Robotics Lab: Homework 1

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Here is the link to my public repo on github:
`https://github.com/TonyManz1/Robotics_Lab_HW.git`

We want to specify that all the participants of the group worked at each stage of the development of the project. In order to simplify the drafting of the report (as recommended by the professor) we have fairly divided the writing of the development of the various points.

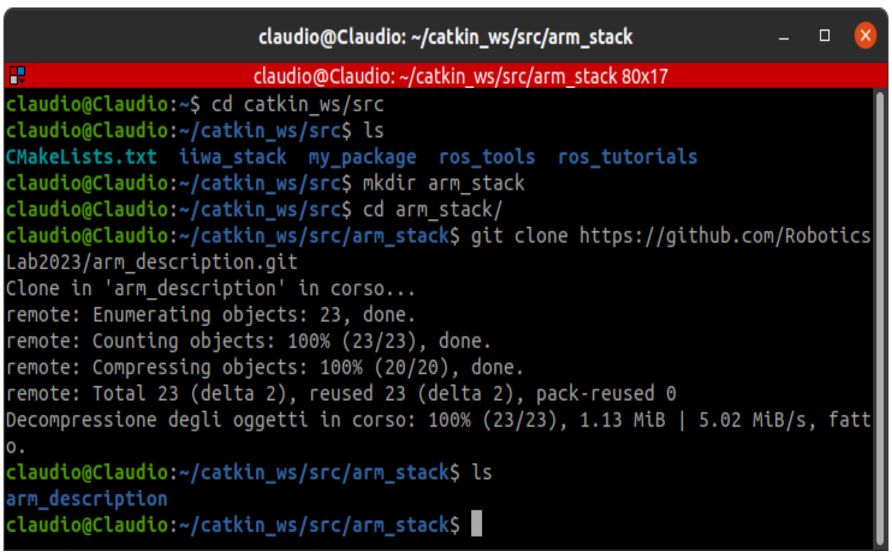
Here is the link to my public repo on github: https://github.com/TonyManz1/HW1_RL_Manzoni.git

Building your robot manipulator

1. Create the description of your robot and visualize it in Rviz

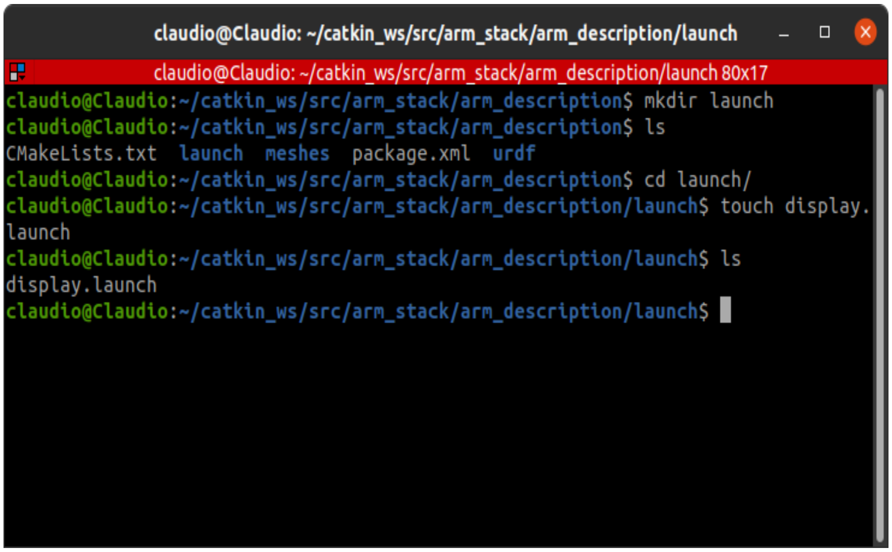
(a) Download the arm_description package from the repo https://github.com/RoboticsLab2023/arm_description.git into your catkin_ws using git commands

In first place it has been downloaded the "**arm_description**" folder available on GitHub with the command "**git clone https://github.com/RoboticsLab2023/arm_description.git**" inside the directory "**catkin_ws/src/arm_stack**", which contains all the folders that are needed for operating the robot **.**



(b) Within the package create a launch folder containing a launch file named display.launch that loads the URDF as a robot_description ROS param and starts the robot_state_publisher node, the joint_state_publisher node, and the rviz node. Launch the file using roslaunch. **Note**: To visualize your robot in rviz you have to changhe the Fixed Frame in the lateral bar and add the RobotModel plugin interface. **Optional**: save a .rviz configuration file, thad auto- matically loads the RobotModel plugin by default, and give it as an argument to your node in the display.launch file

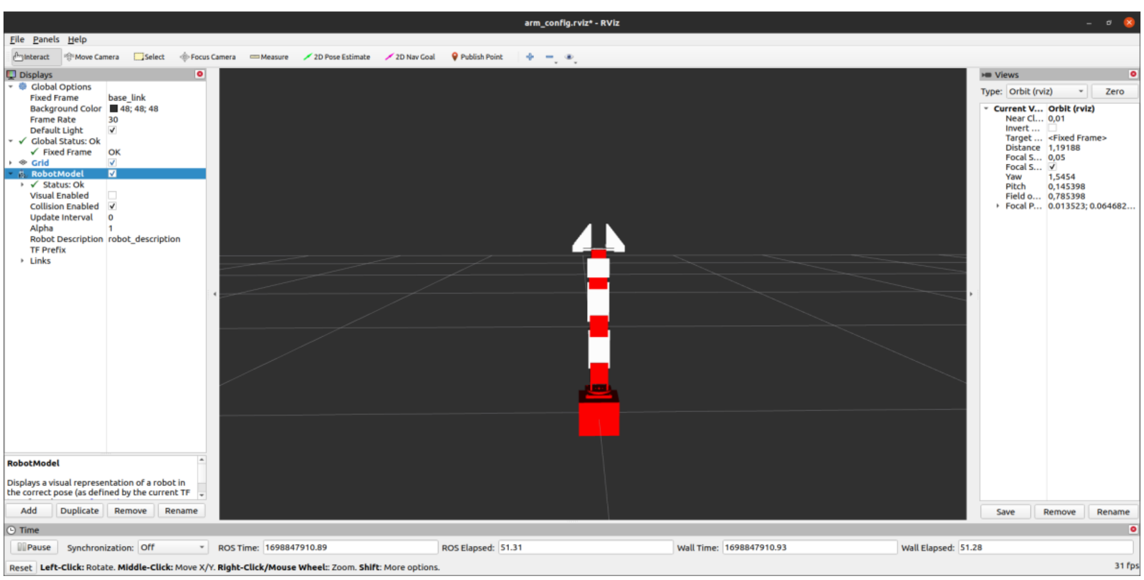
It has been created a folder named "**launch**" that contains the launch files necessary to define and configure the start of the system's parameters and nodes. This point has been done firstly through the command "**mkdir launch**" in order to create the folder and then with the command **"touch display.launch**" to create the file that contains the URDF model with all the parameters of the robot and the boot parameters of the nodes: "**robot_state_publisher**", "**joint_state_publisher**" and "**rviz**". The configuration file "**arm_config.rviz**" that contains the "**RobotModel plugin**" has been saved inside the directory "**/arm_stack/arm_description/config**".



To start the visualization of the robot in rviz environment it has been used the command "**roslaunch arm_description display.launch**".

(c) Substitute the collision meshes of your URDF with primitive shapes. Use <box> geometries of reasonabe size approximating the links. **Hint**: Enable collision visualization in rviz (go to the lateral bar > Robot model > Collision Enabled) to adjust the collision meshes size

It has been substituted the collision meshes of the URDF with primitive shapes of reasonable size. To show the results of this point it is displayed the following image:

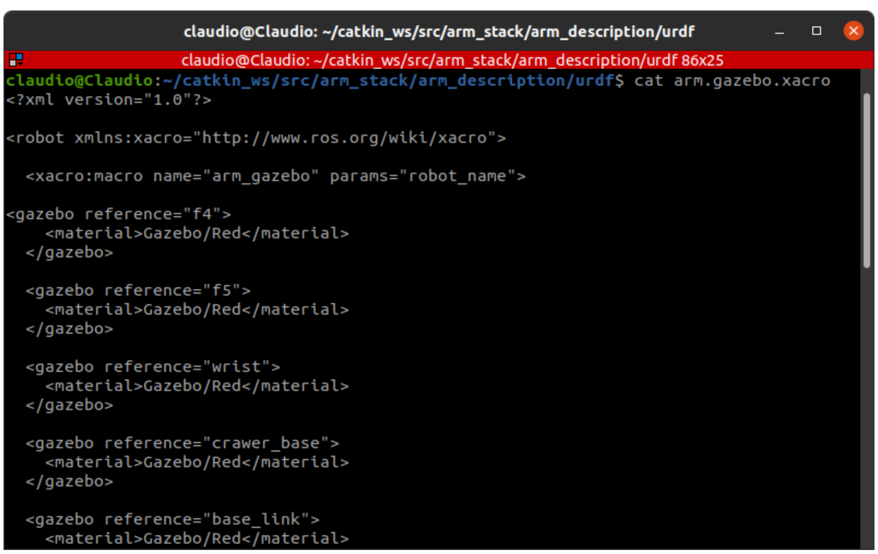


(d) Create a file named arm.gazebo.xacro within your package, define a xacro:macro inside your file containing all the <gazebo> tags you find within your arm.urdf and import it in your URDF using xacro:include. Remember to rename your URDF file to arm.urdf.xacro, add the string xmlns:xacro="http://www.ros.org/wiki/xacro" within the <robot> tag, and load the URDF in your launch file using the xacro routine

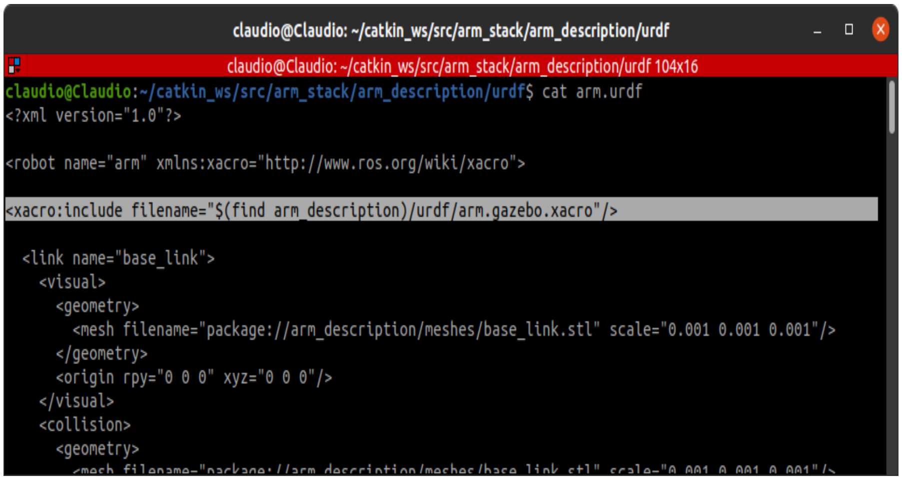
It has been created the file **“arm_gazebo.xacro”** inside the package **“arm_description”.**

Inside this file it has been added **the xacro:macro <xacro:macro name="arm_gazebo" params="robot_name">** that contains all the Gazebo tags present inside the file “**arm.urdf**”.

