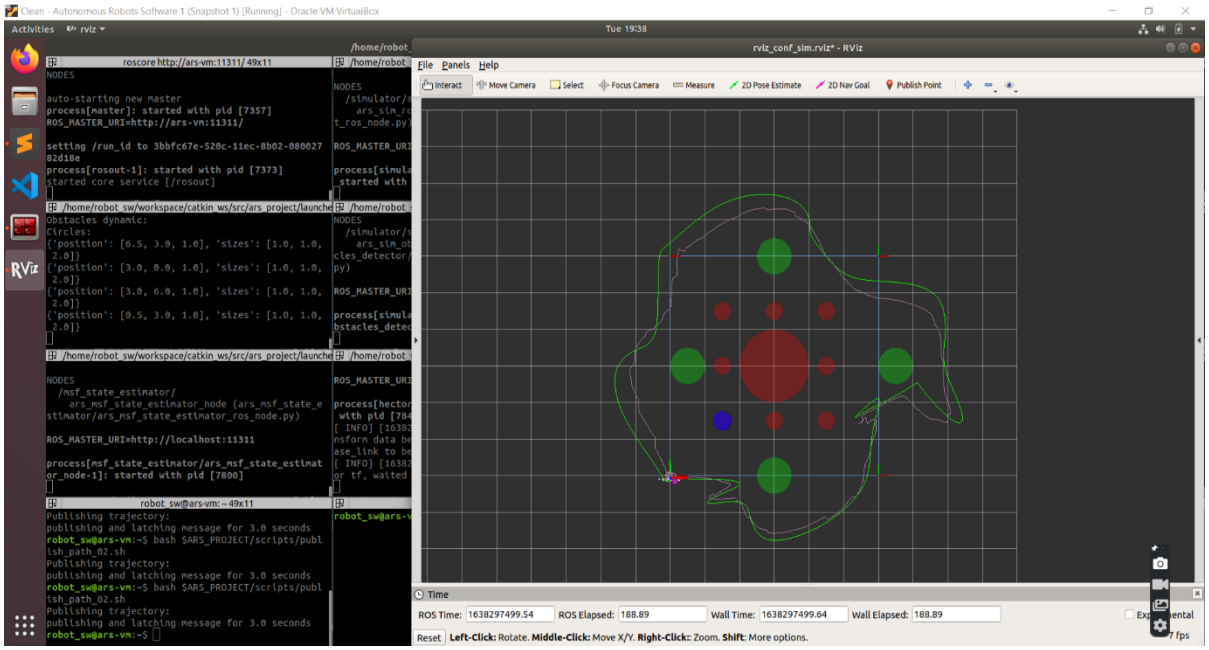
roslaunch ars_launchers robot_msf_state_estimator.launch

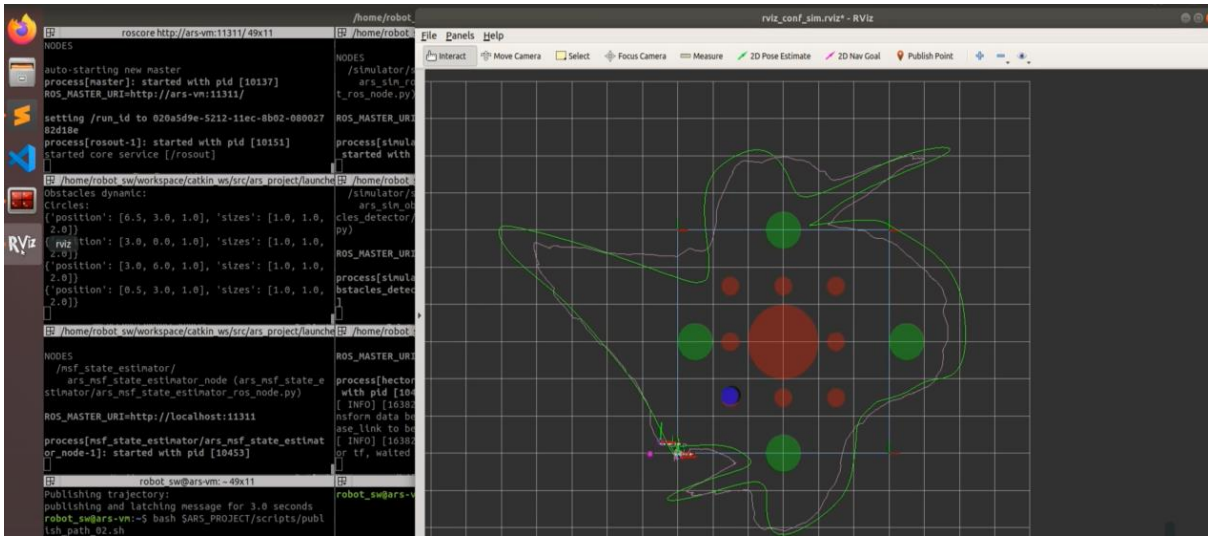
roslaunch ars_launchers robot_trajectory_estim.launch

