

# **ROS Framework Tutorial**

Demo



## Head Control Module – Lidar Scan –



# Demo Contents



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# How to Run the Demo Program



## 1. Running Programs in the PPC (Perception PC)

### 1. roscore

roscore is a collection of nodes and programs that are pre-requisites of a ROS-based system. You **must** have roscore running in order for ROS nodes to communicate. It is launched using the `roscore` command.

**NOTE:** If you use roslaunch, it will automatically start roscore if it detects that it is not already running.

- Connect to the PPC (Perception PC) with SSH client program.
  - **IP Address:** 10.17.3.35
  - **User Name :** robotis
  - **Password :** 111111
- roscore can be launched using the roscore executable:  
`$ roscore`

### 2. THORMANG Sensors (Web Camera (HD Camera), Depth Camera (RealSense))

- Type the following command :  
`$ roslaunch thormang3_sensors thormang3_sensors.launch`



# How to Run the Demo Program



## 2. Running Programs in the MPC (Motion PC)

- Connect to the MPC via SSH client program.
  - **IP Address :** 10.17.3.30
  - **User Name :** robotis
  - **Password :** 111111

### 1. Timesync the MPC to the PPC

Synchronizing the MPC to the PPC is important so you can synchronize the data values of the connected devices

- Type and run the following shell script :

```
#!/bin/sh
sudo date --set='`date -u` -2 secs'
sudo ntpdate 10.17.3.35
sudo hwclock -w
```

- Or type the following :

```
$ ./timesync_ppc
```



# How to Run the Demo Program



## 2. Running Programs in the MPC

### 3. THORMANG3 Manager

`thormang3_manager` is a base node using ROBOTIS' framework. `thormang3_manager` must be running before you can run the Simple Demo nodes and before you can check the sensors as they are using `thormang3_manager`.

- To run `thormang3_manager`, simply type the following command:

```
$ sudo bash
```

```
# roslaunch thormang3_manager thormang3_manager.launch
```

### 4. TF

TF is a package that lets the user keep track of multiple coordinate frames over time. TF maintains the relationship between coordinate frames in a tree structure buffered in time, and lets the user transform points, vectors, etc. between any two coordinate frames at any desired point in time.

- To run TF, simply type the following command:

```
$ roslaunch robotis_humanoid_description robotis_humanoid.launch
```



# How to Run the Demo Program



## 3. Running Programs in the OPC (Operation PC)

### 1. Timesync the OPC to the PPC

In the ROS system, the time synchronization between the PC is important.

- Make the shell script as follows :

```
#!/bin/sh
sudo date --set='-2 secs'
sudo ntpdate 10.17.3.35
sudo hwclock -w
```

- Run the shell script

### 2. Visualization

- To launch the GUI, type the following command:

```
$ roslaunch robotis_humanoid_description robotis_humanoid_control.launch
```

### 3. Demo

- To launch the demo, type the following command:

```
$ roslaunch thormang3_demo thormang3_demo.launch
```

### 4. Note

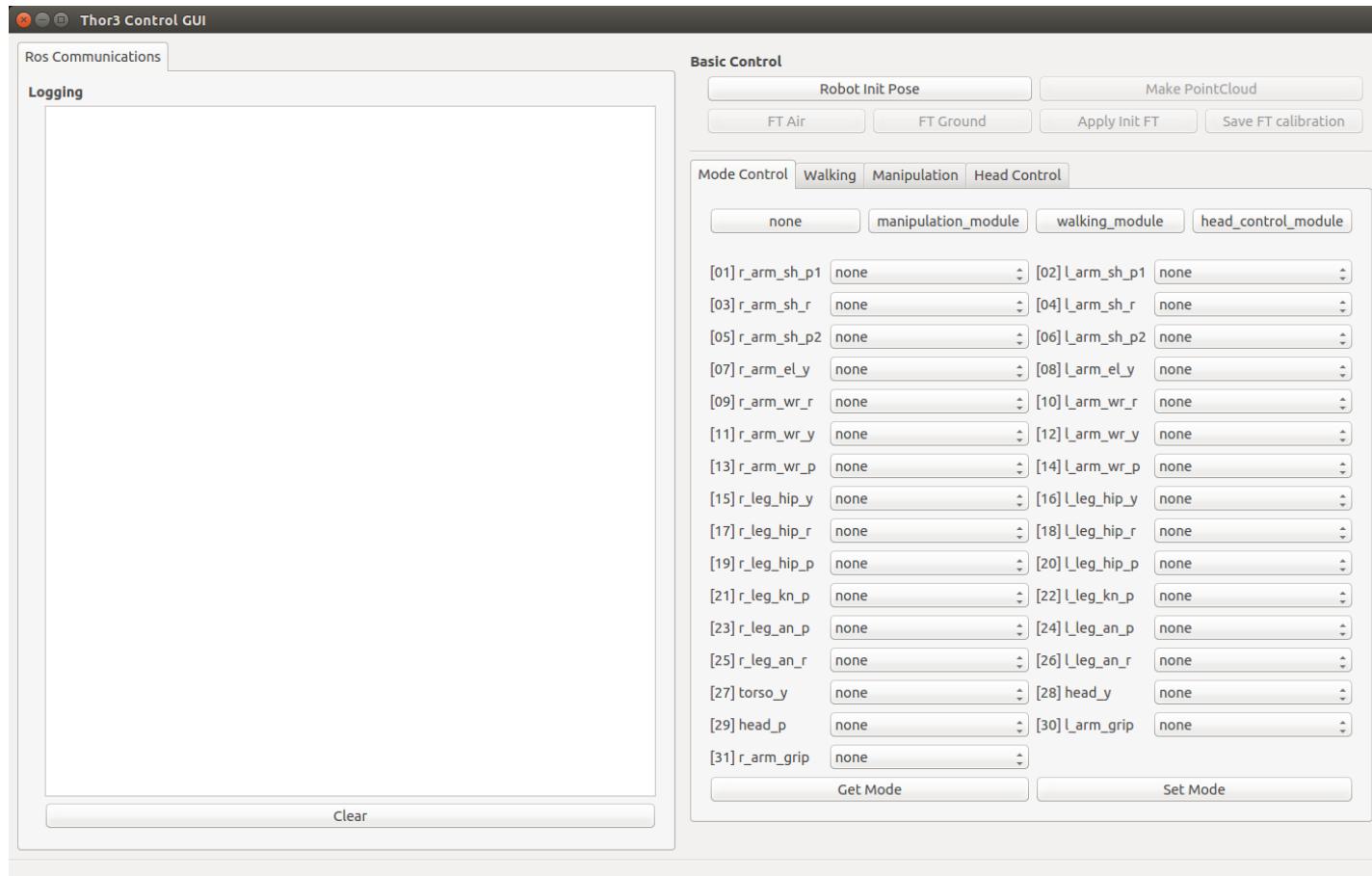
- Refer to User's Guide to set ROS Environment.