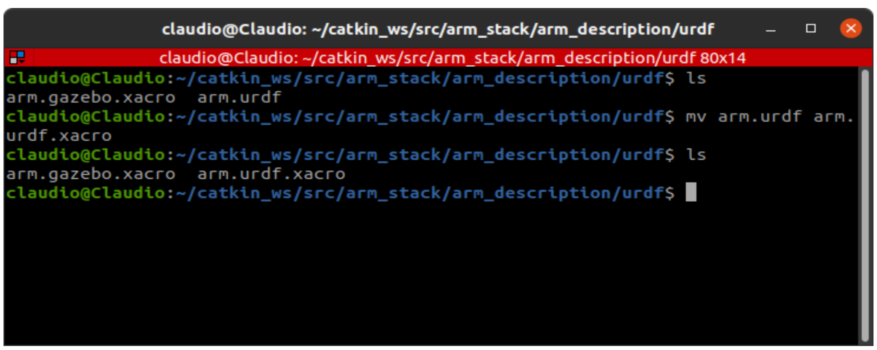
When the arm.urdf file is compiled, what is inside the “arm.gazebo.xacro” file will be included inside the Xacro file that contains this instruction: **“<xacro:include filename="$(find arm_description)/urdf/arm.gazebo.xacro"/>”**. This is useful in order to split the URDF model in smaller and manageable parts, so we can have a better organization of the code and also allowing the reutilization of the components.



The file “**arm.gazebo.xacro**” has been included inside “**arm.urdf**” through the xacro:include marked on the image.



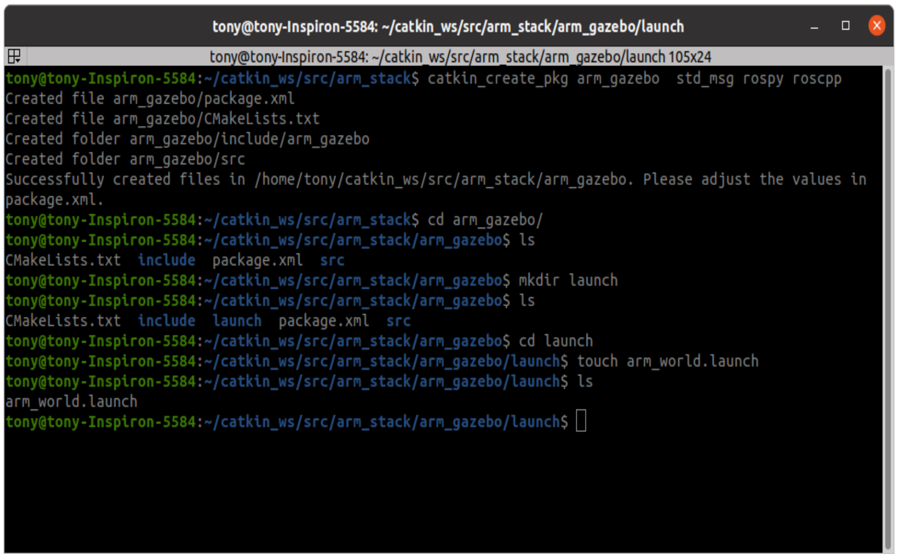
At last the file “**arm.urdf**” has been renamed in **“arm.urdf.xacro”**



2. Add transmission and controllers to your robot and spawn it in Gazebo

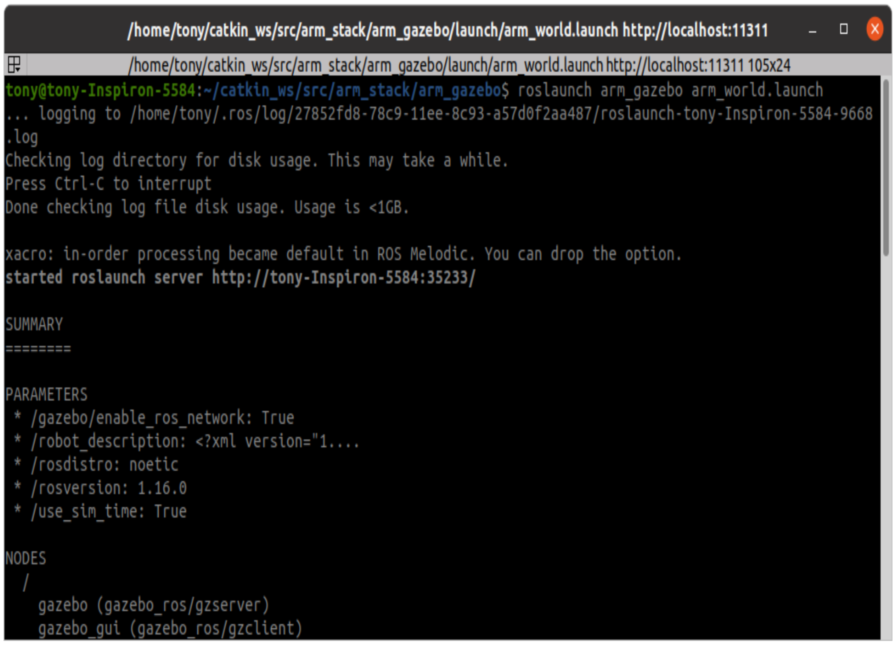
(a) Create a package named arm_gazebo
(b) Within this package create a launch folder containing a arm_world.launch file

In those passages it has been created in first the package arm_gazebo with the command "**catkin_create_pkg arm_gazebo std_msgs rospy roscpp"** and then it was filled with the launch folder. In second place it was created the file "**arm_world.launch**".

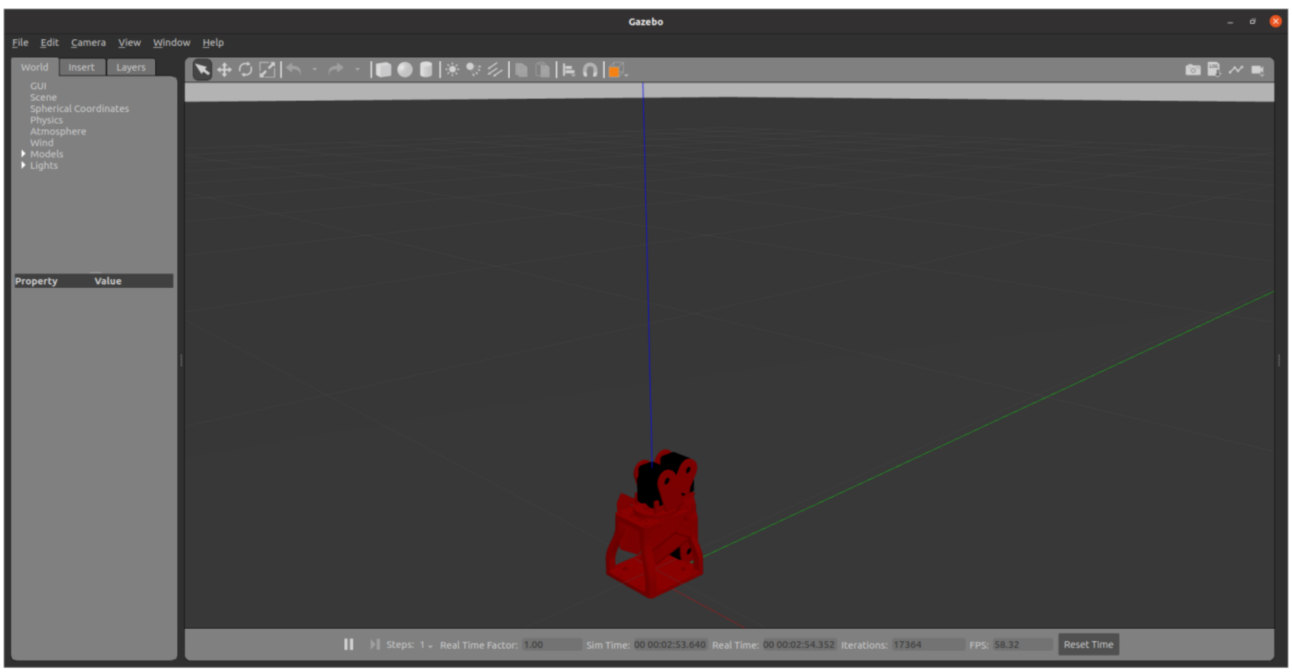


(c) Fill this launch file with commands that load the URDF into the ROS Parameter Server and spawn your robot using the spawn_model node. **Hint**: follow the iiwa_world.launch example from the package iiwa_stack: https://github.com/IFL-CAMP/iiwa_stack/tree/master. Launch the arm_world.launch file to visualize the robot in Gazebo

To accomplish this point it was used as example the iiwa. To show the results in Gazebo it is required to launch the "**arm_world.launch"** file.

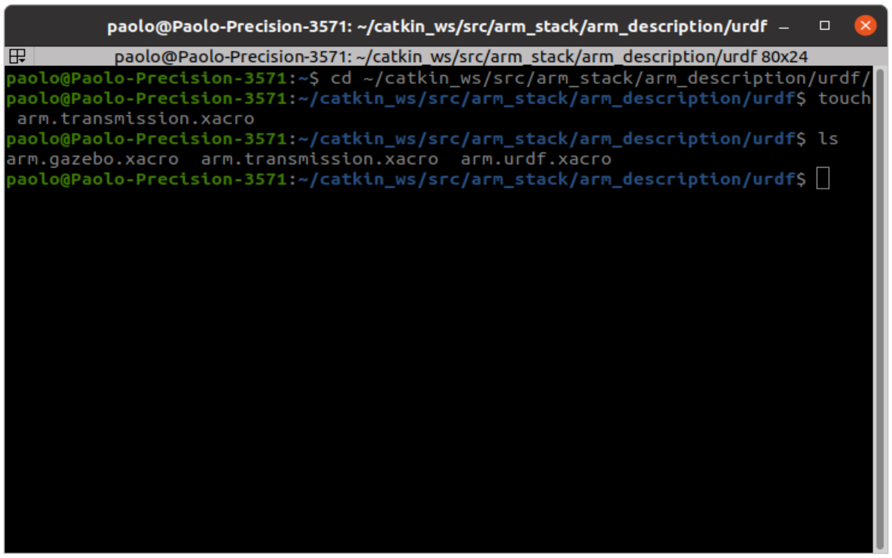


As we can see the robot collapses on itself because it must be added the transmissions and the controllers.

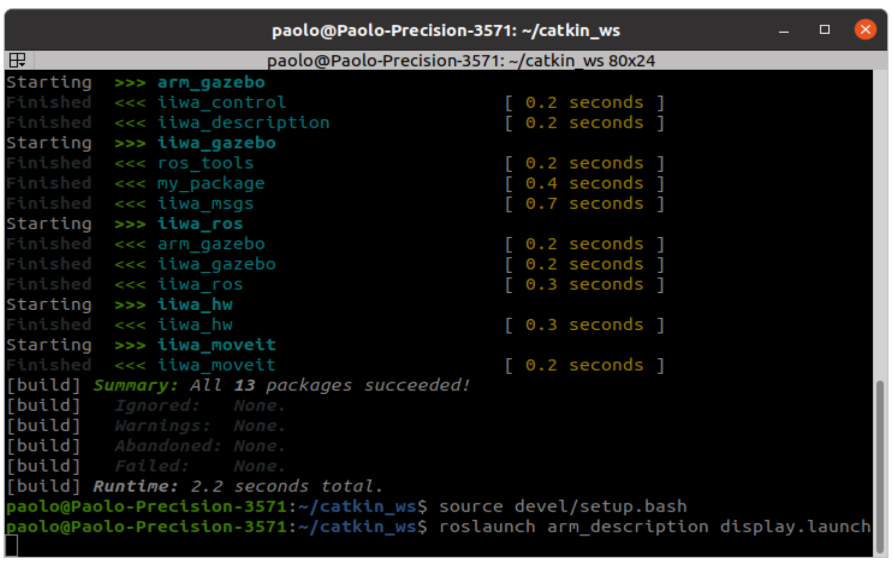


(d) Now add a PositionJointInterface as hardware interface to your robot: create a arm.transmission.xacro file into your arm_description/urdf folder containing a xacro:macro with the hardware interface and load it into your arm.urdf.xacro file using xacro:include. Launch the file

The file “**arm.transmission.xacro**” has been created with the command “**touch**” in the following path “**~/catkin_ws/src/arm_stack/arm_description/urdf/**”.