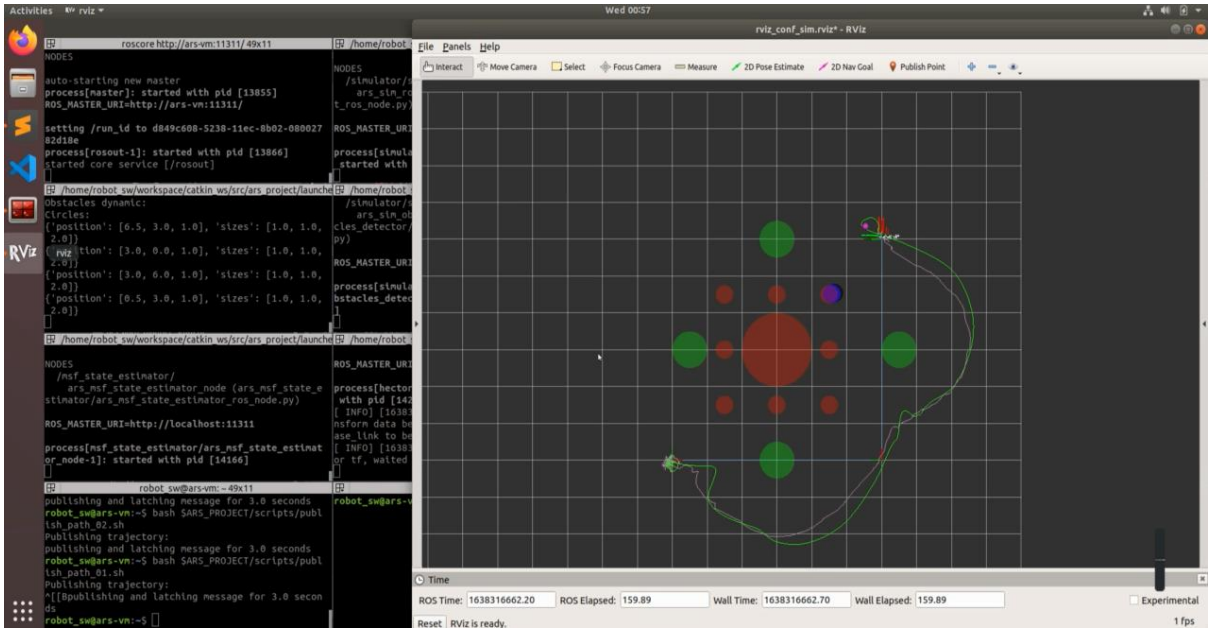
roslaunch ars_launchers robot_motion_controller_pid.launch robot_cmd_ctr_stamped:=/robot_cmd_ctr_stamped robot_cmd_ctr:=/robot_cmd_ctr flag_use_state_estim:=True

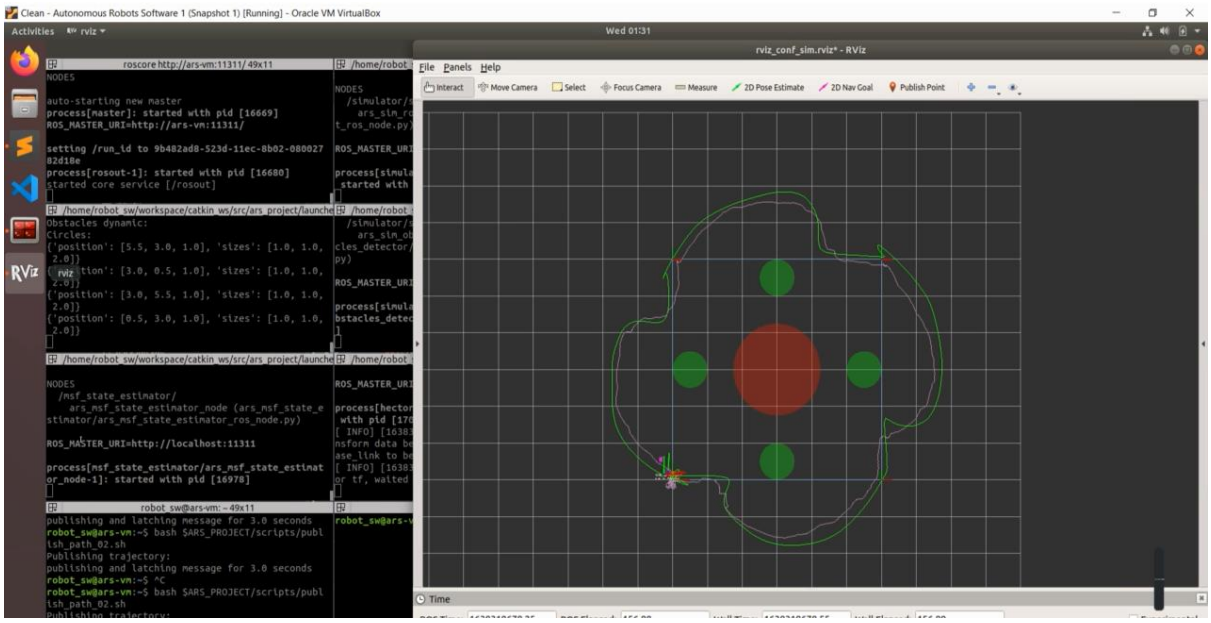
roslaunch ars_launchers robot_path_follower.launch flag_use_state_estim:=True