# Visualization



## 1. GUI (OPC)

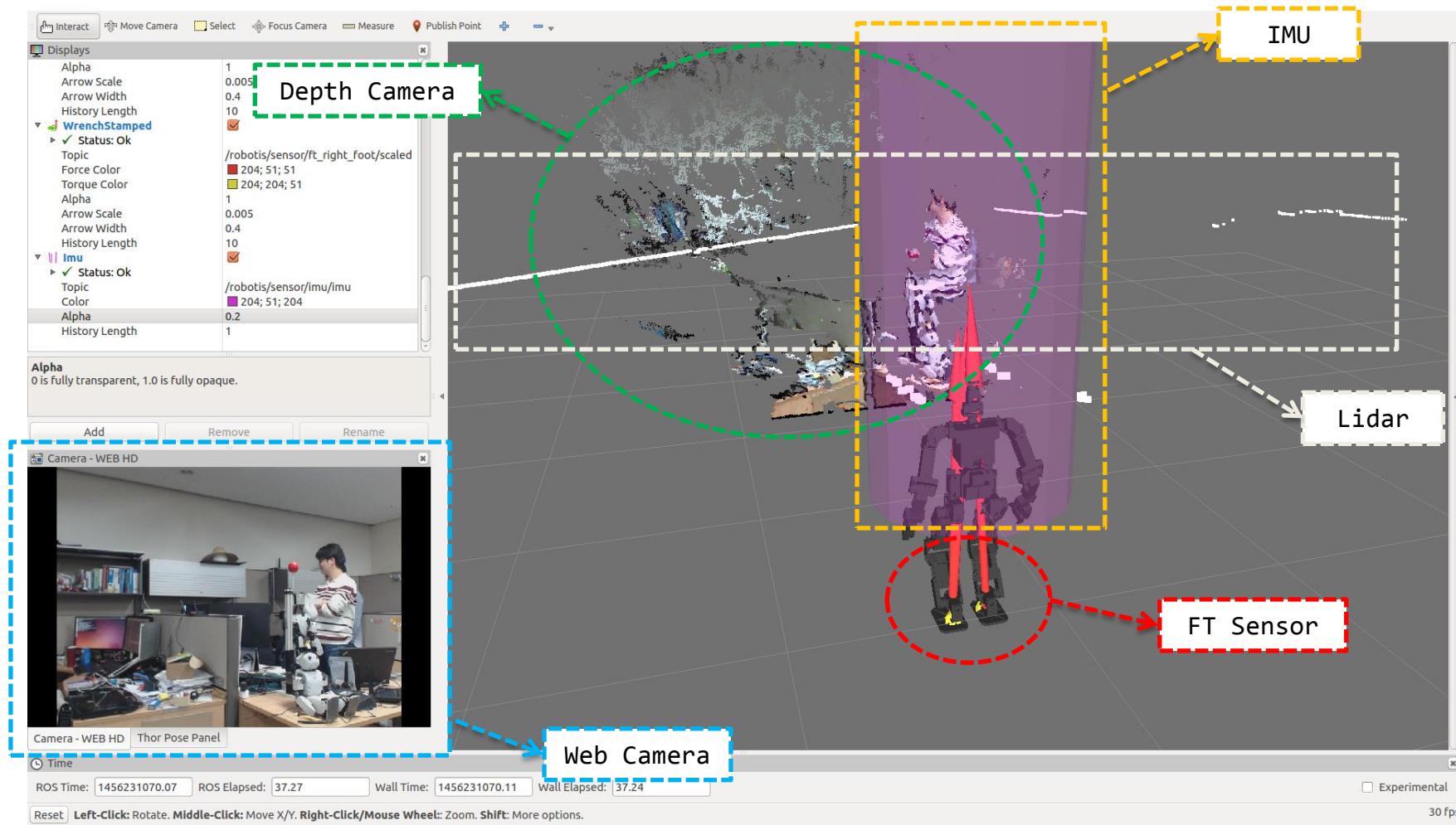




# Visualization



## 2. Robot State and Sensors (OPC)





# Demo



## CONTENTS

### 1. Basic Demo

- Initial Pose and FT Sensor Initialization
- Setting the Robot's Mode

### 2. Head Control Demo

- Assemble LaserScan
- Control Head Joints

### 3. Manipulation Demo

- Control Individual Joint
- FK
- IK (using rviz)
- Path Planning Demo

### 4. Walking Demo

- Initial Pose
- Balance
- Direction Walking

# **Basic Demo**

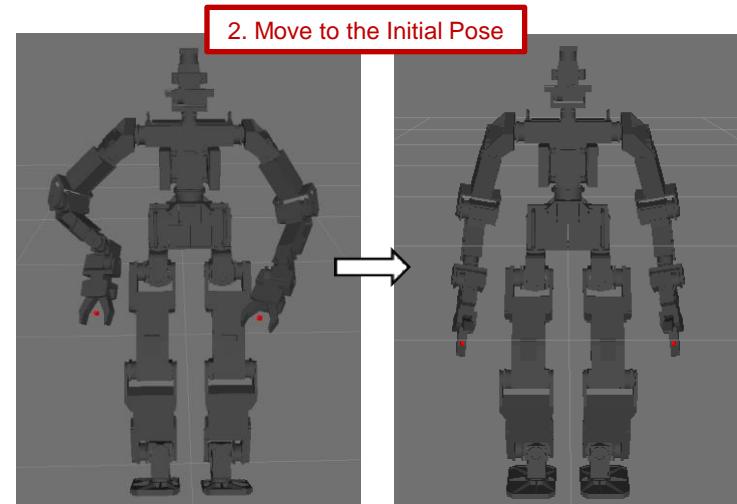
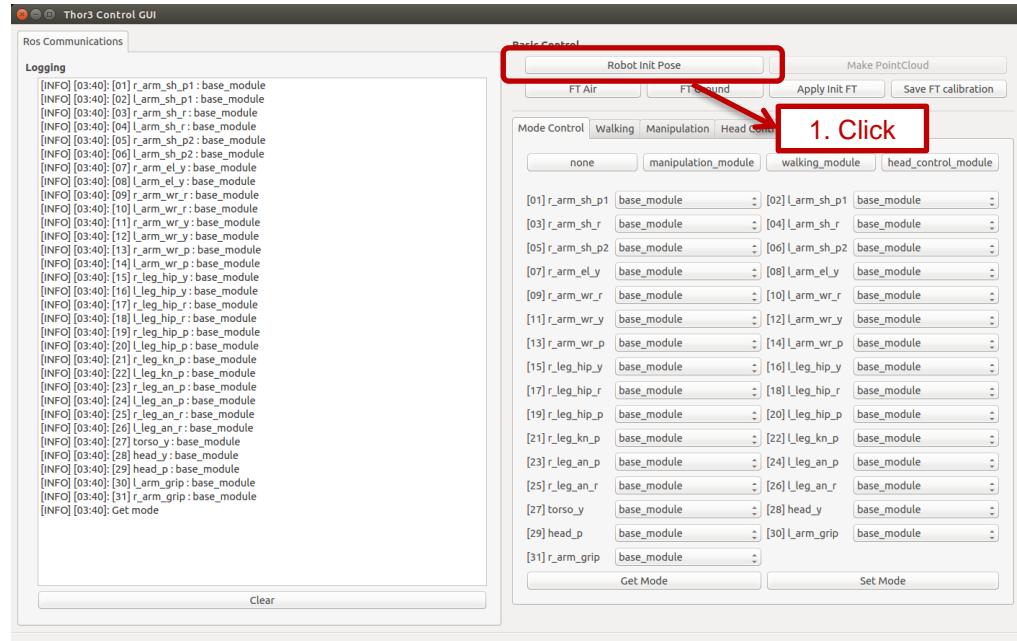


# Basic Demo



## 1. Basic Demo

- Initial Pose
  - Click 'Robot Init Pose.' The robot will move to its initial pose.



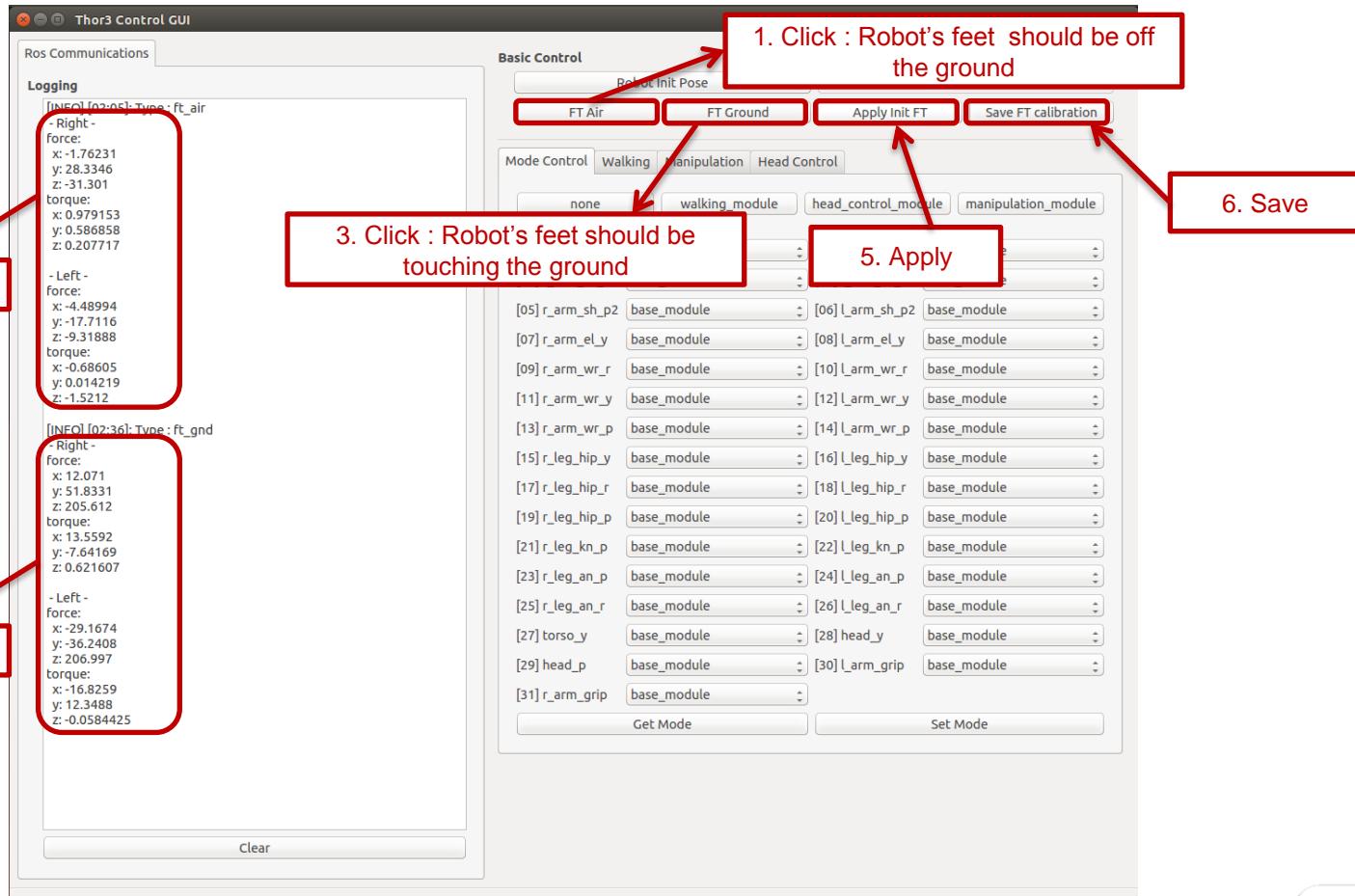


# Basic Demo



## 1. Basic Demo

- FT Sensor Calibration
  - Calibrate the FT sensor prior to running the Walking Demo.



