Getting Started With USARSim

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Autumn 2017

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INTRO

- USARSim was the first server used as a simulation infrastructure for a virtual robot competition
- In 2016, Robocup Virtual Robot Committees decided to change the server to Gazebo/ROS
- USARSim fans and previous Competitors could use the USARSim code to connect to the Gazebo environments using the provided USARGazebo plugin.
- In This Lecture, USARGazebo will be explained in some details according to the RobocupRescuePackage.

REQUIREMENTS

- Hardware :
  a. core i-7(CLK 3GHz)
  b. Mem 8GB
  c. nVidia Geforce GTX780Ti
- Software :
  a. Recommend :
     i. Ubuntu 14
     ii. Gazebo 5
     iii. Indigo

REQUIREMENTS

- In Robocup 2017, Software requirements was as followed:
  - Ubuntu 16.04
  - Kinetic
  - Gazebo7

- As in Robocup 2017, all the teams decided to participate using ROS/Gazebo manner, this structure remained unchanged and there might be some changes in the following instructions.

INSTALLATION

- First the Gazebo package should be installed.
- It is worth mentioning that RobocupRescuePackage does not require ROS installation. So if any ROS version has not been installed, you only have to use following commands:

```
$ sudo apt-get install libgazebo5 libgazebo5-dev gazebo5
$ sudo apt-get install protobuf-compiler
```

Installation

- If you already have install ROS indigo with desktop-full command, it may installed Gazebo2. In the case, at first, you have to remove Gazebo 2, and then, you can install Gazebo 5.

```
$ sudo apt-get purge gazebo2*
$ sudo apt-get autoremove
$ sudo apt-get install libgazebo5 libgazebo5-dev gazebo5
$ sudo apt-get install protobuf-compiler
```

INSTALLATION PROBLEMS

- In Gazebo5 installation, you will often encounter "broken dependency” error. So don’t worry and just follow these 3 steps.

1: Start with a clean installed Ubuntu 14.

(no tips, just do it by an ordinally method)

2: ROS indigo installation, if you need ROS indigo.

```
$ sudo apt-get install ros-indigo-desktop
```

Installation Problems

3: Gazebo5 installation with running over "broken dependency" error

```
$ sudo dpkg --configure -a
$ sudo apt-get install -f
$ sudo sh -c 'echo "deb http://packages.osrfoundation.org/gazebo/ubuntu
`lsb_release -cs` main" > /etc/apt/sources.list.d/gazebo-latest.list'
$ wget http://packages.osrfoundation.org/gazebo.key -O - | sudo apt-key add -
$ sudo apt-get update
$ sudo apt-get install libgazebo5 libgazebo5-dev
$ sudo apt-get install gazebo5
$ sudo apt-get install protobuf-compiler
```

Installation Problems

- If you are already using Gazebo4 and ROS hydro by installing drcsim-hydro package, you may need to install “libgazebo4-dev” package instead of “libgazebo5-dev”.

```
$ sudo apt-get install libgazebo4-dev
```

How to setup

- You can install “git ” or download the package from the [github repository](#).

```
sudo apt-get update
sudo apt-get upgrade
sudo apt-get install git
$ cd ~
$ git clone https://github.com/m-shimizu/RoboCupRescuePackage/
```

How to Setup

- After downloading or cloning the RoboCupRescuePackage, you have to “make” it using the following Commands:

```
$ cd ~/RoboCupRescuePackage
$ source ./.bashrc.USARGazebo
$ mkdir build
$ cd build
$ cmake ../
$ make
```

How to use

- By this tutorial, you need to open four Terminal pages for running the package.
- The following commands should be written in corresponding terminals.
- 1st Terminal:

```
$ cd ~/RoboCupRescuePackage
$ source ./.bashrc.USARGazebo
$ gazebo USARGazebo.world
```

  - Gazebo will be oppend and show the world file which is in the USARGazebo.world

How to use

- 2nd Terminal:

```
$ telnet localhost 3000
```

Now, These 3 Commands(GETSTARTPOSES, INIT, DRIVE) could be used in this terminal.
Here is some examples:

(1) GETSTARTPOSES
Getting Usable Start Location

(2) INIT {ClassName pioneer3at_with_sensors}{Name Robot1}{Location 5,10,0.3}{Rotation 0,0,0}

a. Spawn a pioneer3at robot named “robot1”at the coordinate (5 , 10 , 0.3) with no rotation
b. Spawning multi robots requires 1 sec interval between each robot spawning.