bash $ARS_PROJECT/scripts/publish_path_01.sh


Clean - Autonomous Robots Software 1 (Snapshot 1) [Running] - Oracle VM VirtualBox
Activities
rviz
Tue 19:38
rviz_conf_sim.rviz* - RViz
File Panels Help
Interact Move Camera Select Focus Camera Measure 2D Pose Estimate 2D Nav Goal Publish Point
roscore http://ars-vm:11311/ 49x11
NODES
auto-starting new master
process[master]: started with pid [7357]
ROS_MASTER_URI=http://ars-vm:11311/
setting /run_id to 3bbfc67e-520c-11ec-8b02-080027 82d18e
process[rosout-1]: started with pid [7373]
started core service [/rosout]
/home/robot_sw/workspace/catkin_ws/src/ars_project/launche
Obstacles dynamic:
Circles:
{'position': [6.5, 3.0, 1.0], 'sizes': [1.0, 1.0, 2.0]}
{'position': [3.0, 0.0, 1.0], 'sizes': [1.0, 1.0, 2.0]}
{'position': [3.0, 6.0, 1.0], 'sizes': [1.0, 1.0, 2.0]}
{'position': [0.5, 3.0, 1.0], 'sizes': [1.0, 1.0, 2.0]}
/home/robot_sw/workspace/catkin_ws/src/ars_project/launche
NODES
/msf_state_estimator/
ars_msf_state_estimator_node (ars_msf_state_estimator/ars_msf_state_estimator_ros_node.py)
ROS_MASTER_URI=http://localhost:11311
process[msf_state_estimator/ars_msf_state_estimator_node-1]: started with pid [7800]
robot_sw@ars-vm: ~ 49x11
Publishing trajectory:
publishing and latching message for 3.0 seconds
robot_sw@ars-vm:~$ bash $ARS_PROJECT/scripts/publish_path_02.sh
Publishing trajectory:
publishing and latching message for 3.0 seconds
robot_sw@ars-vm:~$ bash $ARS_PROJECT/scripts/publish_path_02.sh
Publishing trajectory:
publishing and latching message for 3.0 seconds
robot_sw@ars-vm:~$
Time
ROS Time: 1638297499.54
ROS Elapsed: 188.89
Wall Time: 1638297499.64
Wall Elapsed: 188.89
Reset
Left-Click: Rotate. Middle-Click: Move X/Y. Right-Click: Zoom. Shift: More options.


rviz_conf_sim.rviz* - RViz
File Panels Help
Interact Move Camera Select Focus Camera Measure 2D Pose Estimate 2D Nav Goal Publish Point
roscore http://ars-vm:11311/ 49x11
NODES
auto-starting new master
process[master]: started with pid [10137]
ROS_MASTER_URI=http://ars-vm:11311/
setting /run_id to 020a5d9e-5212-11ec-8b02-080027 82d18e
process[rosout-1]: started with pid [10151]
started core service [/rosout]
/home/robot_sw/workspace/catkin_ws/src/ars_project/launche
Obstacles dynamic:
Circles:
{'position': [6.5, 3.0, 1.0], 'sizes': [1.0, 1.0, 2.0]}
{'position': [3.0, 0.0, 1.0], 'sizes': [1.0, 1.0, 2.0]}
{'position': [3.0, 6.0, 1.0], 'sizes': [1.0, 1.0, 2.0]}
{'position': [0.5, 3.0, 1.0], 'sizes': [1.0, 1.0, 2.0]}
/home/robot_sw/workspace/catkin_ws/src/ars_project/launche
NODES
/msf_state_estimator/
ars_msf_state_estimator_node (ars_msf_state_estimator/ars_msf_state_estimator_ros_node.py)
ROS_MASTER_URI=http://localhost:11311
process[msf_state_estimator/ars_msf_state_estimator_node-1]: started with pid [10453]
robot_sw@ars-vm: ~ 49x11
Publishing trajectory:
publishing and latching message for 3.0 seconds
robot_sw@ars-vm:~$ bash $ARS_PROJECT/scripts/publish_path_02.sh





6_ars_path_planner

cd $ARS_CATKIN_WORKSPACE

source $ARS_CATKIN_WORKSPACE/devel/setup.bash

rospack profile

roscore

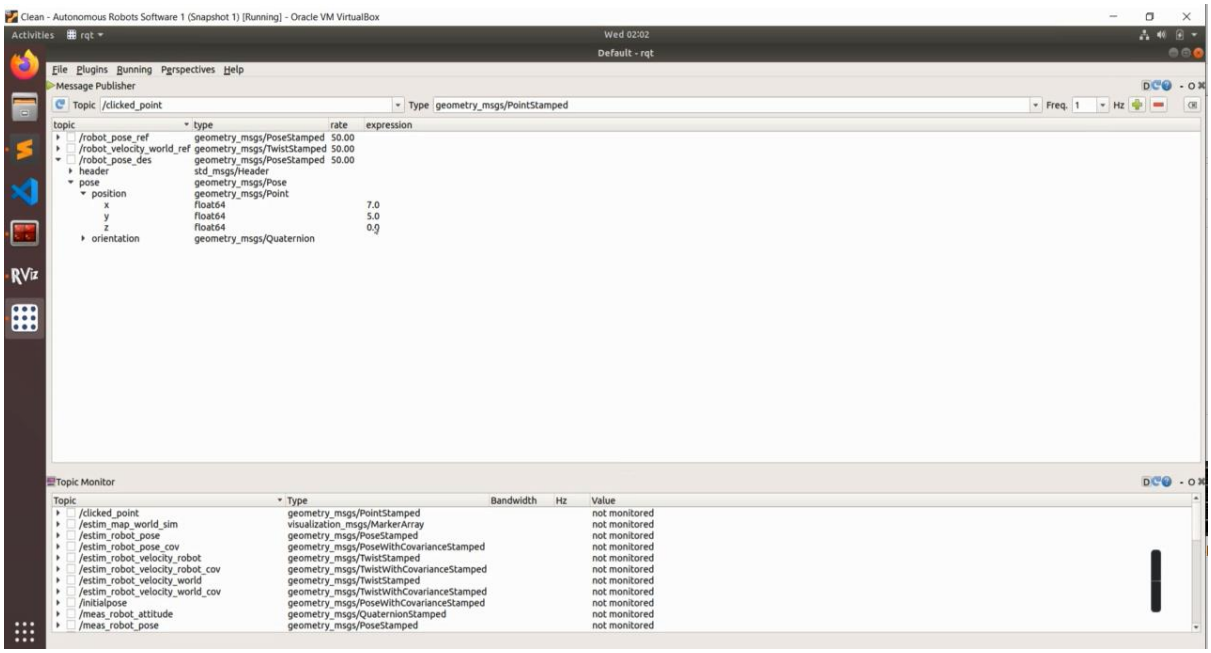
roslaunch ars_launchers robot_simulator.launch