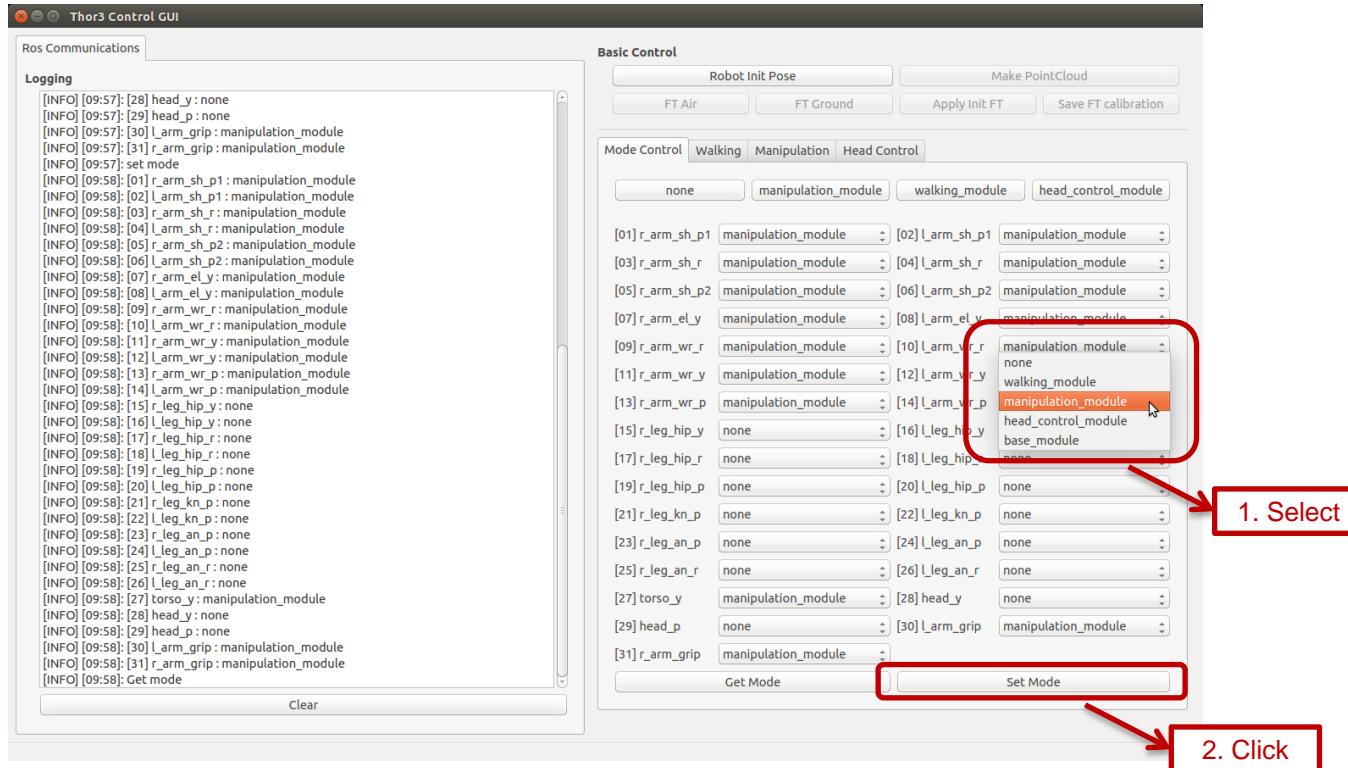


# Basic Demo



## 1. Basic Demo

- Setting the Control Module of Each Joint
  - Select the desired Control Module from the dropdown menu then click '**Set Mode**'.
  - Control Modules : Walking Module, Manipulation Module, Head Control Module



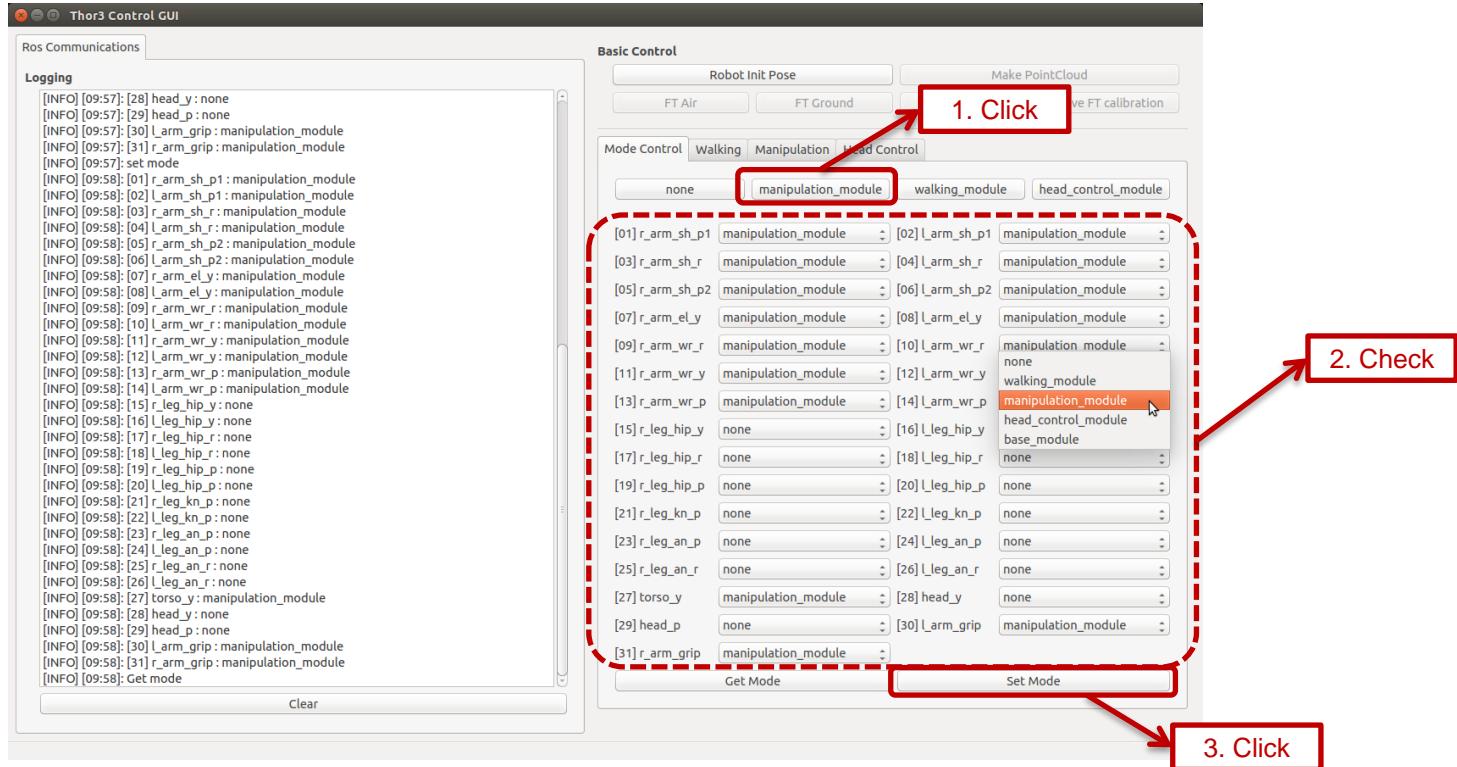


# Basic Demo



## 1. Basic Demo

- Setting the Control Module using the preset button.
  - Click one of the preset buttons. Then click the '**Set Mode**' button.



# **Head Control Demo**



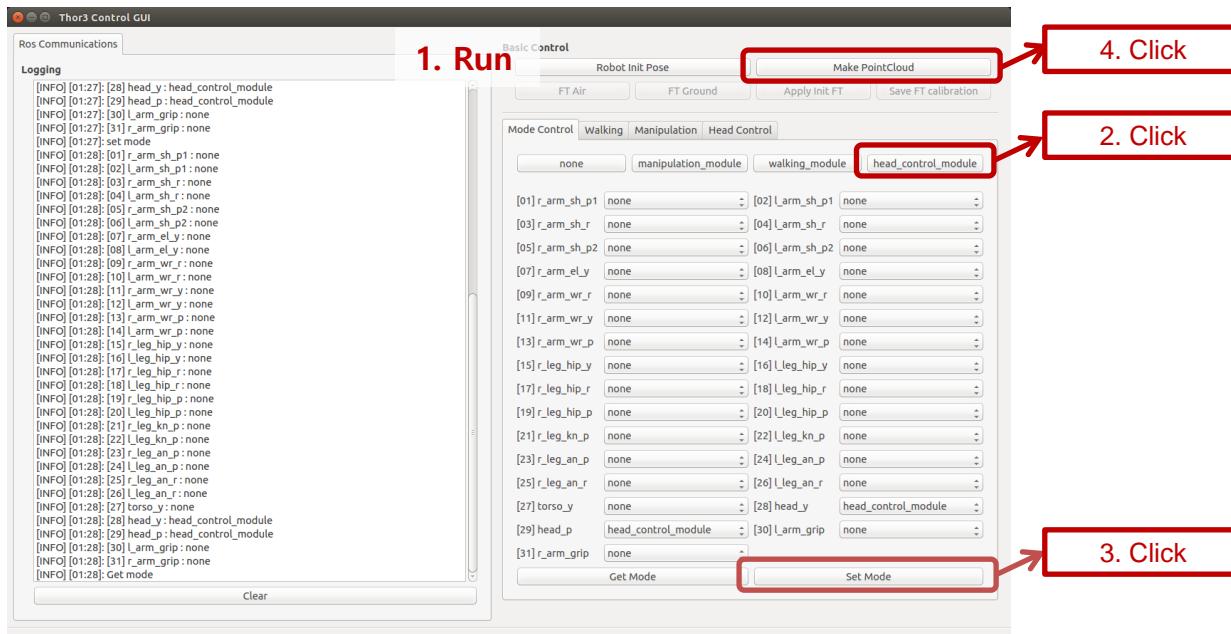
# Head Control Demo



## 2. Head Control Demo

### ▪ Assemble LaserScan

1. Move the head pitch joint to assemble LaserScan
  - Set mode : head\_control\_module
    - » Click 'head\_control\_module'
    - » Click 'Set Mode'
  - Click 'Make PointCloud' button