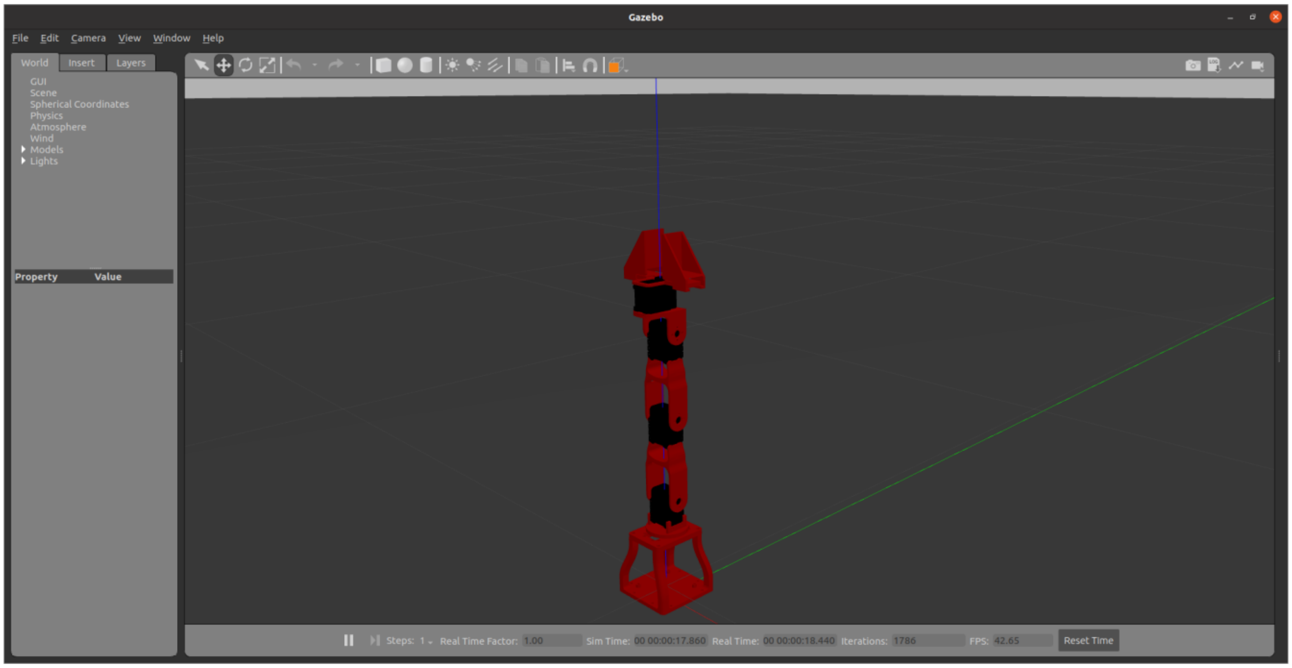


Then the “**arm.transmission.xacro**” file has been correctly filled; and then it has been launched, with the following commands : “**catkin build**”, “**source devel/setup.bash**”, “**roslaunch arm_description display.launch**” and “**roslaunch arm_gazebo arm_world.launch**”.



Then it was added the xacro inside “**arm.urdf.xacro**” using “**<xacro:include filename="$(find arm_description)/urdf/arm.transmission.xacro"/>**”.

With “**roslaunch arm_gazebo arm_world.launch**” command the following image is displayed.

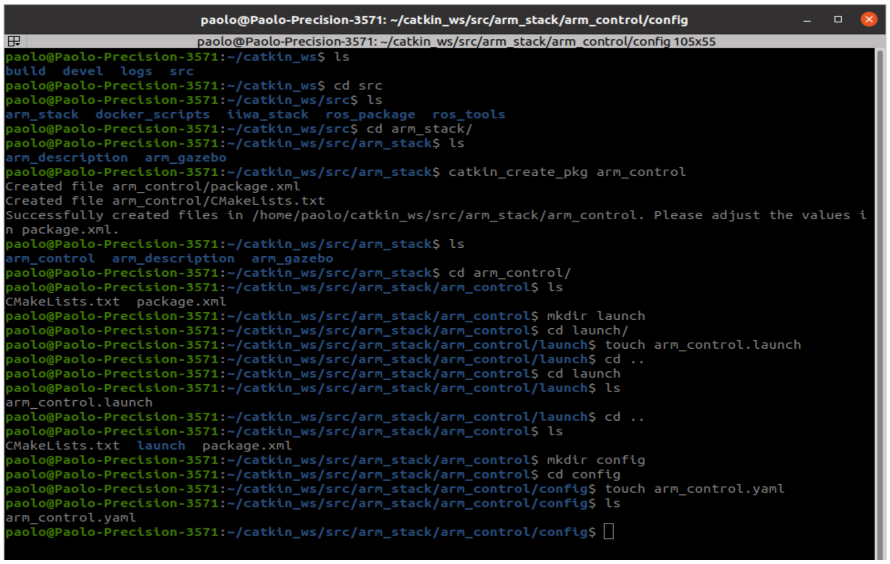


At the begin of the simulation we can notice that the manipulator stays standing on itself before it collapses due the absence of the controllers.

The same result is obtained launching the command: “**roslaunch arm_description display.launch**”.

(e) Add joint position controllers to your robot: create a arm_control package with a arm_control.launch file inside its launch folder and a arm_control.yaml file within its config folder

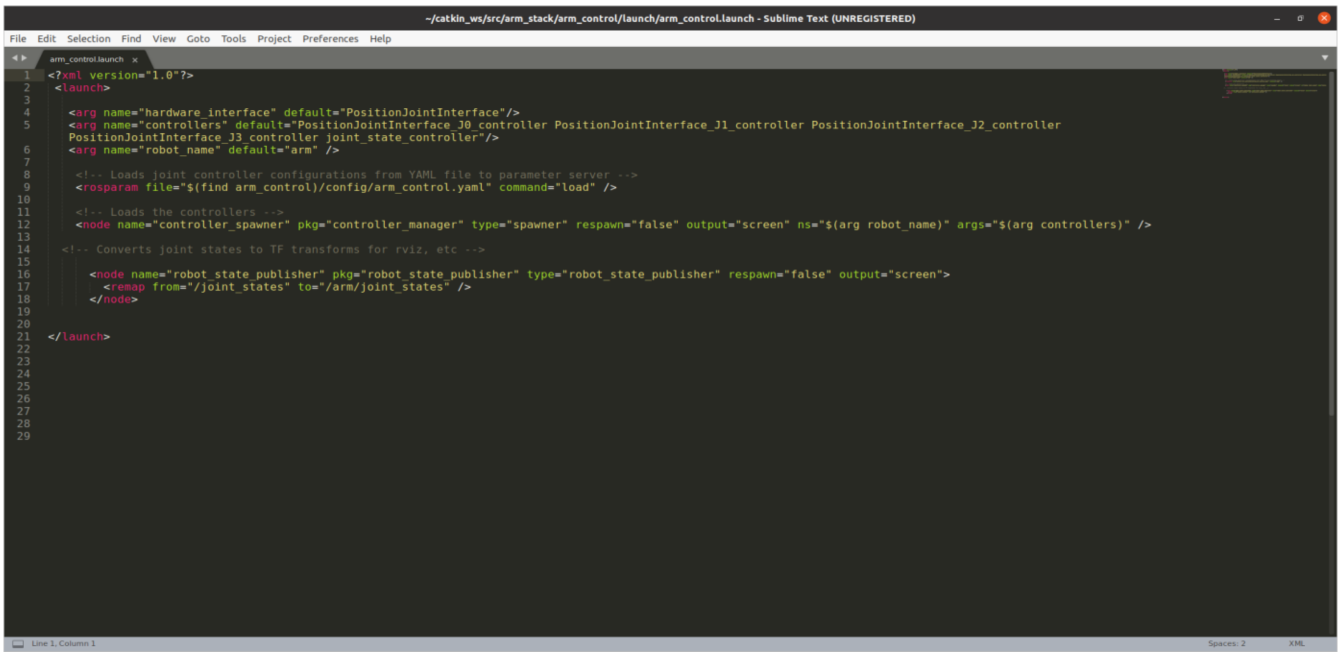
To create the package, move to the following path " **~/catkin_ws/src/arm_stack/**"; it has been made with the following command “**catkin_create_pkg arm_control**”. Then launch and config folders must be made with the “**mkdir**” command, inside the new package and the “**arm_control.launch**” and “**arm_control.yaml**” files has been created in the respective folders: “**launch**” and “**config**”.



(f) Fill the arm_control.launch file with commands that load the joint controller configurations from the .yaml file to the parameter server and spawn the controllers using the controller_manager package. **Hint**: follow the iiwa_control.launch example from corresponding package

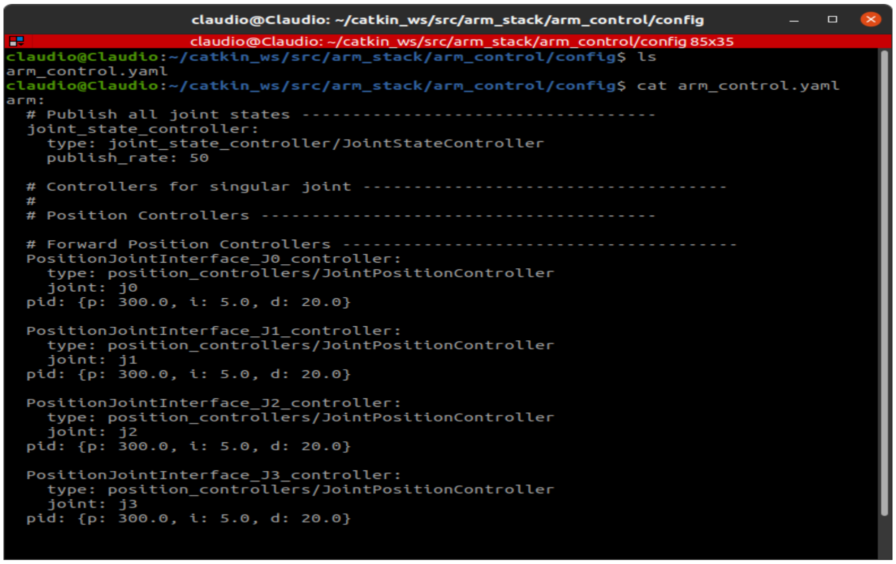
Inside the "**arm_control.launch**" file it has been uploaded the parameters from the "**arm_control.config**" file through the following code line:
<rosparam file="$(find arm_control)/config/arm_control.yaml" command="load" />.

The controllers have been spawned thorough the following node:
<node name="controller_spawner" pkg="controller_manager" type="spawner" respawn="false" output="screen" ns="$(arg robot_name)" args="$(arg controllers)" />.