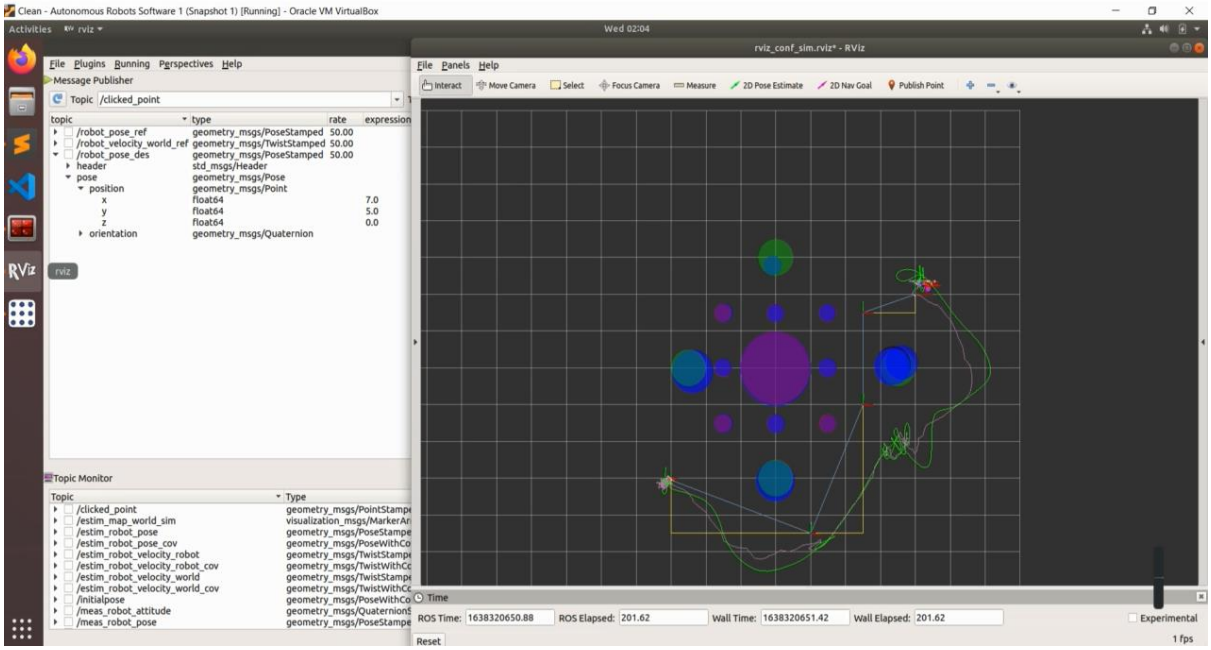
```
rosrun rviz rviz -d $(rospack find
ars_config)/config/rviz_config/rviz_conf_sim.rviz


roslaunch ars_launchers robot_trajectory.launch


roslaunch ars_launchers environment_simulator.launch
environment_description_yaml_file:="$(rospack find
ars_config)/config/environment/obstacles_env_01.yaml"


#rostopic pub -1 /simulator/sim_environment/flag_dynamic_obstacles
std_msgs/Bool "data: true"


roslaunch ars_launchers obstacles_detector_simulator.launch


roslaunch ars_launchers robot_simulator_sensors_robot.launch


roslaunch ars_launchers mapper_simulator.launch


roslaunch ars_launchers robot_obstacle_avoidance_react.launch


roslaunch ars_launchers robot_msf_state_estimator.launch


roslaunch ars_launchers robot_trajectory_estim.launch


roslaunch ars_launchers robot_motion_controller_pid.launch
robot_cmd_ctr_stamped:=/robot_cmd_ctr_stamped
robot_cmd_ctr:=/robot_cmd_ctr flag_use_state_estim:=True
```

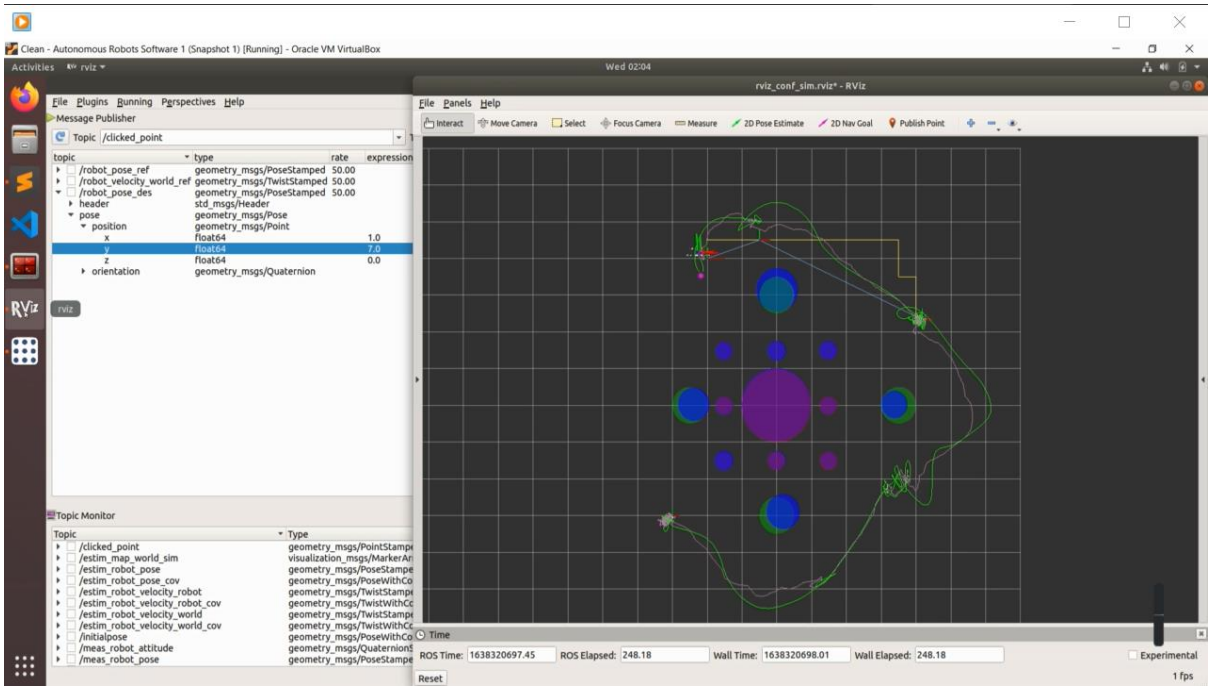
roslaunch ars_launchers robot_path_follower.launch
flag_use_state_estim:=True