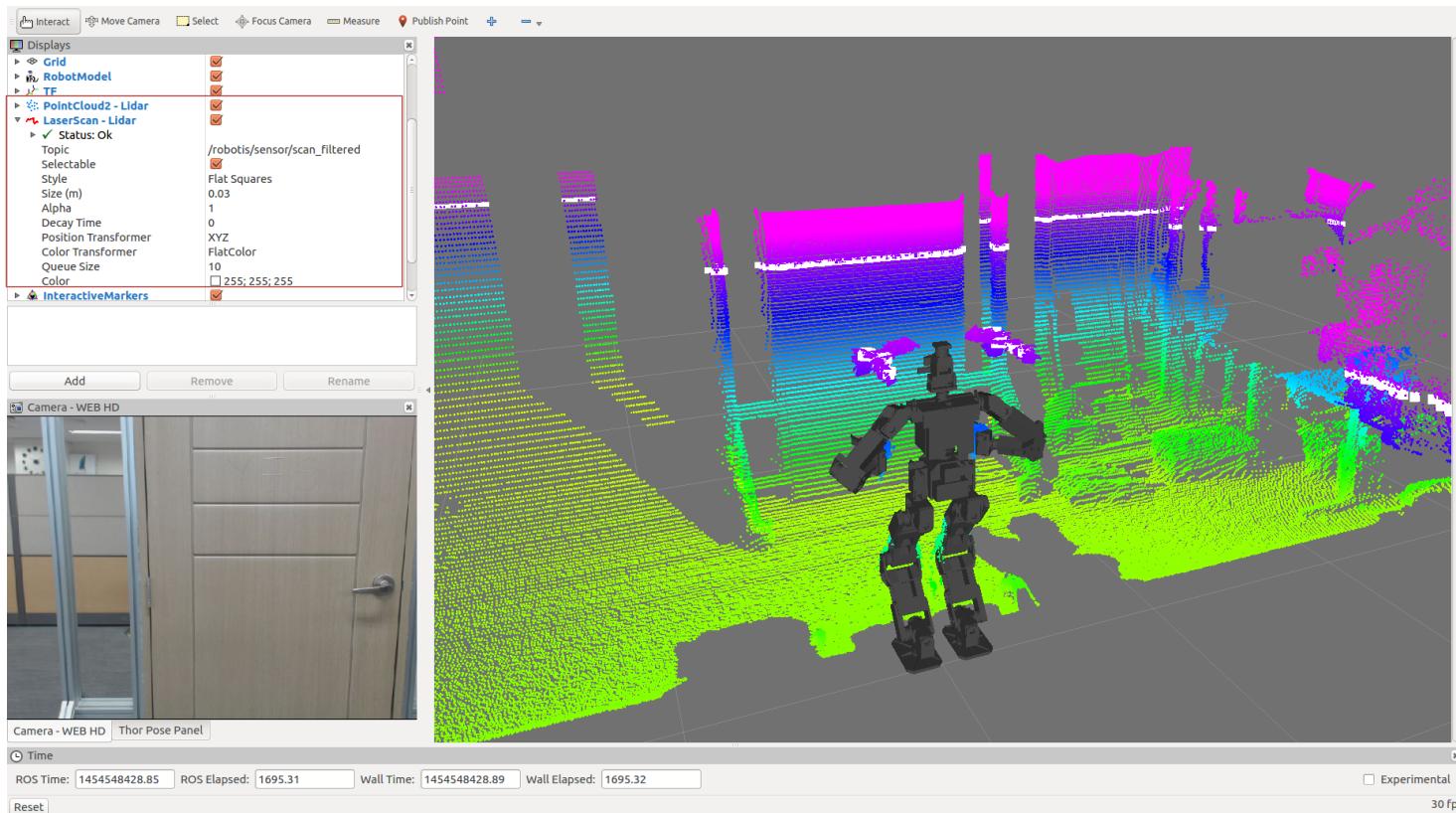


# Head Control Demo



## 2. Head Control Demo

- Assemble LaserScan
- 2. LaserScan and TF automatically create the PointCloud
- 3. Check PointCloud and LaserScan (white line) in rviz





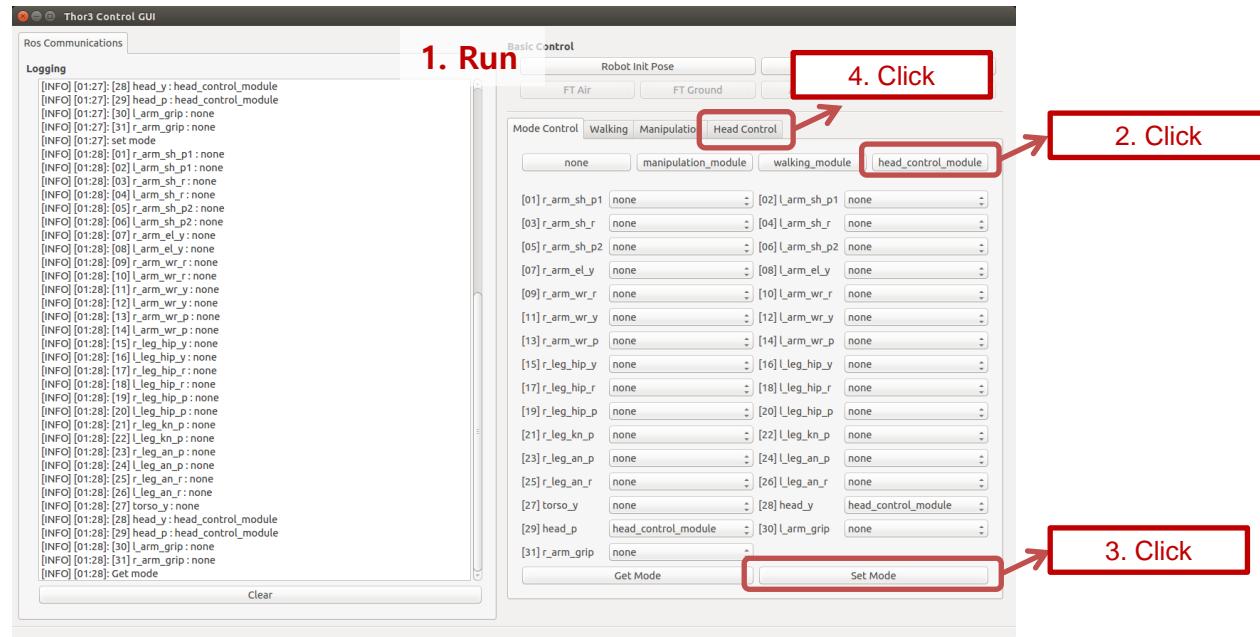
# Head Control Demo



## 2. Head Control Demo

- Control Pan/Tilt Head Joints

1. Set mode : head\_control\_module
  - Click '**head\_control\_module**'
  - Click '**Set Mode**' button
2. Change control tab to '**Head Control**'



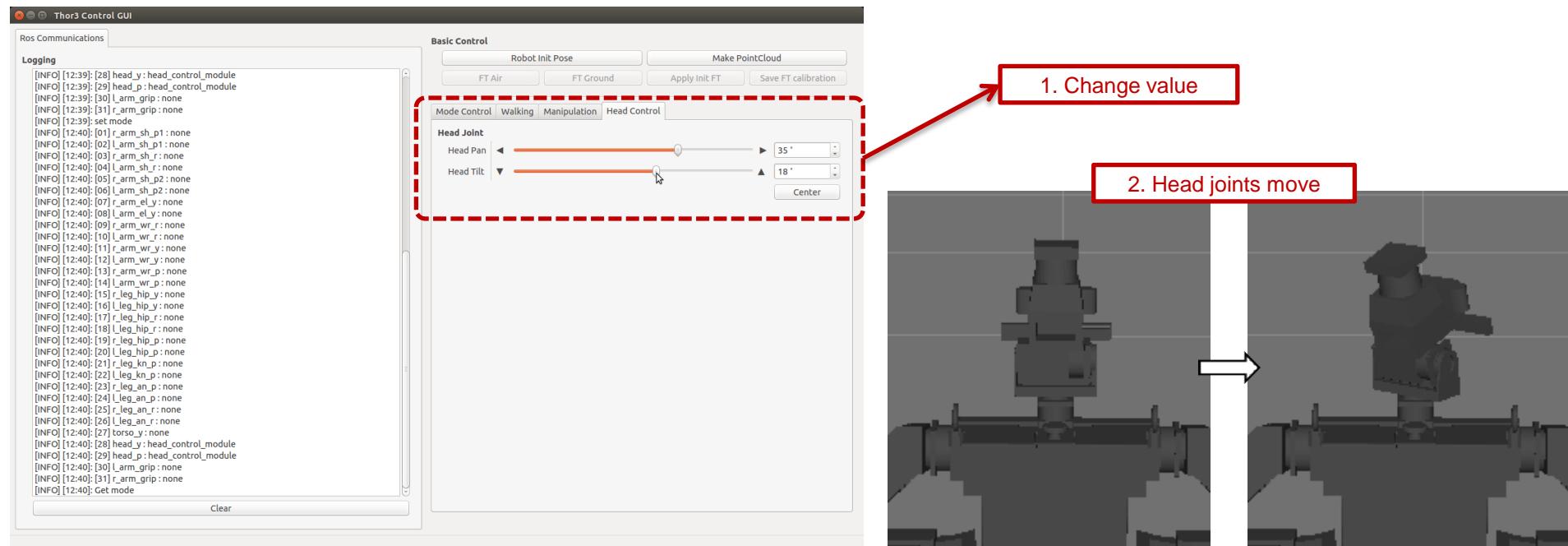


# Head Control Demo



## 2. Head Control Demo

- Control Pan/Tilt Head Joints
- 3. Move the slide bar or input the joint angle values to move the head joint