How to use

- 2nd Terminal (Cont'):

  DRIVE {RIGHT 1.0}{LEFT 1.0}
  Drive the robot with speed 1 in each wheel
  MULTIDRIVE {FRFlipper 1.57}{FLFlipper 1.57}{RRFlipper 1.57}{RLFlipper 1.57}
  Move flipper arms of a crawler robot with "MULTIDRIVE" command

- 3rd Terminal:

  $ telnet localhost 5003

  And then type "OK"

  - This command returns a frame of camera image in USARSim style.

How to use

- 3rd Terminal (Cont'):
  - With this commands, you can get a long landscaped jpeg image consisted from 4 robot cameras.
  - Each robot's camera image has width=640 and height=480.
  - Camera images are located side-by-side and first spawned robot's camera's image is located at left end of a jpeg image.
  - If a robot has two cameras, currently you can see only right camera's image.

How to use

- 4th Terminal:

```
$ cd ~/RoboCupRescuePackage
$ source ./.bashrc.USARGazebo
$ cd build
$ ./robot_teleop pioneer3at_with_sensors 2
```

  - Now, you can control the robot with keyboard.

    "robot_teleop" is a program which have a plugin named"SkidSteerDrive" and control the robot through the "/vel_cmd" topic.

How to use

- 4th terminal (Cont’):

  In “robot_teleop”:

  - The 1st argument is the robot model name. Please check it in the model name tree in the left sidebar of the gazebo window. If you see a different name like "pioneer3at_with_sensors_0", replace the 1st argument with it.
  - The 2nd argument is a plugin type number defined in this program. You shouldn’t change this argument.

How to use

- 4th terminal (Cont’):
  - In order to stop this program, push control key and C key on your keyboard at same time.
  - Shutdown process of Gazebo needs 15~20 sec. You should wait at least this much time to before starting the Gazebo again.

How to use

- XML tags for USARGazebo in a world file are as followed

  - Location and orientation of start point

    ```
    <StartPose_1>LOCATIONNAME1 X Y Z Roll Pitch Yaw</StartPose_1>
    <StartPose_2>LOCATIONNAME2 X Y Z Roll Pitch Yaw</StartPose_2>
    <StartPose_3>LOCATIONNAME3 X Y Z Roll Pitch Yaw</StartPose_3>
    <StartPose_4>LOCATIONNAME4 X Y Z Roll Pitch Yaw</StartPose_4>
    ```

  - Turning Ground Truth on

    ```
    <GroundTruth>true</GroundTruth>
    ```

ROBOTS

- pioneer3at_with_sensors series
  a. Classname :
     i. pioneer3at_with_sensors
     ii. pioneer3at_with_sensors_r
     iii. pioneer3at_with_sensors_b
     iv. pioneer3at_with_sensors_g
     v. pioneer3at_with_sensors_y
  b. Equipments :
     i. 2 encoder sensors
     ii. 1 camera
     iii. 1 range sensor

ROBOTS

- pioneer2dx_with_sensors series
  a. Classname :
     i. pioneer2dx_with_sensors_r
     ii. pioneer2dx_with_sensors_b
     iii. pioneer2dx_with_sensors_g
     iv. pioneer2dx_with_sensors_y
  b. Equipments :
     i. 1 camera
     ii. 1 range sensor

ROBOTS

- turtlebot_with_sensors series
  a. Classname :
     i. turtlebot_with_sensors_r
     ii. turtlebot_with_sensors_b
     iii. turtlebot_with_sensors_g
     iv. turtlebot_with_sensors_y
  b. Equipments :
     i. 1 camera
     ii. 1 range sensor

ROBOT

- crawler_robot series
  a. Classname :
     i. crawler_robot_r
     ii. crawler_robot_b
     iii. crawler_robot_g
     iv. crawler_robot_y
  b. Equipments :
     i. 1 camera
     ii. 1 range sensor
     iii. 4 flipper arms.

ROBOTS

- crawler_robot series
  a. Flipper arms :
     i. You can control the angle of a flipper arm with MULTIDRIVE command.
     ii. MULTIDRIVE {FRFlipper 1.57}{FLFlipper 1.57}{RRFlipper 1.57}{RLFlipper 1.57}

Sample Client

- A sample client software was prepared to show fundamental usage of the RoboCupRescuePackage.
- See https://github.com/m-shimizu/USARSimSampleClient
- In USARSimSampleClient :
  - You can spawn 4 robots
  - 4 robot's camera images transferred in jpeg format are shown on rviz

Workable USARSim Command

- USARSim commands
  - INIT
  - GETCONF
  - GETGEO
  - DRIVE
  - MULTIDRIVE
    i. only for controlling flipper arms
  - GETSTARTPOSES
    i. It can return effective start point parameters
    ii. It can not read parameters from map but it can read those from world file as plugin options
- Image Server
  - OK (return Jpeg image)