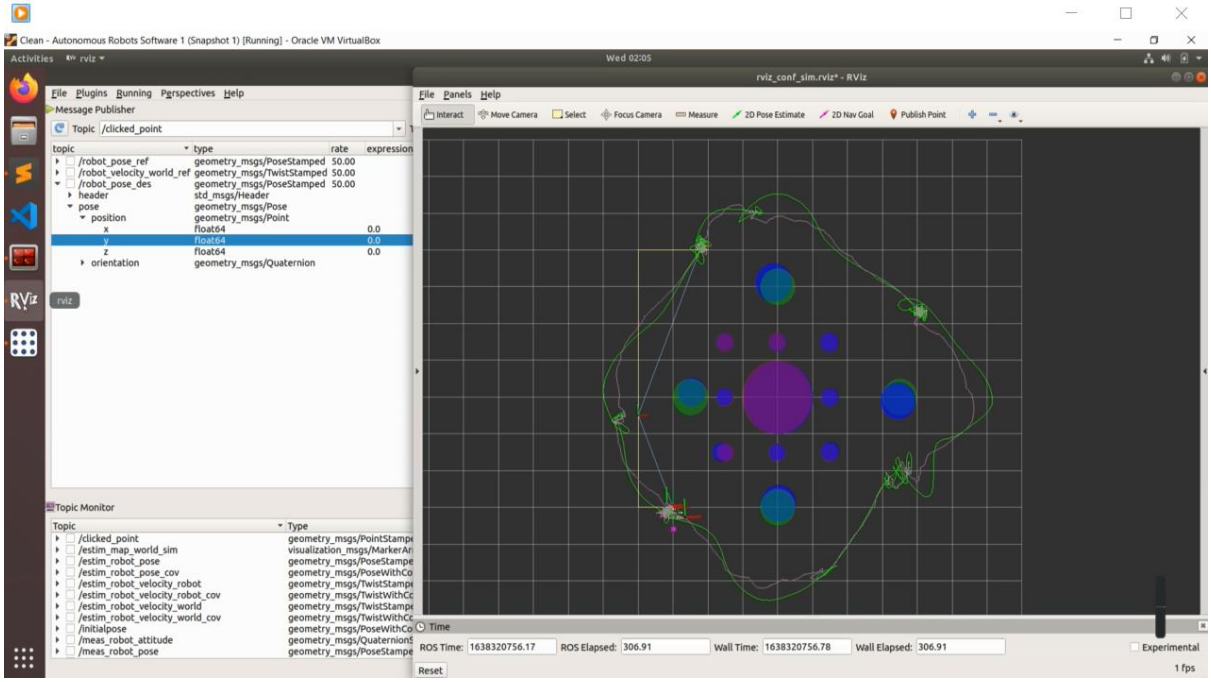
roslaunch ars_launchers robot_path_planner.launch
flag_use_state_estim:=True

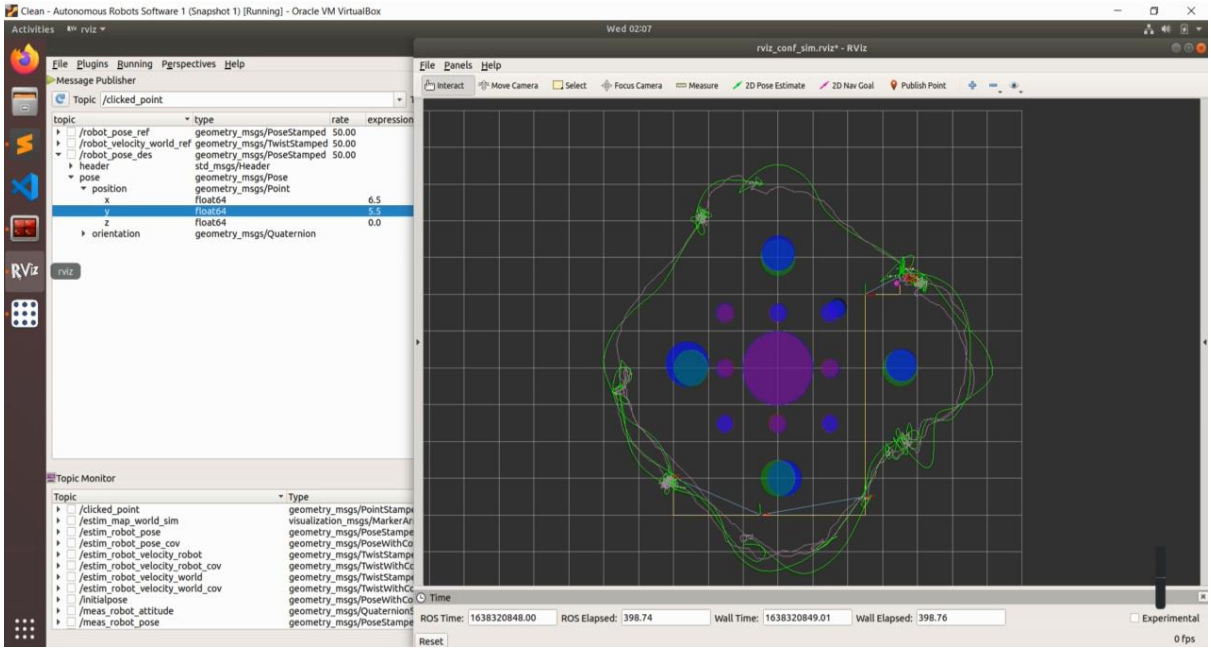
#example (7 5) ; (1 7) ; (0 0) ; (6.5 5.5)