(g) Fill the arm arm_control.yaml adding a joint_state_controller and a JointPositionController to all the joints

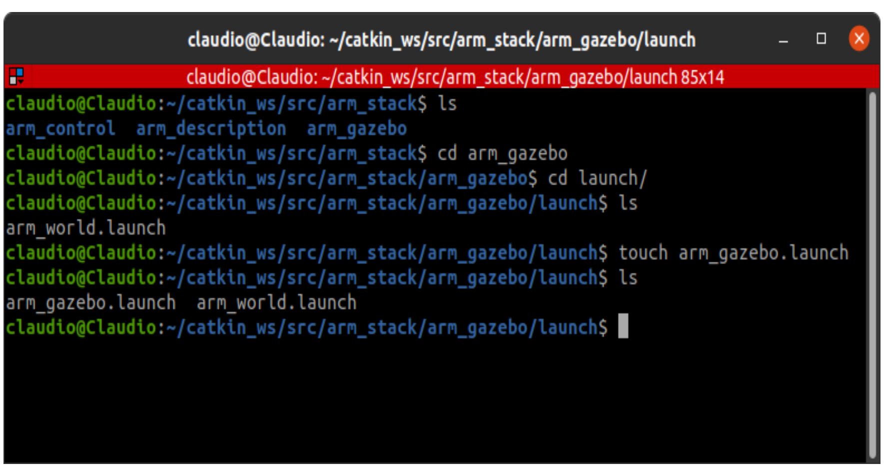
The file "**arm.control.yalm**" has been filled with a joint_state_controller and a JointPositionController to all the joints as it is shown in the following picture.



```
claudio@Claudio: ~/catkin_ws/src/arm_stack/arm_control/config
claudio@Claudio: ~/catkin_ws/src/arm_stack/arm_control/config 85x35
claudio@Claudio:~/catkin_ws/src/arm_stack/arm_control/config$ ls
arm_control.yaml
claudio@Claudio:~/catkin_ws/src/arm_stack/arm_control/config$ cat arm_control.yaml
arm:
  # Publish all joint states -----------------------------------
  joint_state_controller:
    type: joint_state_controller/JointStateController
    publish_rate: 50

  # Controllers for singular joint ------------------------------------
  #
  # Position Controllers ---------------------------------------

  # Forward Position Controllers ---------------------------------------
  PositionJointInterface_J0_controller:
    type: position_controllers/JointPositionController
    joint: j0
  pid: {p: 300.0, i: 5.0, d: 20.0}

  PositionJointInterface_J1_controller:
    type: position_controllers/JointPositionController
    joint: j1
  pid: {p: 300.0, i: 5.0, d: 20.0}

  PositionJointInterface_J2_controller:
    type: position_controllers/JointPositionController
    joint: j2
  pid: {p: 300.0, i: 5.0, d: 20.0}

  PositionJointInterface_J3_controller:
    type: position_controllers/JointPositionController
    joint: j3
  pid: {p: 300.0, i: 5.0, d: 20.0}
```

(h) Create an arm_gazebo.launch file into the launch folder of the arm_gazebo package loading the Gazebo world with arm_world.launch and spawning the controllers within arm_control.launch. Go to the arm_description package and add the gazebo_ros_control plugin to your main URDF into the arm.gazebo.xacro file. Launch the simulation and check if your controllers are correctly loaded

Firstly it has been created the "**arm_gazebo.launch**" file inside the launch folder of the "**arm_gazebo**" package.



```
claudio@Claudio: ~/catkin_ws/src/arm_stack/arm_gazebo/launch
claudio@Claudio: ~/catkin_ws/src/arm_stack/arm_gazebo/launch 85x14
claudio@Claudio:~/catkin_ws/src/arm_stack$ ls
arm_control  arm_description  arm_gazebo
claudio@Claudio:~/catkin_ws/src/arm_stack$ cd arm_gazebo
claudio@Claudio:~/catkin_ws/src/arm_stack/arm_gazebo$ cd launch/
claudio@Claudio:~/catkin_ws/src/arm_stack/arm_gazebo/launch$ ls
arm_world.launch
claudio@Claudio:~/catkin_ws/src/arm_stack/arm_gazebo/launch$ touch arm_gazebo.launch
claudio@Claudio:~/catkin_ws/src/arm_stack/arm_gazebo/launch$ ls
arm_gazebo.launch  arm_world.launch
claudio@Claudio:~/catkin_ws/src/arm_stack/arm_gazebo/launch$
```

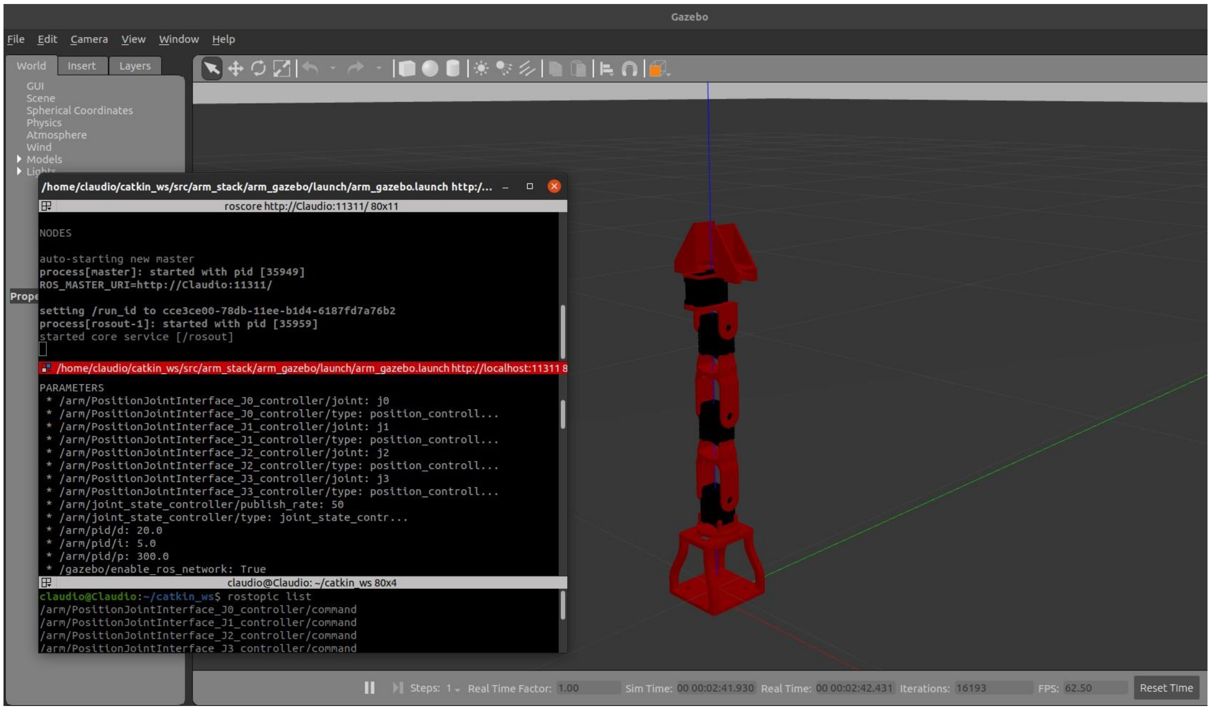
Then we get inside the arm_control.launch and to load the controllers it has been used:
<arg name="controllers" default="PositionJointInterface_J0_controller PositionJointInterface_J1_controller PositionJointInterface_J2_controller PositionJointInterface_J3_controller joint_state_controller"/>

```
claudio@Claudio: ~/catkin_ws/src/arm_stack/arm_control/launch
claudio@Claudio: ~/catkin_ws/src/arm_stack/arm_control/launch 87x11
claudio@Claudio:~/catkin_ws/src/arm_stack/arm_control/launch$ cat arm_control.launch
<?xml version="1.0"?>
 <launch>

   <arg name="hardware_interface" default="PositionJointInterface"/>
   <arg name="controllers" default="
   PositionJointInterface_J0_controller
   PositionJointInterface_J1_controller
   PositionJointInterface_J2_controller
   PositionJointInterface_J3_controller joint_state_controller"/>
   <arg name="robot_name" default="arm" />
```

At this point we went to the "**arm_description**" package and we added the gazebo_ros_control plugin to our main URDF into the "**arm.gazebo.xacro**" file.

```
claudio@Claudio: ~/catkin_ws/src/arm_stack/arm_description/urdf
claudio@Claudio: ~/catkin_ws/src/arm_stack/arm_description/urdf 82x18
claudio@Claudio:~/catkin_ws/src/arm_stack/arm_description/urdf$ cat arm.gazebo.xac
ro
<?xml version="1.0"?>

<robot xmlns:xacro="http://www.ros.org/wiki/xacro">

  <xacro:macro name="arm_gazebo" params="robot_name">

    <gazebo>
      <plugin name="gazebo_ros_control" filename="libgazebo_ros_control.so">
        <robotNamespace>/${robot_name}</robotNamespace>
      </plugin>
    </gazebo>

<gazebo reference="f4">
    <material>Gazebo/Red</material>
  </gazebo>

  <gazebo reference="f5">
```

At last, it has been launched the simulation and it has been checked if our controllers were correctly loaded.



3. Add a camera sensor to your robot

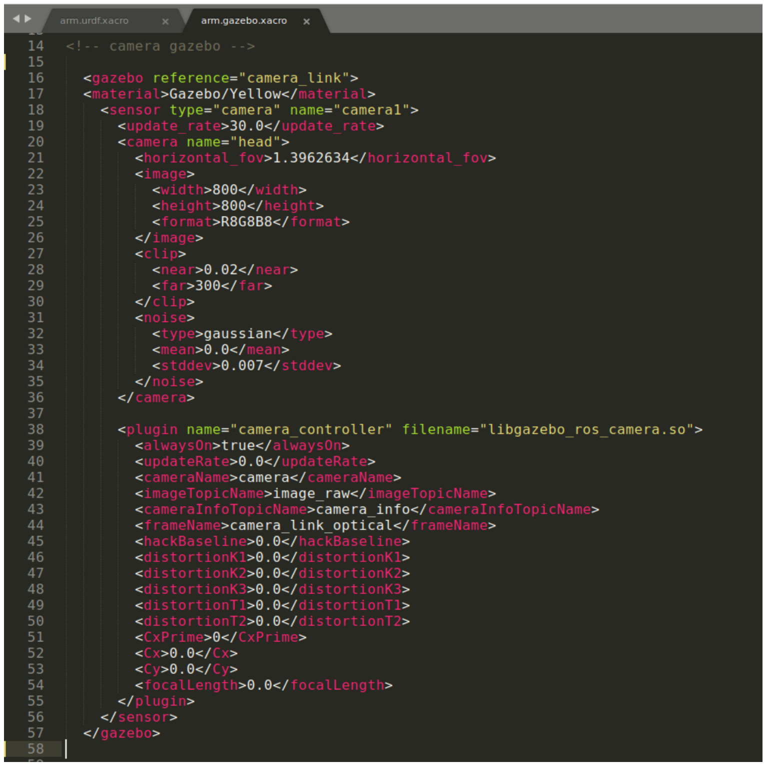
(a) Go into your arm.urdf.xacro file and add a camera_link and a fixed camera_joint with base_link as a parent link. Size and position the camera link opportunely.

