

# Robot Operating System

## Lab 1: Packages, launch files, parameters and topic remapping

### 1 Goals

In this lab we will see the main tools to analyze nodes and topics.

#### 1.1 Using the terminals

In ROS, a lot of commands have to be run from the terminal. Each terminal should be configured either to run ROS 1 things, or ROS 2 things. A simple shortcut allows changing this:

```
ros1ws # type this to configure the terminal for ROS 1 (default)
ros2ws # type this to configure the terminal for ROS 2 (has to be done manually once)
```

You can change the default behavior by updating the line of your `.bashrc` file:

```
source /opt/ecn/ros_management_tools/ros_management.bash -p -k -lo -ros1 # default to ROS 1
source /opt/ecn/ros_management_tools/ros_management.bash -p -k -lo -ros2 # default to ROS 2
```

Each time a package is compiled, the corresponding command should be run in order to refresh the package list.

#### 1.2 Bring up Baxter

Even if you have a real Baxter robot it can be a good idea to test the lab in simulation first. In both cases, we want to have a RViz display, which is mandatory in simulation and quite handy on the real robot. RViz is run automatically in both cases.

##### 1.2.1 On the real robot

Baxter is a ROS1-based robot. To work with ROS 2 we thus have to run a bridge that transforms all or some topics between ROS 1 and ROS 2.

A launch file is available in the `baxter_bridge` package to run both the bridge and RViz.

You have to connect to Baxter's ROSMASTER in the terminal where you run the bridge:

```
ros2ws && ros_baxter # so that your ROSMASTER is Baxter
ros2 launch baxter_bridge baxter_bridge_launch.py
```

In you are in a lab on the real Baxter, remind the lab assistant to allow multiple publishers for this lab. It can be done from a ROS 1 terminal:

```
ros1ws && ros_baxter # so that your ROSMASTER is Baxter
rosparam set allow_multiple true
```

### 1.2.2 In simulation (including virtual machine users)

The Baxter simulator behaves as the actual Baxter from the ROS 2 side, only with a very limited part of the same topics and services.

The `baxter_bridge` node should be run from a ROS 2 terminal:

```
ros2ws # if needed
ros2 launch baxter_simple_sim sim_launch.py
```

The launch file also runs RViz.

## 1.3 Initial state

Whether in simulation or on the robot, Baxter is not moving and is waiting for commands on any arm.

A few in/out topics exist and can be listed through:

```
rostopic list (ROS 1, if on the real robot)
ros2 topic list (ROS 2)
```

## 1.4 Compiling the package

The folder should be put in your ROS 2 workspace (`~/ros2/src`). Compilation is done by calling `colcon` from the root of the workspace, which is done automatically with `colbuild`:

```
cd ~/ros2
colbuild -p move_joint
```

## 2 Running the control nodes

A basic control GUI can be run with:

```
ros2 launch move_joint slider_launch.py
```

It runs a node that sends the slider value on a topic (here `setpoint`).

The Baxter robot has  $2 \times 7$  joints as shown in Fig. 1, the names of which are listed in the table.

A special node called `move_joint` should be used to change the value published by the slider GUI, to the setpoint of a particular joint.

```
# this runs the node without a parameter, it will not be happy
ros2 run move_joint move_joint
```

```
# this runs the node with a joint_name parameter
# the topics are still different!
ros2 run move_joint move_joint --ros-args -p joint_name:=right_e0
```

```
# this runs the node with a joint_name parameter
# it also tells to use /setpoint instead of /joint_setpoint
ros2 run move_joint move_joint --ros-args -p joint_name:=right_e0 \
                                     -r joint_setpoint:=setpoint
```

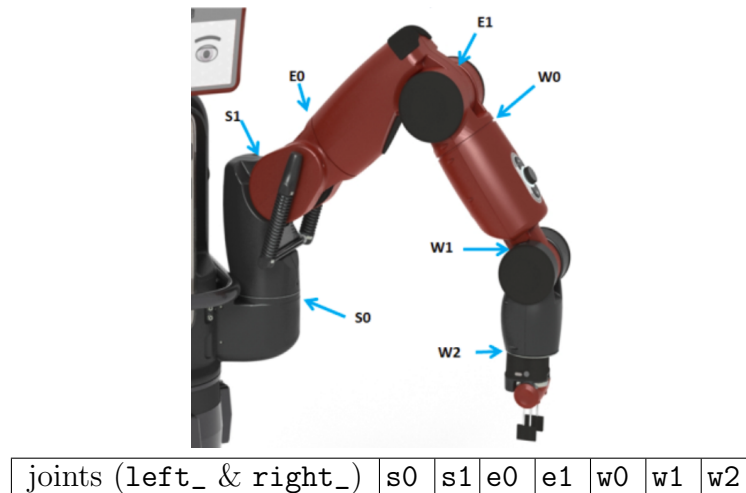


Figure 1: Baxter joints

## 2.1 Initial state of the control nodes

Use `ros2 node` and `ros2 topic` to get the information on the nodes. There are currently two limitations:

- The `move_joint` node needs a parameter to tell which joint it should be controlling
- The slider publishes on `setpoint` while the `move_joint` node listens to `joint_setpoint`

Additionally, it would be nice to run the two nodes in the same launch file.

## 2.2 Regroup all nodes in the same launch file

Open the `slider_launch.py` and add a line equivalent to calling `move_joint`.

Then, add a parameter to tell which joint should be controlled:

```
parameters = {'joint_name': 'right_e0'}
```

To run this launch file, you can go to its folder and type `ros2 launch ./slider_launch.py`. Display the graph (`rqt_graph`) to detect that the slider node and `move_joint` do not communicate, because they do not use the same topics.

## 2.3 Remapping

In this section we will remap the topic name of `move_joint` such that it uses `setpoint` instead of `joint_setpoint`.

Modify the launch file by adding this argument to the `move_joint` node:

```
remappings = {'joint_setpoint': 'setpoint'}
```

Run the launch file again and you should be able to control the chosen joint.

## 3 Playing with launch files

### 3.1 Argument for joint name

Now that a launch file exists to control 1 joint from a slider, we will change the hard-coded joint name to an argument:

```
sl.declare_arg('name', 'right_e0')
```

This syntax tells the launch file that it now has a `name` argument, with default value `'right_e0'`.

Change the hard-coded value to the argument one `sl.arg('right_e0')` and check that the behavior is the same

Also, you can rename the slider GUI by giving an additional argument:

```
sl.node('slider_publisher', 'slider_publisher', name=sl.arg('name'), ...)
```

Then, run the launch file with another name, for instance:

```
ros2 launch ./slider_launch.py name:=left_e0
```

On another terminal, try to run the same launch file for another joint. What happens?

### 3.2 Including launch files in other launch files

In this last section we will write a new launch file that will include the previous one, for various joint names. In order to avoid node / topic duplicates, each node relative to a specific joint will be in their own namespace.

The syntax to include a launch file in another one is as follows:

```
sl.include('move_joint', 'slider_launch.py', launch_arguments = {'name': 'right_e0'})
```

It should be called from a namespace block, with this syntax:

```
with sl.group(ns = 'right_e0'):
    sl.include('move_joint', 'slider_launch.py', launch_arguments = {'name': 'right_e0'})
```

Check that the behavior is similar to the previous one. Then, write a for loop to run this code for many joint names:

```
for joint in ('right_e0', 'right_e1', ...):
    with sl.group(ns = joint):
        sl.include(...)
```