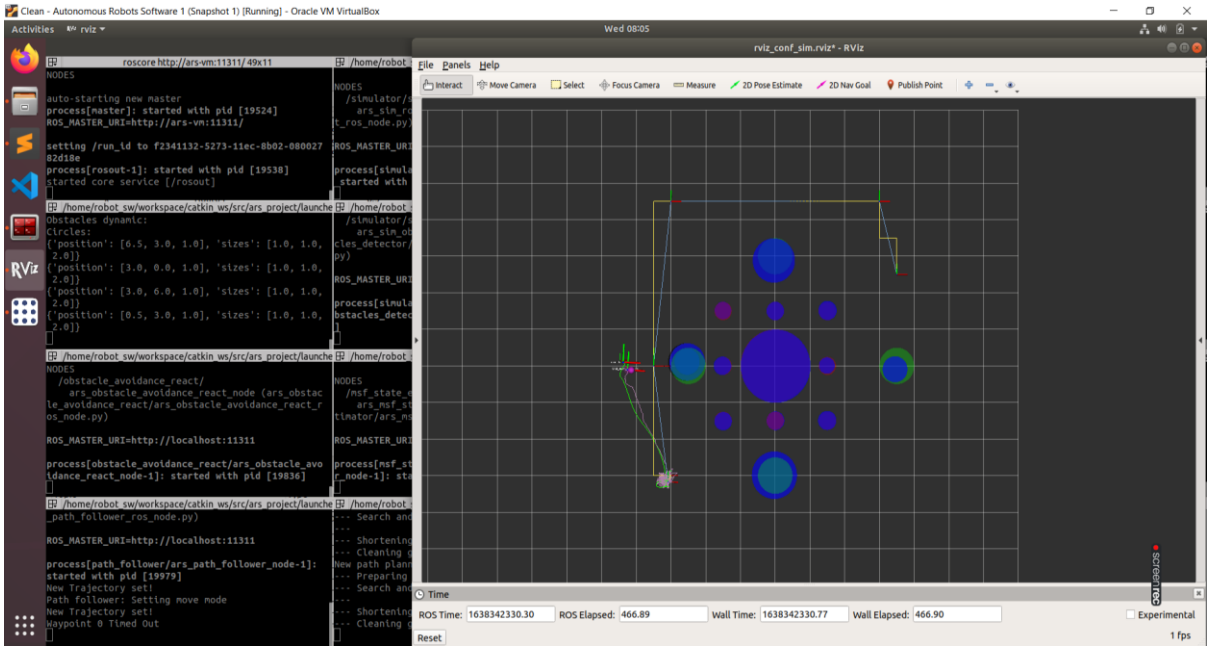

Clean - Autonomous Robots Software 1 (Snapshot 1) [Running] - Oracle VM VirtualBox
Activities
rviz
Wed 02:04
File Plugins Running Perspectives Help
Message Publisher
Topic /clicked_point
topic type rate expression
/robot_pose_ref geometry_msgs/PoseStamped 50.00
/robot_velocity_world_ref geometry_msgs/TwistStamped 50.00
/robot_pose_des geometry_msgs/PoseStamped 50.00
header std_msgs/Header
pose geometry_msgs/Pose
position geometry_msgs/Point
x float64 7.0
y float64 5.0
z float64 0.0
orientation geometry_msgs/Quaternion
rviz
Topic Monitor
Topic Type
/clicked_point geometry_msgs/PointStampe
/estim_map_world_sim visualization_msgs/MarkerAr
/estim_robot_pose geometry_msgs/PoseStampe
/estim_robot_pose_cov geometry_msgs/PoseWithCo
/estim_robot_velocity_robot geometry_msgs/TwistStampe
/estim_robot_velocity_robot_cov geometry_msgs/TwistWithCo
/estim_robot_velocity_world geometry_msgs/TwistStampe
/estim_robot_velocity_world_cov geometry_msgs/TwistWithCo
/initialpose geometry_msgs/PoseWithCo
/meas_robot_attitude geometry_msgs/QuaternionS
/meas_robot_pose geometry_msgs/PoseStampe
rviz_conf_sim.rviz* - RViz
File Panels Help
Interact Move Camera Select Focus Camera Measure 2D Pose Estimate 2D Nav Goal Publish Point
Time
ROS Time: 1638320650.88 ROS Elapsed: 201.62 Wall Time: 1638320651.42 Wall Elapsed: 201.62
Experimental
Reset
1 fps