# **Manipulation Demo**

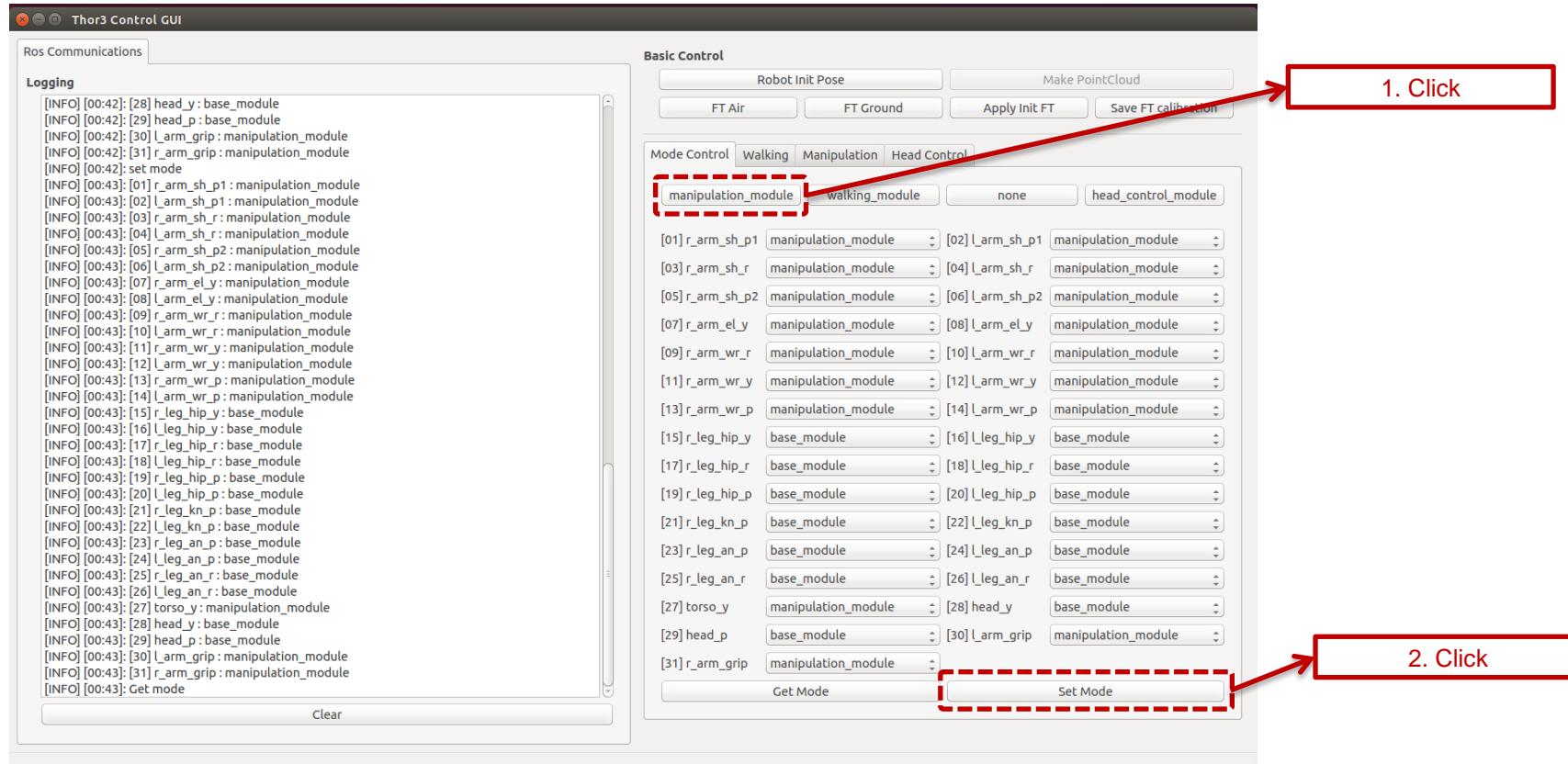


# Manipulation Demo



## 3. Manipulation Demo

- Set Mode





# Manipulation Demo



## 3. Manipulation Demo

- Manipulation Initial Pose
2. Click 'Manipulation Init\_Pose.'

Screenshot of the Thor3 Control GUI showing the Basic Control panel.

The 'Joint Control' section is highlighted with a red dashed box. Inside this box, the 'Manipulation Init Pose' button is also highlighted with a red box and labeled '1. Click' with a red arrow pointing to it.

**Basic Control**

- Buttons: Robot Init Pose, Make PointCloud, FT Air, FT Ground, Apply Init FT, Save FT calibration

**Mode Control**: Walking, Manipulation, Head Control

**Joint Control**

- Joint Name: l\_arm\_sh\_p1
- Joint Value [deg]: 0.00 °
- Buttons: Get Current Joint Angle, Set Destination Joint Angle

**Forward Kinematics**

- left\_arm
- Buttons: Get Current Position

**Inverse Kinematics**

- position x [m]: 0.000 m
- orientation roll [deg]: 0.000 °
- position y [m]: 0.000 m
- orientation pitch [deg]: 0.000 °
- position z [m]: 0.000 m
- orientation yaw [deg]: 0.000 °
- Buttons: Set Destination Position

**Gripper**

- r\_arm\_grip
- Buttons: ON, OFF

**Figure Demo**

- Buttons: Figure Demo Init Pose, Line, Circle

**Logging**

```
[INFO] [00:25]: [29] head_p : base_module  
[INFO] [00:25]: [30] l_arm_grip : manipulation_module  
[INFO] [00:25]: [31] r_arm_grip : manipulation_module  
[INFO] [00:25]: set mode  
[INFO] [00:26]: [01] r_arm_sh_p1 : manipulation_module  
[INFO] [00:26]: [02] l_arm_sh_p1 : manipulation_module  
[INFO] [00:26]: [03] r_arm_sh_r : manipulation_module  
[INFO] [00:26]: [04] l_arm_sh_r : manipulation_module  
[INFO] [00:26]: [05] r_arm_sh_p2 : manipulation_module  
[INFO] [00:26]: [06] l_arm_sh_p2 : manipulation_module  
[INFO] [00:26]: [07] r_arm_el_y : manipulation_module  
[INFO] [00:26]: [08] l_arm_el_y : manipulation_module  
[INFO] [00:26]: [09] r_arm_wr_r : manipulation_module  
[INFO] [00:26]: [10] l_arm_wr_r : manipulation_module  
[INFO] [00:26]: [11] r_arm_wr_y : manipulation_module  
[INFO] [00:26]: [12] l_arm_wr_y : manipulation_module  
[INFO] [00:26]: [13] r_arm_wr_p : manipulation_module  
[INFO] [00:26]: [14] l_arm_wr_p : manipulation_module  
[INFO] [00:26]: [15] r_leg_hip_y : base_module  
[INFO] [00:26]: [16] l_leg_hip_y : base_module  
[INFO] [00:26]: [17] r_leg_hip_r : base_module  
[INFO] [00:26]: [18] l_leg_hip_r : base_module  
[INFO] [00:26]: [19] r_leg_hip_p : base_module  
[INFO] [00:26]: [20] l_leg_hip_p : base_module  
[INFO] [00:26]: [21] r_leg_kn_p : base_module  
[INFO] [00:26]: [22] l_leg_kn_p : base_module  
[INFO] [00:26]: [23] r_leg_an_p : base_module  
[INFO] [00:26]: [24] l_leg_an_p : base_module  
[INFO] [00:26]: [25] r_leg_an_r : base_module  
[INFO] [00:26]: [26] l_leg_an_r : base_module  
[INFO] [00:26]: [27] torso_y : manipulation_module  
[INFO] [00:26]: [28] head_y : base_module  
[INFO] [00:26]: [29] head_p : base_module  
[INFO] [00:26]: [30] l_arm_grip : manipulation_module  
[INFO] [00:26]: [31] r_arm_grip : manipulation_module  
[INFO] [00:26]: Get mode  
[INFO] [04:34]: Send Ini. Pose
```