We went inside our "**arm.urdf.xacro**" file and we have added a "**camera_link**" and a fixed "**camera_joint**" with "**base_link**" as a parent link. After that we have chosen the size and position of the camera link opportunely.

```
arm.urdf.xacro

<!--CAMERA-->

  <joint name="camera_joint" type="fixed">
    <axis xyz="0 1 0"/>
    <origin xyz="0 0.03 0" rpy="0 0 1.5708"/>
    <parent link="base_link"/>
    <child link="camera_link"/>
  </joint>

  <link name="camera_link">
    <collision>
      <origin xyz="0 0 0" rpy="0 0 0"/>
      <geometry>
        <box size="0.02 0.04 0.04"/>
      </geometry>
    </collision>

   <visual>
      <origin xyz="0 0 0" rpy="0 0 0" />
      <geometry>
        <box size="0.02 0.04 0.04"/>
      </geometry>
    </visual>

    <inertial>
      <origin xyz="0 0 0.02" rpy="0 0 0"/>
      <mass value="1e-5"/>
      <inertia ixx="1e-6" ixy="0" ixz="0" iyy="1e-6" iyz="0" izz="1e-6" />
    </inertial>
  </link>
```

(b) In the arm.gazebo.xacro add the gazebo sensor reference tags and the libgazebo_ros_camera plugin to your xacro (slide 74-75)

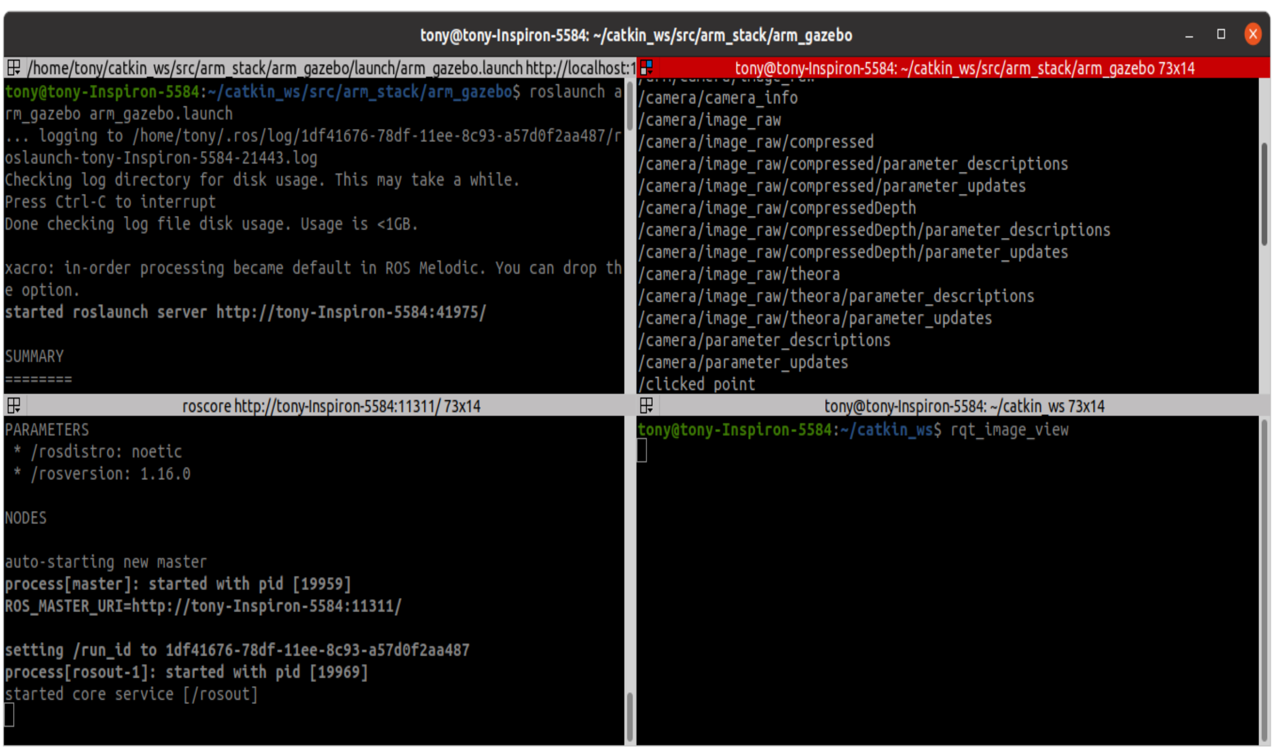
As shown by the slides (74-75) we went inside the "**arm_gazebo.xacro**" file and we have added the gazebo sensor reference tags and the libgazebo_ros_camera plugin.



```xml
<!-- camera gazebo -->

  <gazebo reference="camera_link">
  <material>Gazebo/Yellow</material>
    <sensor type="camera" name="camera1">
      <update_rate>30.0</update_rate>
      <camera name="head">
        <horizontal_fov>1.3962634</horizontal_fov>
        <image>
          <width>800</width>
          <height>800</height>
          <format>R8G8B8</format>
        </image>
        <clip>
          <near>0.02</near>
          <far>300</far>
        </clip>
        <noise>
          <type>gaussian</type>
          <mean>0.0</mean>
          <stddev>0.007</stddev>
        </noise>
      </camera>

      <plugin name="camera_controller" filename="libgazebo_ros_camera.so">
        <alwaysOn>true</alwaysOn>
        <updateRate>0.0</updateRate>
        <cameraName>camera</cameraName>
        <imageTopicName>image_raw</imageTopicName>
        <cameraInfoTopicName>camera_info</cameraInfoTopicName>
        <frameName>camera_link_optical</frameName>
        <hackBaseline>0.0</hackBaseline>
        <distortionK1>0.0</distortionK1>
        <distortionK2>0.0</distortionK2>
        <distortionK3>0.0</distortionK3>
        <distortionT1>0.0</distortionT1>
        <distortionT2>0.0</distortionT2>
        <CxPrime>0</CxPrime>
        <Cx>0.0</Cx>
        <Cy>0.0</Cy>
        <focalLength>0.0</focalLength>
      </plugin>
    </sensor>
  </gazebo>
```

(c) Launch the Gazebo simulation with using arm_gazebo.launch and check if the image topic is correctly published using rqt_image_view

We have launched the simulation with the command "**roslaunch arm_gazebo.launch**" and we have checked if the image topic is correctly published using "**rqt_image_view**".

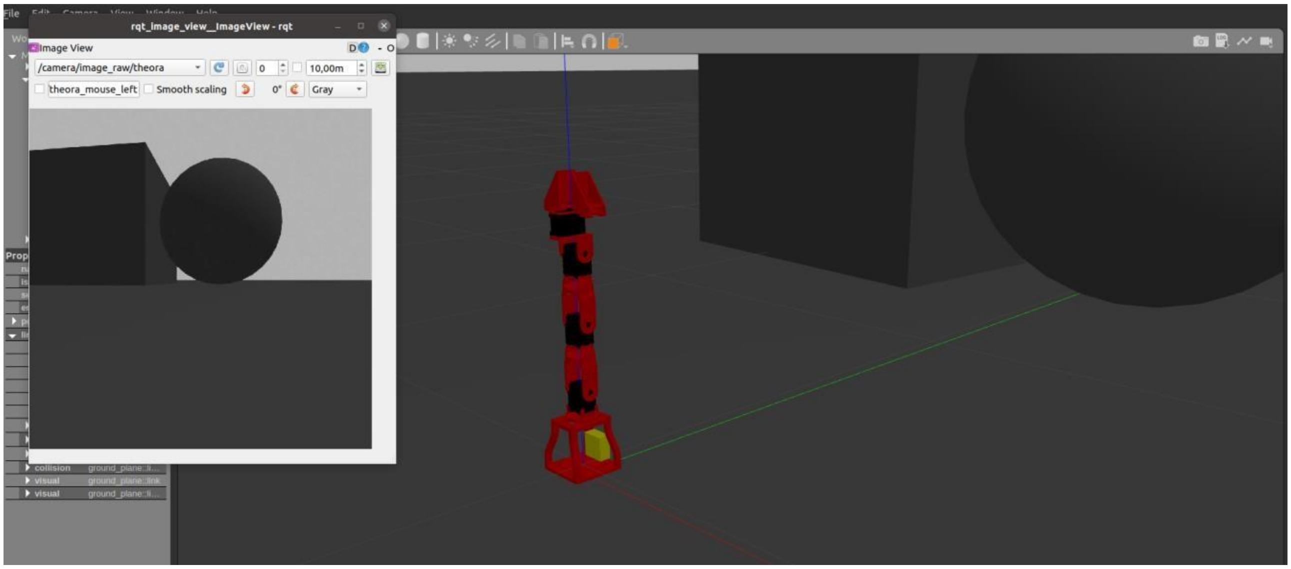


```
tony@tony-Inspiron-5584:~/catkin_ws/src/arm_stack/arm_gazebo$ roslaunch a
rm_gazebo arm_gazebo.launch
... logging to /home/tony/.ros/log/1df41676-78df-11ee-8c93-a57d0f2aa487/r
oslaunch-tony-Inspiron-5584-21443.log
Checking log directory for disk usage. This may take a while.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.

xacro: in-order processing became default in ROS Melodic. You can drop th
e option.
started roslaunch server http://tony-Inspiron-5584:41975/

SUMMARY
========
```

```
/camera/camera_info
/camera/image_raw
/camera/image_raw/compressed
/camera/image_raw/compressed/parameter_descriptions
/camera/image_raw/compressed/parameter_updates
/camera/image_raw/compressedDepth
/camera/image_raw/compressedDepth/parameter_descriptions
/camera/image_raw/compressedDepth/parameter_updates
/camera/image_raw/theora
/camera/image_raw/theora/parameter_descriptions
/camera/image_raw/theora/parameter_updates
/camera/parameter_descriptions
/camera/parameter_updates
/clicked_point
```

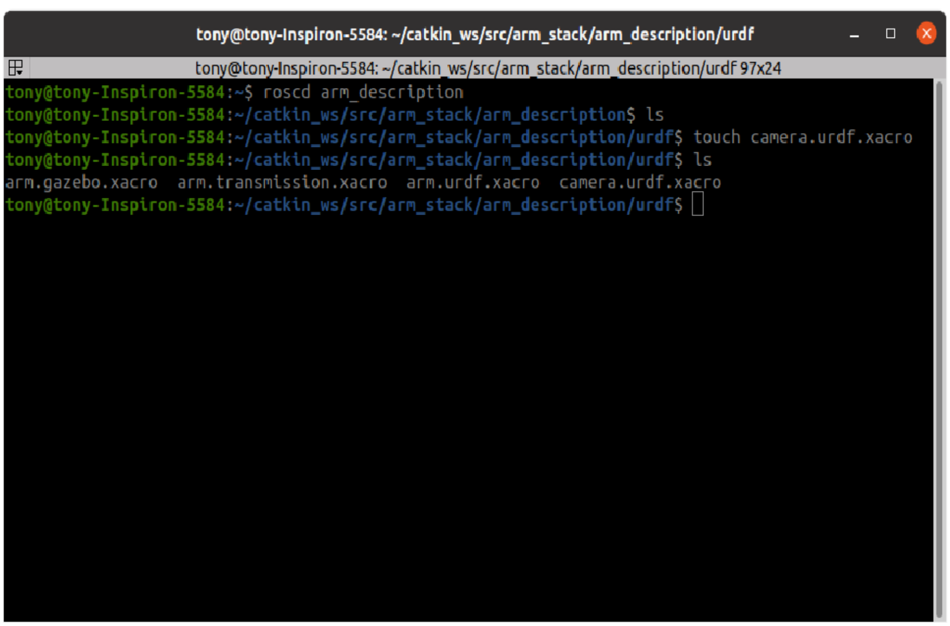
```
PARAMETERS
 * /rosdistro: noetic
 * /rosversion: 1.16.0

NODES

auto-starting new master
process[master]: started with pid [19959]
ROS_MASTER_URI=http://tony-Inspiron-5584:11311/

setting /run_id to 1df41676-78df-11ee-8c93-a57d0f2aa487
process[rosout-1]: started with pid [19969]
started core service [/rosout]
```

```
tony@tony-Inspiron-5584:~/catkin_ws$ rqt_image_view
```