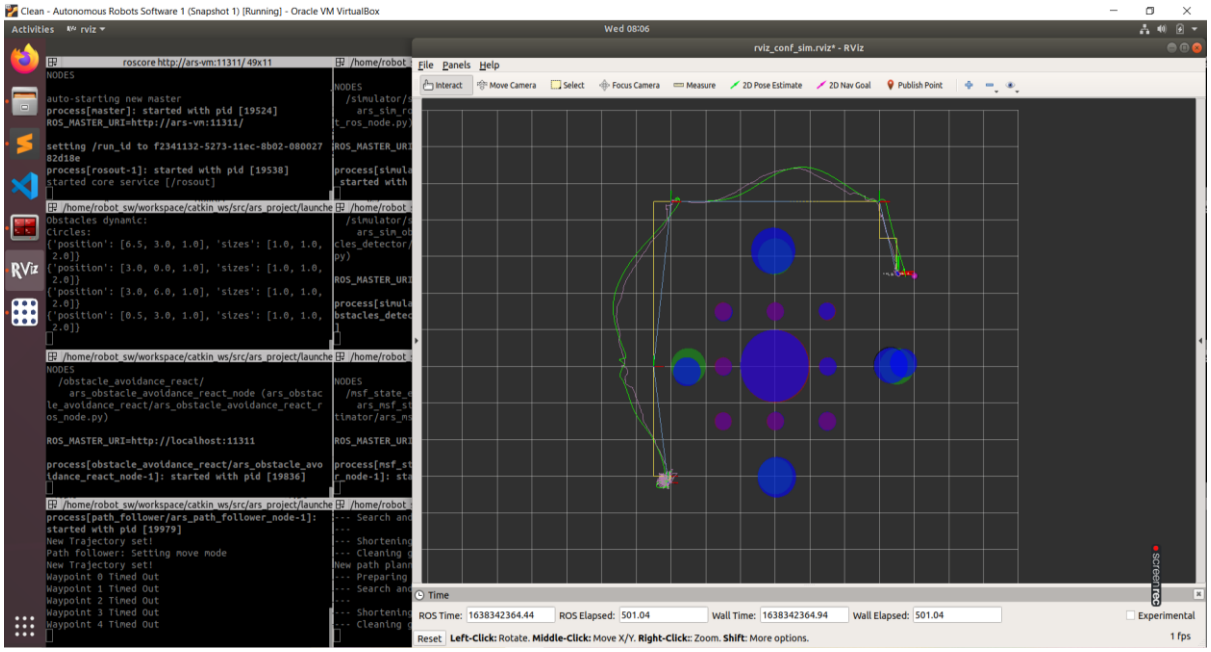

Clean - Autonomous Robots Software 1 (Snapshot 1) [Running] - Oracle VM VirtualBox
Activities
rviz
Wed 02:04
File Plugins Running Perspectives Help
Message Publisher
Topic /clicked_point
topic type rate expression
/robot_pose_ref geometry_msgs/PoseStamped 50.00
/robot_velocity_world_ref geometry_msgs/TwistStamped 50.00
/robot_pose_des geometry_msgs/PoseStamped 50.00
header std_msgs/Header
pose geometry_msgs/Pose
position geometry_msgs/Point
x float64 1.0
y float64 7.0
z float64 0.0
orientation geometry_msgs/Quaternion
rviz
Topic Monitor
Topic Type
/clicked_point geometry_msgs/PointStampe
/estim_map_world_sim visualization_msgs/MarkerAr
/estim_robot_pose geometry_msgs/PoseStampe
/estim_robot_pose_cov geometry_msgs/PoseWithCo
/estim_robot_velocity_robot geometry_msgs/TwistStampe
/estim_robot_velocity_robot_cov geometry_msgs/TwistWithCo
/estim_robot_velocity_world geometry_msgs/TwistStampe
/estim_robot_velocity_world_cov geometry_msgs/TwistWithCo
/initialpose geometry_msgs/PoseWithCo
/meas_robot_attitude geometry_msgs/QuaternionS
/meas_robot_pose geometry_msgs/PoseStampe
rviz_conf_sim.rviz* - RViz
File Panels Help
Interact Move Camera Select Focus Camera Measure 2D Pose Estimate 2D Nav Goal Publish Point
Time
ROS Time: 1638320697.45 ROS Elapsed: 248.18 Wall Time: 1638320698.01 Wall Elapsed: 248.18
Experimental
Reset
1 fps


Clean - Autonomous Robots Software 1 (Snapshot 1) [Running] - Oracle VM VirtualBox
Activities
rviz
Wed 02:05
rviz_conf_sim.rviz* - RViz
File Plugins Running Perspectives Help
Message Publisher
Topic /clicked_point
topic type rate expression
/robot_pose_ref geometry_msgs/PoseStamped 50.00
/robot_velocity_world_ref geometry_msgs/TwistStamped 50.00
/robot_pose_des geometry_msgs/PoseStamped 50.00
header std_msgs/Header
pose geometry_msgs/Pose
position geometry_msgs/Point
x float64 0.0
y float64 0.0
z float64 0.0
orientation geometry_msgs/Quaternion
rviz
Topic Monitor
Topic Type
/clicked_point geometry_msgs/PointStampe
/estim_map_world_sim visualization_msgs/MarkerAr
/estim_robot_pose geometry_msgs/PoseStampe
/estim_robot_pose_cov geometry_msgs/PoseWithCo
/estim_robot_velocity_robot geometry_msgs/TwistStampe
/estim_robot_velocity_robot_cov geometry_msgs/TwistWithCo
/estim_robot_velocity_world geometry_msgs/TwistStampe
/estim_robot_velocity_world_cov geometry_msgs/TwistWithCo
/initialpose geometry_msgs/PoseWithCo
/meas_robot_attitude geometry_msgs/QuaternionS
/meas_robot_pose geometry_msgs/PoseStampe
File Panels Help
Interact Move Camera Select Focus Camera Measure 2D Pose Estimate 2D Nav Goal Publish Point
Time
ROS Time: 1638320756.17 ROS Elapsed: 306.91 Wall Time: 1638320756.78 Wall Elapsed: 306.91
Experimental
Reset
1 fps