Clear

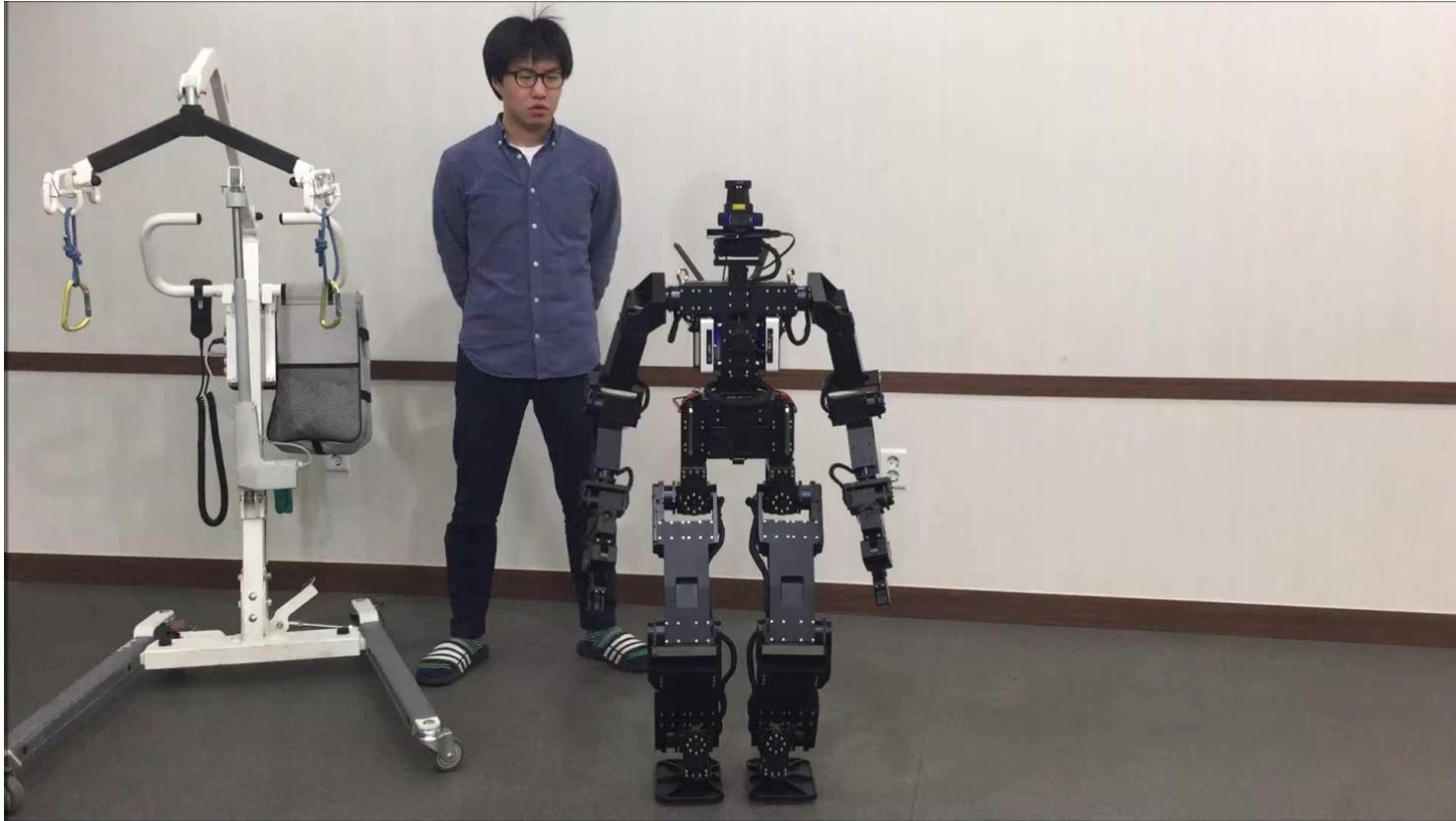


# Manipulation Demo



## 3. Manipulation Demo

- Manipulation Initial Pose Video





# Manipulation Demo



## 3. Manipulation Demo

- Joint Space Control
  - 1. Read present joint angle

The screenshot shows the Thor3 Control GUI interface. On the left is a 'Ros Communications' window displaying log messages. The main window has tabs for 'Basic Control', 'Mode Control', 'Walking', 'Manipulation' (which is selected), and 'Head Control'. In the 'Manipulation' tab, there's a 'Joint Control' section with a dropdown 'Joint Name' set to 'l\_arm\_sh\_p1' and a 'Joint Value [deg]' input field set to '0.00'. Below these are buttons for 'Get Current Joint Angle' and 'Set Destination Joint Angle'. A red dashed box highlights the 'Joint Name' dropdown and the 'Joint Value [deg]' input field. To the right of the main window is a red callout box containing a list of joint names:

1. Select

L\_arm\_sh\_p1  
L\_arm\_sh\_r  
L\_arm\_sh\_p2  
L\_arm\_el\_y  
L\_arm\_wr\_r  
L\_arm\_wr\_y  
L\_arm\_wr\_p  
L\_arm\_grip  
r\_arm\_sh\_p1  
r\_arm\_sh\_r  
r\_arm\_sh\_p2  
r\_arm\_el\_y  
r\_arm\_wr\_r  
r\_arm\_wr\_y  
r\_arm\_wr\_p  
r.arm\_grip

2. Click

The 'Joint Name' dropdown is highlighted with a red border, and a red arrow points from the 'Select' box to it. Another red arrow points from the 'Click' box to the 'Get Current Joint Angle' button.



# Manipulation Demo



## 3. Manipulation Demo

- Joint Space Control
- 2. Write desired joint angle

Screenshot of the Thor3 Control GUI showing the Basic Control panel.

The Basic Control panel includes:

- Ros Communications window displaying log messages.
- Basic Control buttons: Robot Init Pose, Make PointCloud, FT Air, FT Ground, Apply Init FT, Save FT calibration.
- Mode Control tabs: Walking, Manipulation (selected), Head Control.
- Joint Control section:
  - Manipulation Init Pose button.
  - Joint Name dropdown: L\_arm\_sh\_p1 (highlighted with red box 1).
  - Joint Value [deg] input field: 0.00° (highlighted with red box 2).
  - Get Current Joint Angle button.
  - Set Destination Joint Angle button (highlighted with red box 3).
- Forward Kinematics section: left\_arm dropdown, Get Current Position button.
- Inverse Kinematics section: position x [m], orientation roll [deg]; position y [m], orientation pitch [deg]; position z [m], orientation yaw [deg]. Set Destination Position button.
- Gripper section: r\_arm\_grip dropdown, ON, OFF buttons.
- Figure Demo section: Figure Demo Init Pose, Line, Circle buttons.

Red boxes numbered 1, 2, and 3 indicate the steps for selecting the joint, setting its value, and clicking the set button respectively. A red arrow points from the 'Select' box to the 'Joint Name' dropdown.

**1. Select**  
L\_arm\_sh\_p1  
L\_arm\_sh\_r  
L\_arm\_sh\_p2  
L\_arm\_el\_y  
L\_arm\_wr\_r  
L\_arm\_wr\_y  
L\_arm\_wr\_p  
L\_arm\_grip  
r\_arm\_sh\_p1  
r\_arm\_sh\_r  
r\_arm\_sh\_p2  
r\_arm\_el\_y  
r\_arm\_wr\_r  
r\_arm\_wr\_y  
r\_arm\_wr\_p  
r\_arm\_grip

**2. Set Value**

**3. Click**

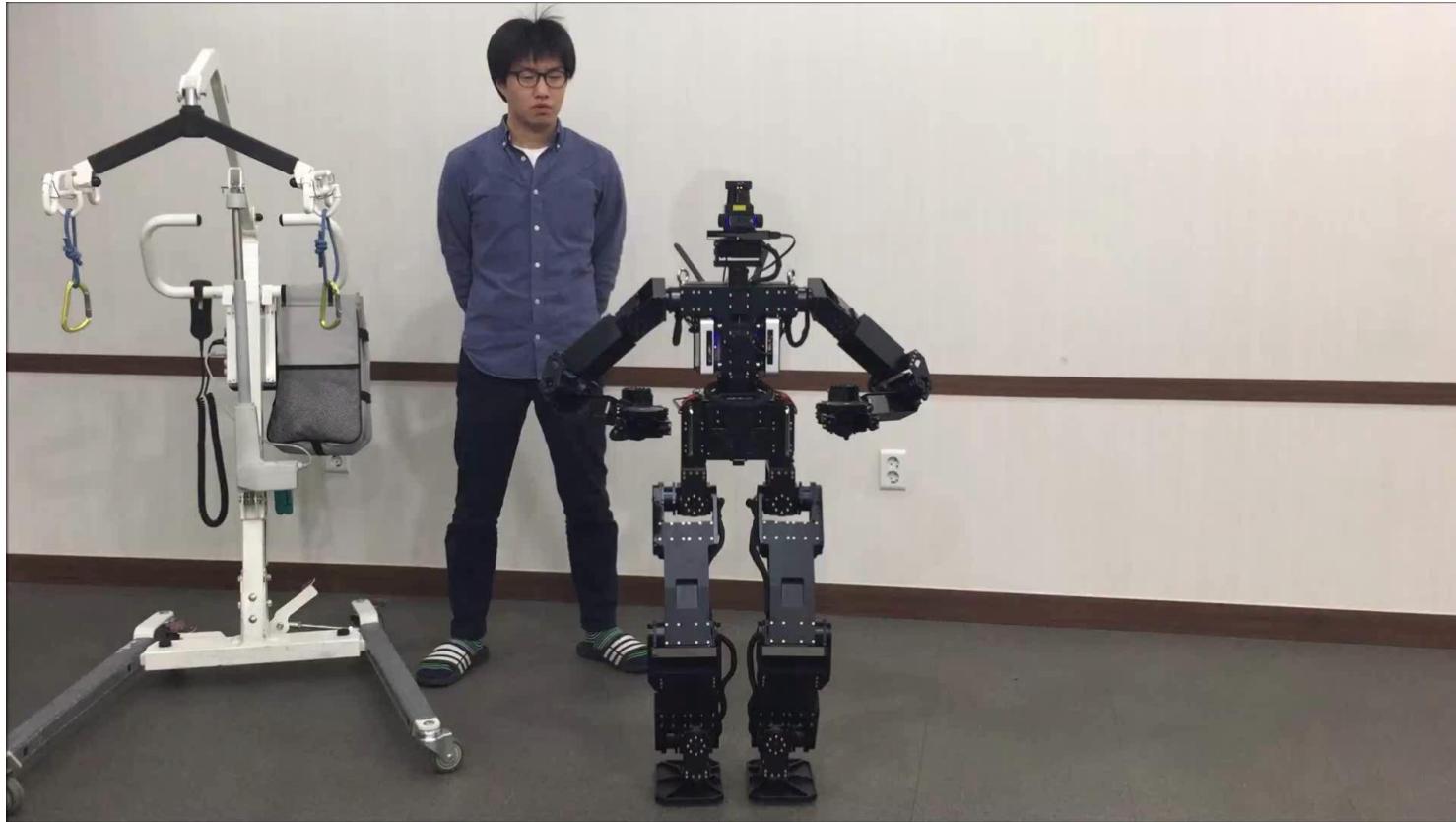


# Manipulation Demo



## 3. Manipulation Demo

- Joint Space Control Video





# Manipulation Demo



## 3. Manipulation Demo

- Task Space Control
  - Read end effector's pose (FK)

The screenshot shows the Thor3 Control GUI interface. On the left is a scrollable window titled "Ros Communications" displaying log messages. On the right is the "Basic Control" tab, which includes sections for "Basic Control", "Joint Control", "Forward Kinematics", "Inverse Kinematics", "Gripper", and "Figure Demo". The "Joint Control" section is highlighted with a red dashed box. Inside, the "Joint Name" dropdown is set to "l\_arm\_sh\_p1" and the "Joint Value [deg]" input field shows "0.00 °". Below these are buttons for "Get Current Joint Angle" and "Set Destination Joint Angle". To the right of the dropdown is a "Get Current Position" button, also enclosed in a red dashed box. A red arrow points from the "left\_arm" dropdown to a callout box labeled "1. Select". Another red arrow points from the "Get Current Position" button to a callout box labeled "2. Click".