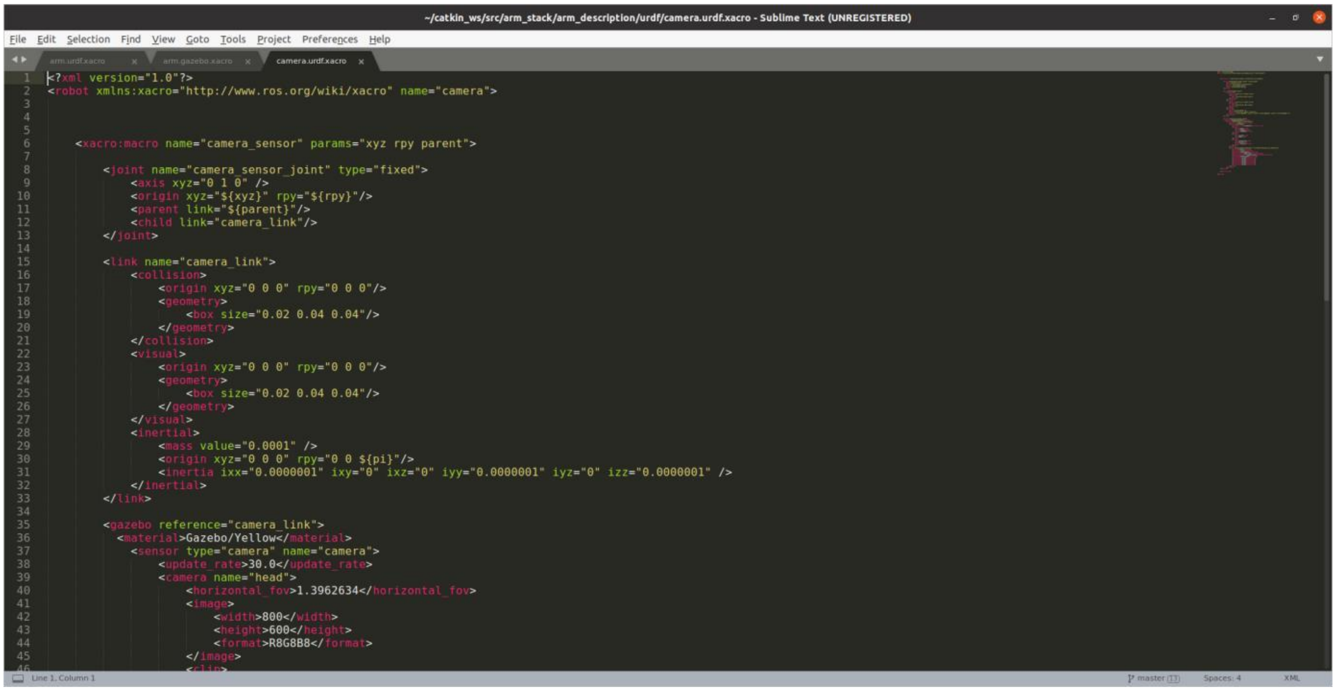


(d) **Optionally**: You can create a camera.xacro file (or download one from https://github.com/CentroEPiaggio/irobotcreate2ros/blob/master/model/camera.urdf.xacro) and add it to your robot URDF using <xacro:include>

We have created the “**camera.xacro**” file and then we have filled it with the one downloaded from the GitHub link. At last, we have modified opportunely the box sizes and the color.



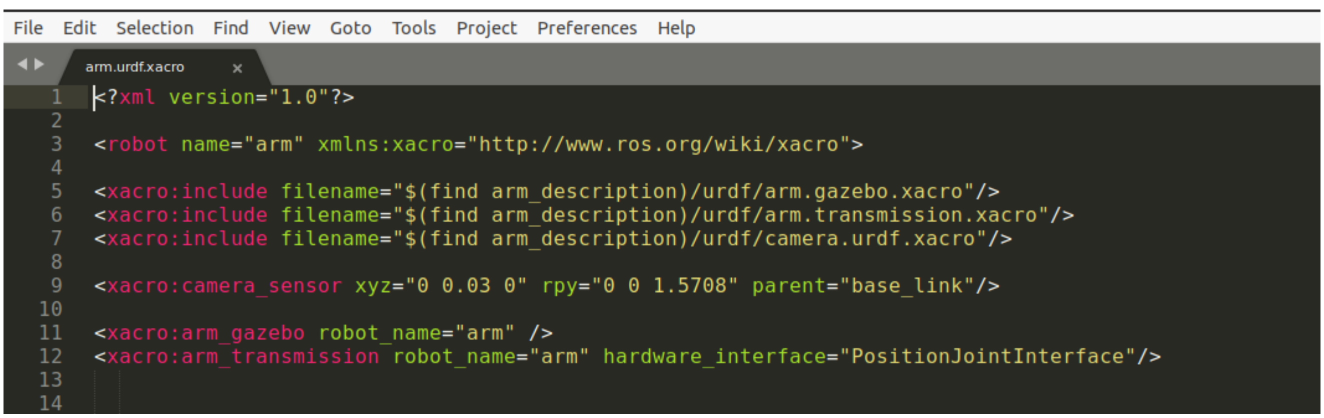
In “**camera.urdf.xacro**” file there is a **<xacro:macro> camera_sensor** to pass xyz, rpy and parent in order to we can assign from my robot file “**arm.urdf.xacro**” the coordinates xyz of the camera origin, the orientation rpy and as parent the link base_link.



```
<?xml version="1.0"?>
<robot xmlns:xacro="http://www.ros.org/wiki/xacro" name="camera">



    <xacro:macro name="camera_sensor" params="xyz rpy parent">

        <joint name="camera_sensor_joint" type="fixed">
            <axis xyz="0 1 0" />
            <origin xyz="${xyz}" rpy="${rpy}"/>
            <parent link="${parent}"/>
            <child link="camera_link"/>
        </joint>

        <link name="camera_link">
            <collision>
                <origin xyz="0 0 0" rpy="0 0 0"/>
                <geometry>
                    <box size="0.02 0.04 0.04"/>
                </geometry>
            </collision>
            <visual>
                <origin xyz="0 0 0" rpy="0 0 0"/>
                <geometry>
                    <box size="0.02 0.04 0.04"/>
                </geometry>
            </visual>
            <inertial>
                <mass value="0.0001" />
                <origin xyz="0 0 0" rpy="0 0 ${pi}"/>
                <inertia ixx="0.0000001" ixy="0" ixz="0" iyy="0.0000001" iyz="0" izz="0.0000001" />
            </inertial>
        </link>

        <gazebo reference="camera_link">
          <material>Gazebo/Yellow</material>
            <sensor type="camera" name="camera">
                <update_rate>30.0</update_rate>
                <camera name="head">
                    <horizontal_fov>1.3962634</horizontal_fov>
                    <image>
                        <width>800</width>
                        <height>600</height>
                        <format>R8G8B8</format>
                    </image>
```

We have included the camera inside the “**arm.urdf.xacro**” file through this command: **<xacro:include filename="$(find arm_description)/urdf/camera.urdf.xacro"/> .**

In file “**arm.urdf.xacro**” we have assigned “0 0 1.5708” at *rpy* parameter because we wanted that the camera to be directed along the y axis, this is the axis along which the robot can move its links in the initial condition and so we have rotated the camera around z axis by 90° (1.5708 radians).

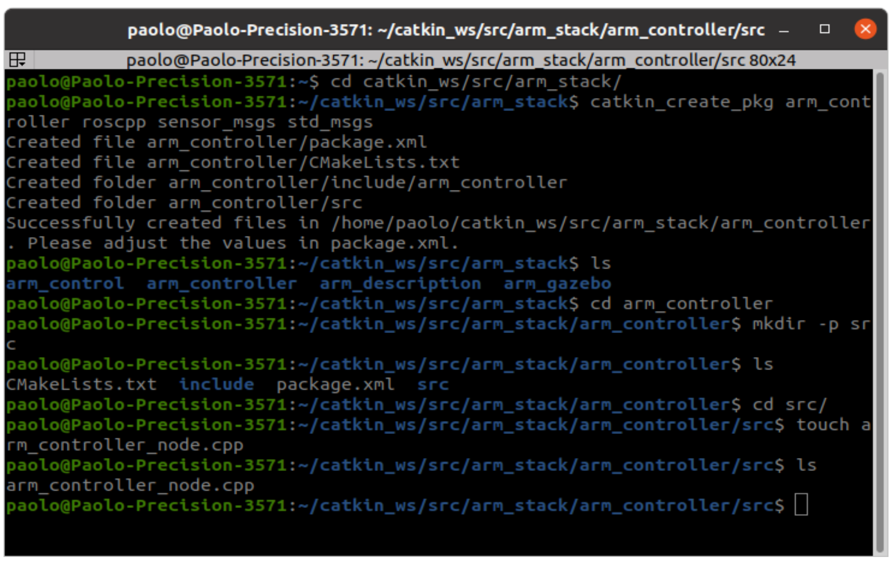


```
<?xml version="1.0"?>

<robot name="arm" xmlns:xacro="http://www.ros.org/wiki/xacro">

<xacro:include filename="$(find arm_description)/urdf/arm.gazebo.xacro"/>
<xacro:include filename="$(find arm_description)/urdf/arm.transmission.xacro"/>
<xacro:include filename="$(find arm_description)/urdf/camera.urdf.xacro"/>

<xacro:camera_sensor xyz="0 0.03 0" rpy="0 0 1.5708" parent="base_link"/>

<xacro:arm_gazebo robot_name="arm" />
<xacro:arm_transmission robot_name="arm" hardware_interface="PositionJointInterface"/>
```

4. Create a ROS publisher node that reads the joint state and sends joint position commands to your robot

(a) Create an arm_controller package with a ROS C++ node named arm_controller_node. The dependencies are roscpp, sensor_msgs and std_msgs. Modify opportunely the CmakeLists.txt file to compile your node. Hint: uncomment add_executable and target_link_libraries lines

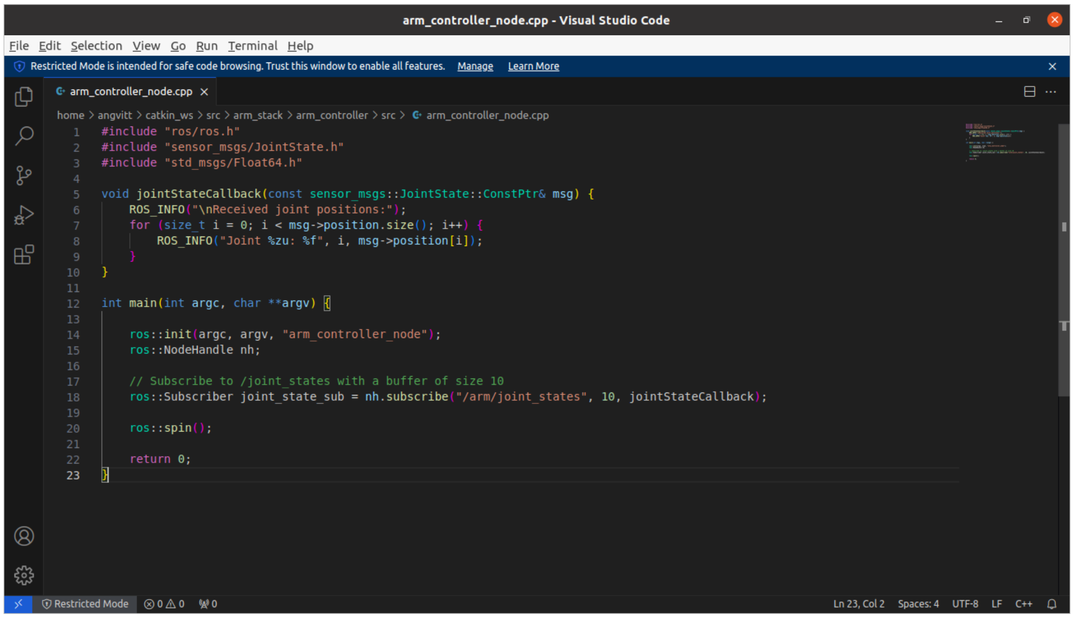
The "**arm_controller**" package has been created with the following command "**catkin_create_pkg arm_controller roscpp sensor_msgs std_msgs**", where the last three represent dependencies, in the following folder **"~/catkin_ws/src/arm_stack/**". Subsequently to create the "**arm_controller_node.cpp**" file the "**src**" folder is created in the "**~/catkin_ws/src/arm_stack/arm_controller**" path and then create the "**arm_controller_node.cpp**" file inside with the "touch" command.