Clean - Autonomous Robots Software 1 (Snapshot 1) [Running] - Oracle VM VirtualBox
Activities
rviz
Wed 02:07
rviz_conf_sim.rviz* - RViz
File Plugins Running Perspectives Help
Message Publisher
Topic /clicked_point
topic type rate expression
/robot_pose_ref geometry_msgs/PoseStamped 50.00
/robot_velocity_world_ref geometry_msgs/TwistStamped 50.00
/robot_pose_des geometry_msgs/PoseStamped 50.00
header std_msgs/Header
pose geometry_msgs/Pose
position geometry_msgs/Point
x float64 6.5
y float64 5.5
z float64 0.0
orientation geometry_msgs/Quaternion
rviz
Topic Monitor
Topic Type
/clicked_point geometry_msgs/PointStampe
/estim_map_world_sim visualization_msgs/MarkerAr
/estim_robot_pose geometry_msgs/PoseStampe
/estim_robot_pose_cov geometry_msgs/PoseWithCo
/estim_robot_velocity_robot geometry_msgs/TwistStampe
/estim_robot_velocity_robot_cov geometry_msgs/TwistWithCo
/estim_robot_velocity_world geometry_msgs/TwistStampe
/estim_robot_velocity_world_cov geometry_msgs/TwistWithCo
/initialpose geometry_msgs/PoseWithCo
/meas_robot_attitude geometry_msgs/QuaternionS
/meas_robot_pose geometry_msgs/PoseStampe
File Panels Help
Interact Move Camera Select Focus Camera Measure 2D Pose Estimate 2D Nav Goal Publish Point
Time
ROS Time: 1638320848.00 ROS Elapsed: 398.74 Wall Time: 1638320849.01 Wall Elapsed: 398.76
Experimental
Reset
0 fps

2nd example:


Clean - Autonomous Robots Software 1 (Snapshot 1) [Running] - Oracle VM VirtualBox
Activities
rviz
Wed 08:05
rviz_conf_sim.rviz* - RViz
File Panels Help
Interact Move Camera Select Focus Camera Measure 2D Pose Estimate 2D Nav Goal Publish Point
roscore http://ars-vm:11311/ 49x11
NODES
auto-starting new master
process[master]: started with pid [19524]
ROS_MASTER_URI=http://ars-vm:11311/
setting /run_id to f2341132-5273-11ec-8b02-080027 82d18e
process[rosout-1]: started with pid [19538]
started core service [/rosout]
/home/robot_sw/workspace/catkin_ws/src/ars_project/launche
Obstacles dynamic:
Circles:
{'position': [6.5, 3.0, 1.0], 'sizes': [1.0, 1.0, 2.0]}
{'position': [3.0, 0.0, 1.0], 'sizes': [1.0, 1.0, 2.0]}
{'position': [3.0, 6.0, 1.0], 'sizes': [1.0, 1.0, 2.0]}
{'position': [0.5, 3.0, 1.0], 'sizes': [1.0, 1.0, 2.0]}
/home/robot_sw/workspace/catkin_ws/src/ars_project/launche
NODES
/obstacle_avoidance_react/
ars_obstacle_avoidance_react_node (ars_obstacle_avoidance_react/ars_obstacle_avoidance_react_ros_node.py)
ROS_MASTER_URI=http://localhost:11311
process[obstacle_avoidance_react/ars_obstacle_avoidance_react_node-1]: started with pid [19836]
/home/robot_sw/workspace/catkin_ws/src/ars_project/launche
_path_follower_ros_node.py)
ROS_MASTER_URI=http://localhost:11311
process[path_follower/ars_path_follower_node-1]: started with pid [19979]
New Trajectory set!
Path follower: Setting move mode
New Trajectory set!
Waypoint 0 Timed Out
Time
ROS Time: 1638342330.30 ROS Elapsed: 466.89 Wall Time: 1638342330.77 Wall Elapsed: 466.90
Experimental
Reset
1 fps


Clean - Autonomous Robots Software 1 (Snapshot 1) [Running] - Oracle VM VirtualBox
Activities
rviz
Wed 08:06
rviz_conf_sim.rviz* - RViz
File Panels Help
Interact Move Camera Select Focus Camera Measure 2D Pose Estimate 2D Nav Goal Publish Point
roscore http://ars-vm:11311/ 49x11
NODES
auto-starting new master
process[master]: started with pid [19524]
ROS_MASTER_URI=http://ars-vm:11311/
setting /run_id to f2341132-5273-11ec-8b02-080027 82d18e
process[rosout-1]: started with pid [19538]
started core service [/rosout]
/home/robot_sw/workspace/catkin_ws/src/ars_project/launche
Obstacles dynamic:
Circles:
{'position': [6.5, 3.0, 1.0], 'sizes': [1.0, 1.0, 2.0]}
{'position': [3.0, 0.0, 1.0], 'sizes': [1.0, 1.0, 2.0]}
{'position': [3.0, 6.0, 1.0], 'sizes': [1.0, 1.0, 2.0]}
{'position': [0.5, 3.0, 1.0], 'sizes': [1.0, 1.0, 2.0]}
/home/robot_sw/workspace/catkin_ws/src/ars_project/launche
NODES
/obstacle_avoidance_react/
ars_obstacle_avoidance_react_node (ars_obstacle_avoidance_react/ars_obstacle_avoidance_react_ros_node.py)
ROS_MASTER_URI=http://localhost:11311
process[obstacle_avoidance_react/ars_obstacle_avoidance_react_node-1]: started with pid [19836]
/home/robot_sw/workspace/catkin_ws/src/ars_project/launche
process[path_follower/ars_path_follower_node-1]: started with pid [19979]
New Trajectory set!
Path follower: Setting move mode
New Trajectory set!
Waypoint 0 Timed Out
Waypoint 1 Timed Out
Waypoint 2 Timed Out
Waypoint 3 Timed Out
Waypoint 4 Timed Out
Time
ROS Time: 1638342364.44 ROS Elapsed: 501.04 Wall Time: 1638342364.94 Wall Elapsed: 501.04
Experimental
Reset
Left-Click: Rotate. Middle-Click: Move X/Y. Right-Click:: Zoom. Shift: More options.
1 fps