Thor3 Control GUI

Ros Communications

Logging

```
[INFO] [00:25]: [29] head_p : base_module
[INFO] [00:25]: [30] l_arm_grip : manipulation_module
[INFO] [00:25]: [31] r_arm_grip : manipulation_module
[INFO] [00:25]: set mode
[INFO] [00:26]: [01] r_arm_sh_p1 : manipulation_module
[INFO] [00:26]: [02] l_arm_sh_p1 : manipulation_module
[INFO] [00:26]: [03] r_arm_sh_r : manipulation_module
[INFO] [00:26]: [04] l_arm_sh_r : manipulation_module
[INFO] [00:26]: [05] r_arm_sh_p2 : manipulation_module
[INFO] [00:26]: [06] l_arm_sh_p2 : manipulation_module
[INFO] [00:26]: [07] r_arm_el_y : manipulation_module
[INFO] [00:26]: [08] l_arm_el_y : manipulation_module
[INFO] [00:26]: [09] r_arm_wr_r : manipulation_module
[INFO] [00:26]: [10] l_arm_wr_r : manipulation_module
[INFO] [00:26]: [11] r_arm_wr_y : manipulation_module
[INFO] [00:26]: [12] l_arm_wr_y : manipulation_module
[INFO] [00:26]: [13] r_arm_wr_p : manipulation_module
[INFO] [00:26]: [14] l_arm_wr_p : manipulation_module
[INFO] [00:26]: [15] r_leg_hip_y : base_module
[INFO] [00:26]: [16] l_leg_hip_y : base_module
[INFO] [00:26]: [17] r_leg_hip_r : base_module
[INFO] [00:26]: [18] l_leg_hip_r : base_module
[INFO] [00:26]: [19] r_leg_hip_p : base_module
[INFO] [00:26]: [20] l_leg_hip_p : base_module
[INFO] [00:26]: [21] r_leg_kn_p : base_module
[INFO] [00:26]: [22] l_leg_kn_p : base_module
[INFO] [00:26]: [23] r_leg_an_p : base_module
[INFO] [00:26]: [24] l_leg_an_p : base_module
[INFO] [00:26]: [25] r_leg_an_r : base_module
[INFO] [00:26]: [26] l_leg_an_r : base_module
[INFO] [00:26]: [27] torso_y : manipulation_module
[INFO] [00:26]: [28] head_y : base_module
[INFO] [00:26]: [29] head_p : base_module
[INFO] [00:26]: [30] l_arm_grip : manipulation_module
[INFO] [00:26]: [31] r_arm_grip : manipulation_module
[INFO] [00:26]: Get mode
[INFO] [04:34]: Send Ini. Pose
```

Basic Control

Robot Init Pose    Make PointCloud

FT Air    FT Ground    Apply Init FT    Save FT calibration

Mode Control Walking Manipulation Head Control

Joint Control

Manipulation Init Pose

Joint Name: l\_arm\_sh\_p1    Joint Value [deg]: 0.00 °

Get Current Joint Angle    Set Destination Joint Angle

Forward Kinematics

left\_arm    Get Current Position

Inverse Kinematics

position x [m]: 0.000 m    orientation roll [deg]: 0.000 °

position y [m]: 0.000 m    orientation pitch [deg]: 0.000 °

position z [m]: 0.000 m    orientation yaw [deg]: 0.000 °

Set Destination Position

Gripper

r\_arm\_grip    ON    OFF

Figure Demo

Figure Demo Init Pose    Line    Circle

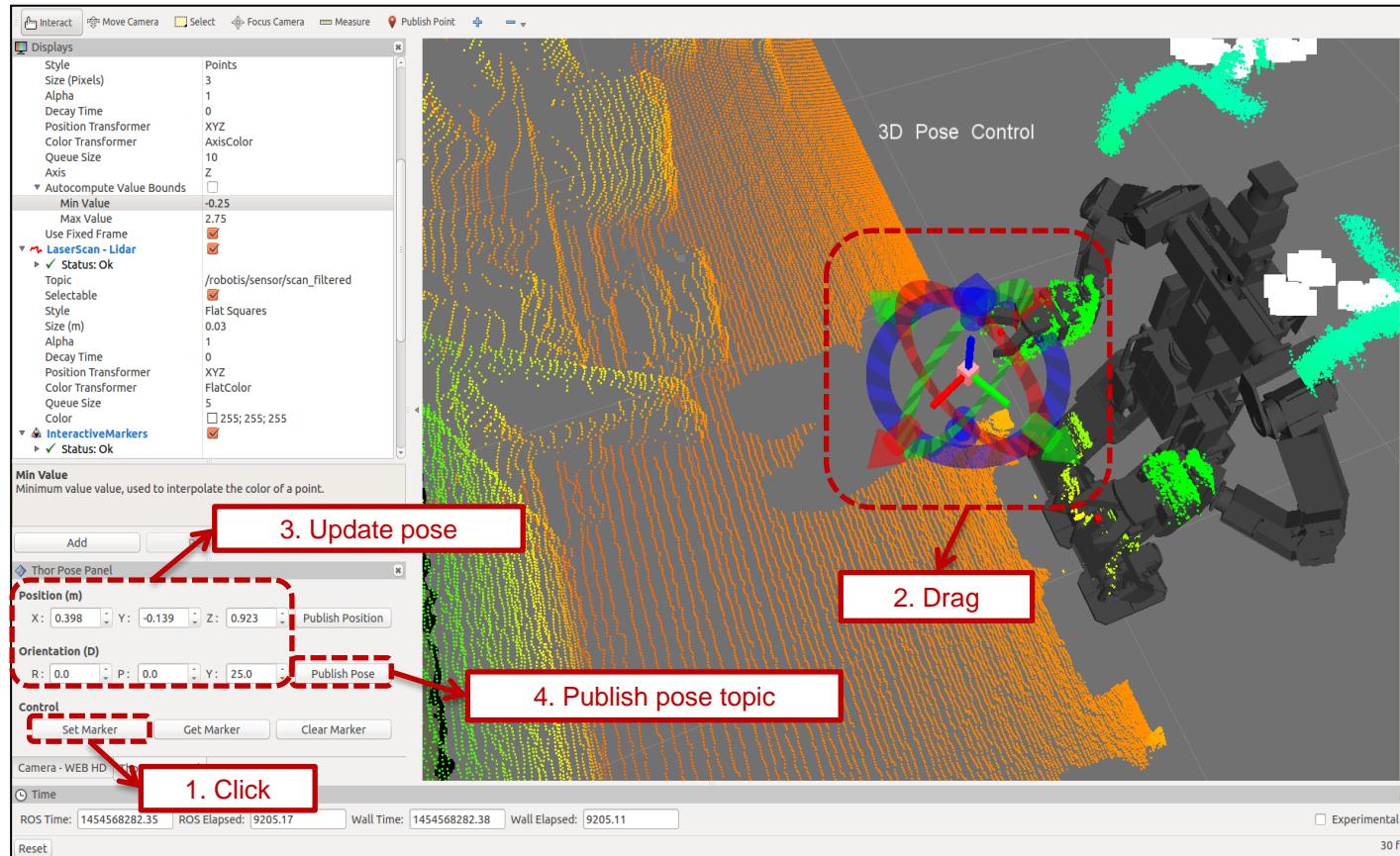


# Manipulation Demo



## 3. Manipulation Demo

- Task Space Control
  - Get end effector's pose using rviz (IK)





# Manipulation Demo



## 3. Manipulation Demo

- Task Space Control
  - Write end effector's pose (IK)

The screenshot shows the Thor3 Control GUI with the following interface elements:

- Ros Communications**: Logging window displaying robot status messages.
- Basic Control**:
  - Mode Control**: Buttons for Robot Init Pose, FT Air, FT Ground, Apply Init FT, Save FT calibration, Head Control, Walking, Manipulation (selected), and Head Control.
  - Joint Control**:
    - Manipulation Init Pose
    - Joint Name: `l_arm_sh_p1`
    - Joint Value [deg]: `0.00 °`
    - Buttons: Get Current Joint Angle, Set Destination Joint Angle
  - Forward Kinematics**:
    - Joint selected: `left_arm`
    - Buttons: Get Current Position, Set Destination Position
  - Gripper**: Buttons for ON and OFF, currently set to `r_arm_grip`.- Figure Demo**: Buttons for Figure Demo Init Pose, Line, and Circle.