The "**CmakeLists.txt**" file has been modified: "**add_executable**" and "**target_link_libraries**" lines are uncommented. So the following lines have been added: "**add_executable(arm_controller_node src/arm_controller_node.cpp)**" and "**target_link_libraries(arm_controller_node ${catkin_LIBRARIES})**".

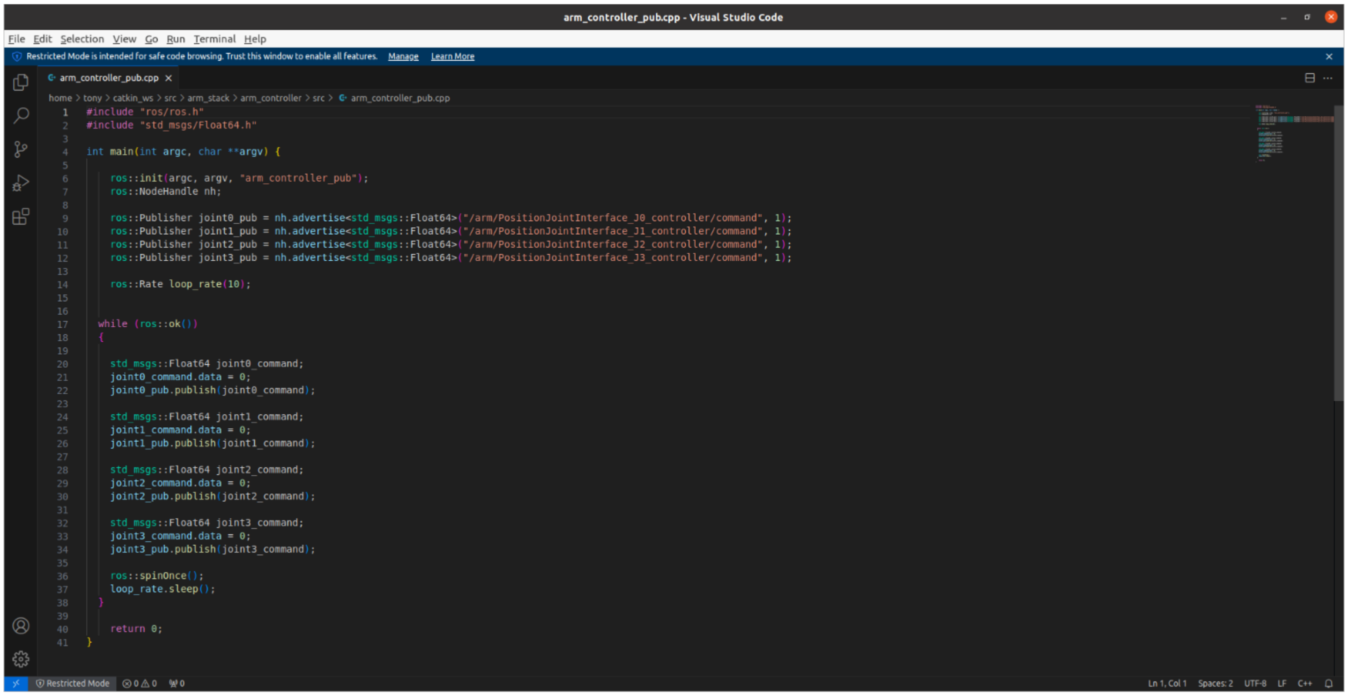
(b) Create a subscriber to the topic joint_states and a callback function that prints the current joint positions (see Slide 45). **Note**: the topic contains a sensor_msgs/JointState

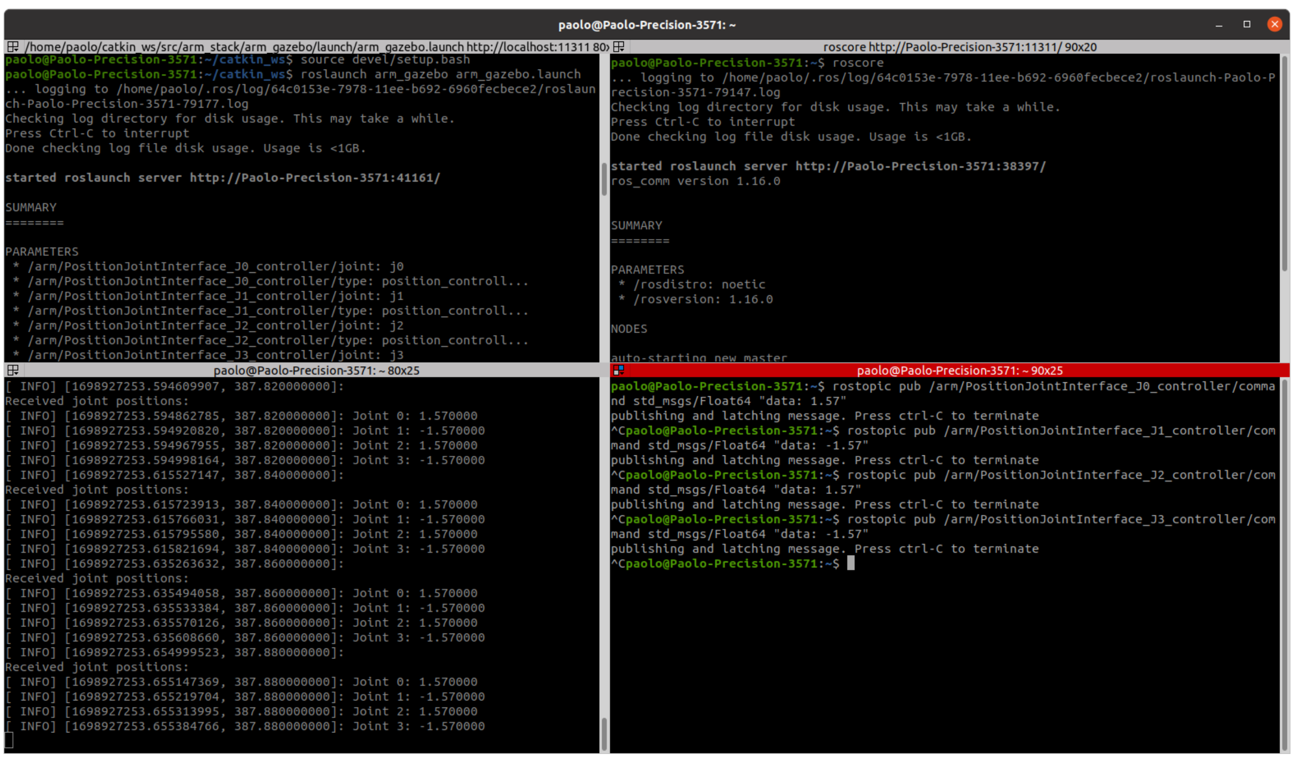
The subscriber is created in the "**arm_controller_node.cpp**" file with the name "**joint_state_sub**" to the topic "**/arm/joint_states**" with a buffer of size 10 using the command "**ros::Subscriber**". The subscriber calls the callback called "**jointStateCallback**" which prints the current joint position.

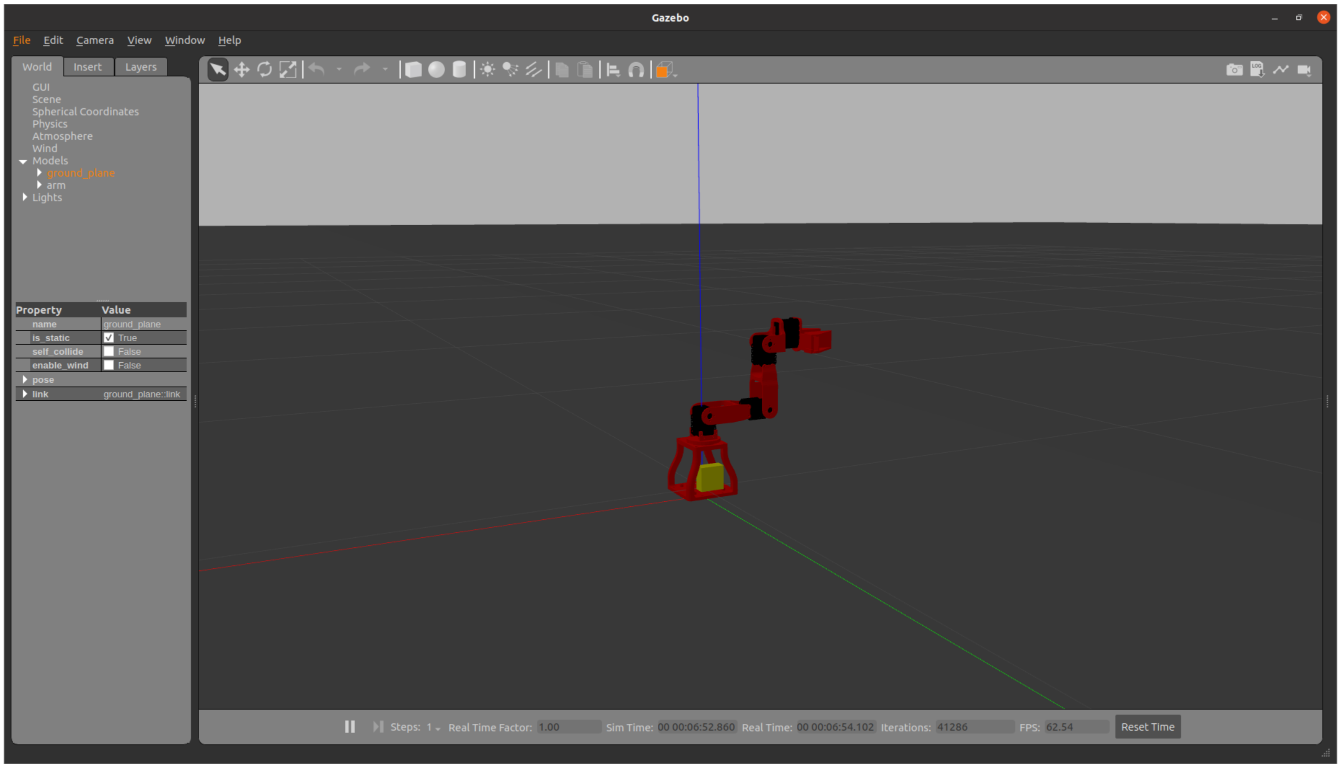


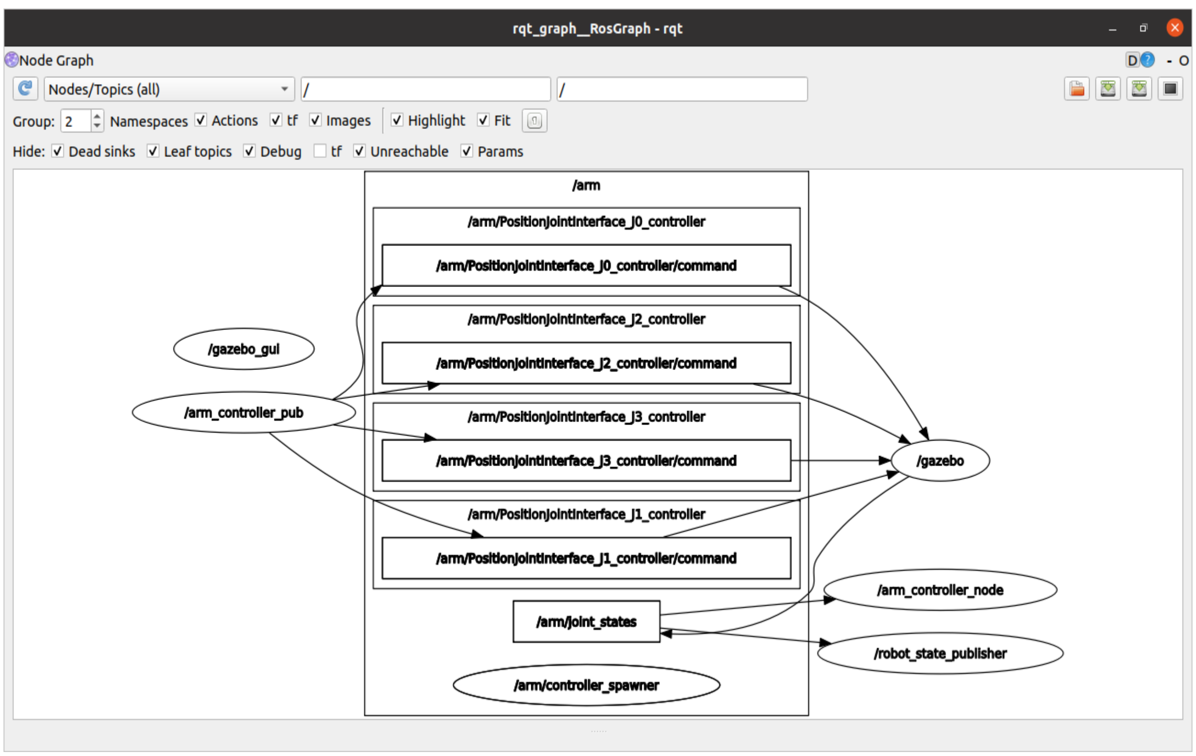
(c) Create publishers that write commands onto the controllers' /command topics (see Slide 46). **Note**: the command is a std_msgs/Float64

Four publishers are created with the name "**joint{n}_pub**" (where n goes from 0 to 3), one for each joint within the "**arm_controller_pub.cpp**" file, with the topic "**/arm/PositionJointInterface_J{n}_controller/command**" using the following command: "**ros::Publisher**". The default values of the joint positions are fixed at 0. The "**arm_controller_pub.cpp**" file is created in the "**~/catkin_ws/src/arm_stack/arm_controller/src**" path with the "**touch**" command. As in point 4.a the "**CmakeLists.txt**" file is modified, the following lines have been added: "**add_executable(arm_controller_pub src/arm_controller_pub.cpp)**" and "**target_link_libraries(arm_controller_pub ${catkin_LIBRARIES})**".
At the end several tests has been carried out, in which the joint angle of joints of the robot are modified to rotate it to a defined configuration: the angle of the joints are controlled where they are: -90° for joint 1 (shoulder), 90° for joint 2 (elbow), -90° for joint 3 (wrist), 90° for joint 0 (base).


arm_controller_pub.cpp - Visual Studio Code
File Edit Selection View Go Run Terminal Help
Restricted Mode is intended for safe code browsing. Trust this window to enable all features. Manage Learn More
arm_controller_pub.cpp
home > tony > catkin_ws > src > arm_stack > arm_controller > src > arm_controller_pub.cpp
#include "ros/ros.h"
#include "std_msgs/Float64.h"
int main(int argc, char **argv) {
ros::init(argc, argv, "arm_controller_pub");
ros::NodeHandle nh;
ros::Publisher joint0_pub = nh.advertise<std_msgs::Float64>("/arm/PositionJointInterface_J0_controller/command", 1);
ros::Publisher joint1_pub = nh.advertise<std_msgs::Float64>("/arm/PositionJointInterface_J1_controller/command", 1);
ros::Publisher joint2_pub = nh.advertise<std_msgs::Float64>("/arm/PositionJointInterface_J2_controller/command", 1);
ros::Publisher joint3_pub = nh.advertise<std_msgs::Float64>("/arm/PositionJointInterface_J3_controller/command", 1);
ros::Rate loop_rate(10);
while (ros::ok())
{
std_msgs::Float64 joint0_command;
joint0_command.data = 0;
joint0_pub.publish(joint0_command);
std_msgs::Float64 joint1_command;
joint1_command.data = 0;
joint1_pub.publish(joint1_command);
std_msgs::Float64 joint2_command;
joint2_command.data = 0;
joint2_pub.publish(joint2_command);
std_msgs::Float64 joint3_command;
joint3_command.data = 0;
joint3_pub.publish(joint3_command);
ros::spinOnce();
loop_rate.sleep();
}
return 0;
}
Restricted Mode
Ln 1, Col 1 Spaces: 2 UTF-8 LF C++


paolo@Paolo-Precision-3571: ~
/home/paolo/catkin_ws/src/arm_stack/arm_gazebo/launch/arm_gazebo.launch http://localhost:11311 80x
paolo@Paolo-Precision-3571:~/catkin_ws$ source devel/setup.bash
paolo@Paolo-Precision-3571:~/catkin_ws$ roslaunch arm_gazebo arm_gazebo.launch
... logging to /home/paolo/.ros/log/64c0153e-7978-11ee-b692-6960fecbece2/roslaunch-Paolo-Precision-3571-79177.log
Checking log directory for disk usage. This may take a while.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.
started roslaunch server http://Paolo-Precision-3571:41161/
SUMMARY
========
PARAMETERS
* /arm/PositionJointInterface_J0_controller/joint: j0
* /arm/PositionJointInterface_J0_controller/type: position_controll...
* /arm/PositionJointInterface_J1_controller/joint: j1
* /arm/PositionJointInterface_J1_controller/type: position_controll...
* /arm/PositionJointInterface_J2_controller/joint: j2
* /arm/PositionJointInterface_J2_controller/type: position_controll...
* /arm/PositionJointInterface_J3_controller/joint: j3
roscore http://Paolo-Precision-3571:11311/ 90x20
paolo@Paolo-Precision-3571:~$ roscore
... logging to /home/paolo/.ros/log/64c0153e-7978-11ee-b692-6960fecbece2/roslaunch-Paolo-Precision-3571-79147.log
Checking log directory for disk usage. This may take a while.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.
started roslaunch server http://Paolo-Precision-3571:38397/
ros_comm version 1.16.0
SUMMARY
========
PARAMETERS
* /rosdistro: noetic
* /rosversion: 1.16.0
NODES
auto-starting new master
paolo@Paolo-Precision-3571: ~ 80x25
[INFO] [1698927253.594609907, 387.820000000]:
Received joint positions:
[INFO] [1698927253.594862785, 387.820000000]: Joint 0: 1.570000
[INFO] [1698927253.594920820, 387.820000000]: Joint 1: -1.570000
[INFO] [1698927253.594967955, 387.820000000]: Joint 2: 1.570000
[INFO] [1698927253.594998164, 387.820000000]: Joint 3: -1.570000
[INFO] [1698927253.615527147, 387.840000000]:
Received joint positions:
[INFO] [1698927253.615723913, 387.840000000]: Joint 0: 1.570000
[INFO] [1698927253.615766031, 387.840000000]: Joint 1: -1.570000
[INFO] [1698927253.615795580, 387.840000000]: Joint 2: 1.570000
[INFO] [1698927253.615821694, 387.840000000]: Joint 3: -1.570000
[INFO] [1698927253.635263632, 387.860000000]:
Received joint positions:
[INFO] [1698927253.635494058, 387.860000000]: Joint 0: 1.570000
[INFO] [1698927253.635533384, 387.860000000]: Joint 1: -1.570000
[INFO] [1698927253.635570126, 387.860000000]: Joint 2: 1.570000
[INFO] [1698927253.635608660, 387.860000000]: Joint 3: -1.570000
[INFO] [1698927253.654999523, 387.880000000]:
Received joint positions:
[INFO] [1698927253.655147369, 387.880000000]: Joint 0: 1.570000
[INFO] [1698927253.655219704, 387.880000000]: Joint 1: -1.570000
[INFO] [1698927253.655313995, 387.880000000]: Joint 2: 1.570000
[INFO] [1698927253.655384766, 387.880000000]: Joint 3: -1.570000
paolo@Paolo-Precision-3571: ~ 90x25
paolo@Paolo-Precision-3571:~$ rostopic pub /arm/PositionJointInterface_J0_controller/command std_msgs/Float64 "data: 1.57"
publishing and latching message. Press ctrl-C to terminate
^Cpaolo@Paolo-Precision-3571:~$ rostopic pub /arm/PositionJointInterface_J1_controller/command std_msgs/Float64 "data: -1.57"
publishing and latching message. Press ctrl-C to terminate
^Cpaolo@Paolo-Precision-3571:~$ rostopic pub /arm/PositionJointInterface_J2_controller/command std_msgs/Float64 "data: 1.57"
publishing and latching message. Press ctrl-C to terminate
^Cpaolo@Paolo-Precision-3571:~$ rostopic pub /arm/PositionJointInterface_J3_controller/command std_msgs/Float64 "data: -1.57"
publishing and latching message. Press ctrl-C to terminate
^Cpaolo@Paolo-Precision-3571:~$


Gazebo
File Edit Camera View Window Help
World Insert Layers
GUI
Scene
Spherical Coordinates
Physics
Atmosphere
Wind
Models
ground_plane
arm
Lights
Property Value
name ground_plane
is_static True
self_collide False
enable_wind False
pose
link ground_plane::link
Steps: 1 Real Time Factor: 1.00 Sim Time: 00 00:06:52.860 Real Time: 00 00:06:54.102 Iterations: 41286 FPS: 62.54
Reset Time


rqt_graph__RosGraph - rqt
Node Graph
Nodes/Topics (all)
/
/
Group: 2 Namespaces Actions tf Images Highlight Fit
Hide: Dead sinks Leaf topics Debug tf Unreachable Params
/arm
/arm/PositionJointInterface_J0_controller
/arm/PositionJointInterface_J0_controller/command
/arm/PositionJointInterface_J2_controller
/arm/PositionJointInterface_J2_controller/command
/arm/PositionJointInterface_J3_controller
/arm/PositionJointInterface_J3_controller/command
/arm/PositionJointInterface_J1_controller
/arm/PositionJointInterface_J1_controller/command
/gazebo_gui
/arm_controller_pub
/gazebo
/arm_controller_node
/arm/joint_states
/robot_state_publisher
/arm/controller_spawner

By rqt_graph you can see the logic of the communication between nodes and topics. In our case the publishers node gives commands to controllers (**/arm/PositionJointInterface_Jx_controller/command** topics), gazebo node receives information by the controllers and it provides this datas to arm/joint_states topic that povides them to subscriber node (**arm_controller_node**).