Three red boxes with arrows point to specific controls:

- 1. Select**: Points to the `Joint Name` dropdown set to `left_arm`.
- 2. Set Value**: Points to the `position x [m]` input field set to `0.000 m`.
- 3. Click**: Points to the `Set Destination Position` button.

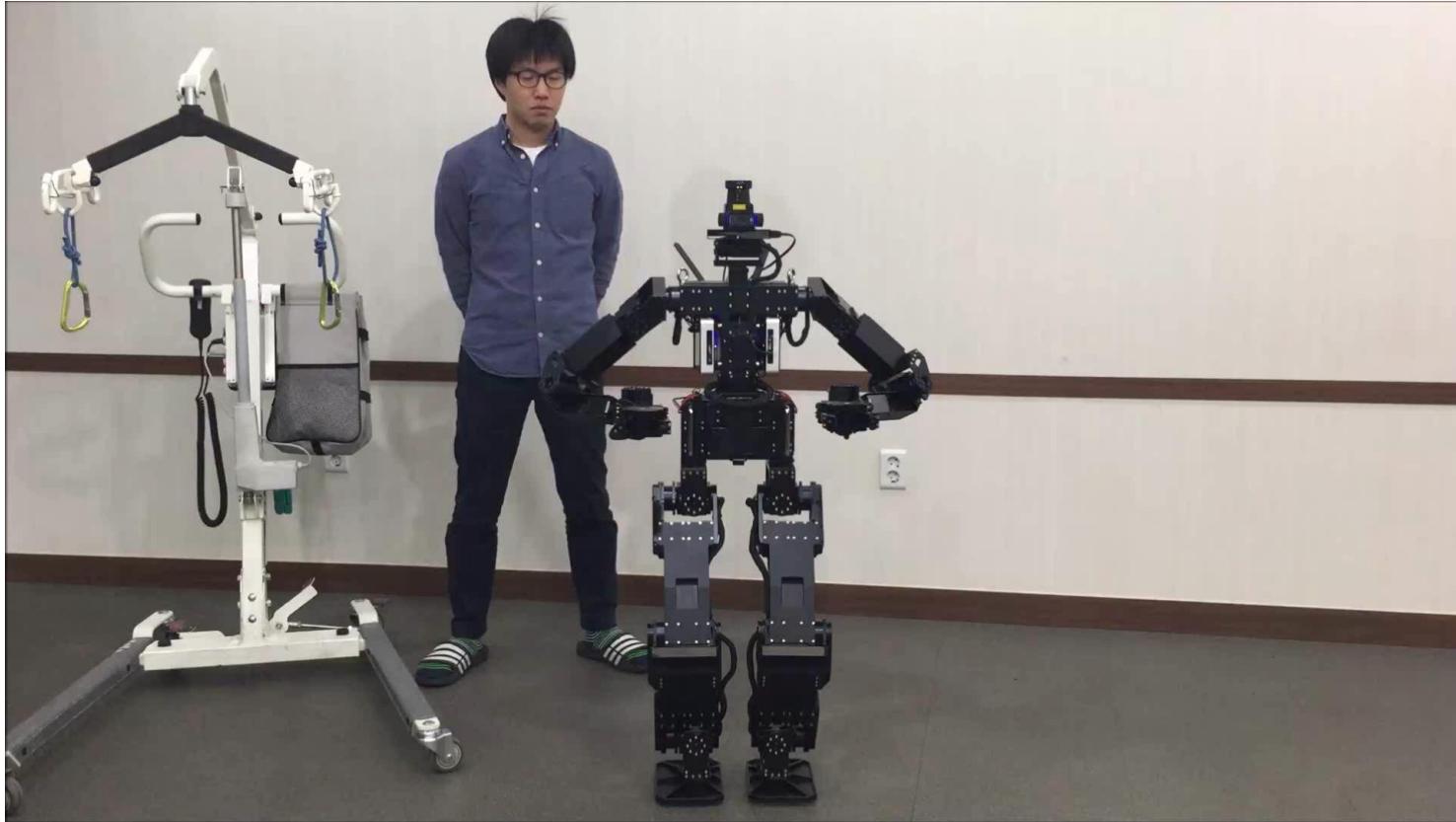


# Manipulation Demo



## 3. Manipulation Demo

- Task Space Control Video





# Manipulation Demo



## 3. Manipulation Demo

- Drawing Line

The screenshot shows the Thor3 Control GUI interface. On the left is a 'Ros Communications' window displaying log messages. On the right is the main control panel.

**Basic Control:** Includes buttons for 'Robot Init Pose', 'Make PointCloud', 'FT Air', 'FT Ground', 'Apply Init FT', and 'Save FT calibration'.

**Mode Control:** Buttons for 'Walking', 'Manipulation' (which is selected), and 'Head Control'.

**Joint Control:** A section for 'Manipulation Init Pose' with fields for 'Joint Name' (set to 'l\_arm\_sh\_p1') and 'Joint Value [deg]' (set to '0.00 °'). Buttons for 'Get Current Joint Angle' and 'Set Destination Joint Angle' are also present.

**Forward Kinematics:** A dropdown menu set to 'left\_arm' with a 'Get Current Position' button.

**Inverse Kinematics:** Fields for 'position x [m]', 'y [m]', and 'z [m]' (all set to '0.000 m'), and orientation fields ('roll', 'pitch', 'yaw') (all set to '0.000 °'). A 'Set Destination Position' button is at the bottom.

**Gripper:** A dropdown menu set to 'r\_arm\_grip' with 'ON' and 'OFF' buttons.

**Figure Demo:** A section with a dropdown menu set to 'left\_arm', a 'Figure Demo Init Pose' button, and three buttons for 'Line' and 'Circle'.

Three red arrows point from numbered boxes on the right to specific controls in the 'Figure Demo' section:

1. Select: Points to the dropdown menu set to 'left\_arm'.
2. Click: Points to the 'Figure Demo Init Pose' button.
3. Click: Points to the 'Line' button.



# Manipulation Demo



## 3. Manipulation Demo

- Drawing Circle

The screenshot shows the Thor3 Control GUI interface. On the left is a 'Ros Communications' window displaying log messages. On the right is the main control panel.

**Basic Control:** Includes buttons for 'Robot Init Pose', 'Make PointCloud', 'FT Air', 'FT Ground', 'Apply Init FT', and 'Save FT calibration'.

**Mode Control:** Buttons for 'Walking', 'Manipulation' (which is selected), and 'Head Control'.

**Joint Control:** A section for 'Manipulation Init Pose' with fields for 'Joint Name' (set to 'l\_arm\_sh\_p1') and 'Joint Value [deg]' (set to '0.00 °'). Buttons for 'Get Current Joint Angle' and 'Set Destination Joint Angle' are also present.

**Forward Kinematics:** A dropdown menu set to 'left\_arm' with a 'Get Current Position' button.

**Inverse Kinematics:** Fields for 'position x [m]', 'y [m]', and 'z [m]' (all set to '0.000 m'), and orientation fields ('roll', 'pitch', 'yaw') (all set to '0.000 °'). A 'Set Destination Position' button is at the bottom.

**Gripper:** A dropdown menu set to 'r\_arm\_grip' with 'ON' and 'OFF' buttons.

**Figure Demo:** A section with three dropdown menus: 'left\_arm', 'right\_arm', and 'Figure Demo Init Pose'. The 'Figure Demo Init Pose' dropdown has options 'Line' and 'Circle'. The 'right\_arm' dropdown is highlighted with a red dashed border.

**Annotations:** Three red boxes with arrows point to specific controls:

1. Select: Points to the 'right\_arm' dropdown.
2. Click: Points to the 'Figure Demo Init Pose' dropdown.
3. Click: Points to the 'Circle' option in the 'Figure Demo Init Pose' dropdown.



# Manipulation Demo



## 3. Manipulation Demo

- Gripper On/Off (Closed/Open)

The screenshot shows the Thor3 Control GUI interface. On the left, the 'Ros Communications' window displays a log of messages from the manipulation module. On the right, the 'Basic Control' panel includes sections for 'Basic Control', 'Joint Control', 'Forward Kinematics', 'Inverse Kinematics', and 'Figure Demo'. A red box highlights the 'Gripper' dropdown menu, which lists 'r\_arm\_grip' and 'l\_arm\_grip'. Red arrows point from these labels to the corresponding 'ON' and 'OFF' buttons below the dropdown. The 'r\_arm\_grip' option is highlighted with a red border.

**Logging**

```
[INFO] [01:45]: [28] head_y : none  
[INFO] [01:45]: [29] head_p : none  
[INFO] [01:45]: [30] l_arm_grip : manipulation_module  
[INFO] [01:45]: [31] r_arm_grip : manipulation_module  
[INFO] [01:45]: set mode  
[INFO] [01:46]: [01] r_arm_sh_p1 : manipulation_module  
[INFO] [01:46]: [02] l_arm_sh_p1 : manipulation_module  
[INFO] [01:46]: [03] r_arm_sh_r : manipulation_module  
[INFO] [01:46]: [04] l_arm_sh_r : manipulation_module  
[INFO] [01:46]: [05] r_arm_sh_p2 : manipulation_module  
[INFO] [01:46]: [06] l_arm_sh_p2 : manipulation_module  
[INFO] [01:46]: [07] r_arm_el_y : manipulation_module  
[INFO] [01:46]: [08] l_arm_el_y : manipulation_module  
[INFO] [01:46]: [09] r_arm_wr_r : manipulation_module  
[INFO] [01:46]: [10] l_arm_wr_r : manipulation_module  
[INFO] [01:46]: [11] r_arm_wr_y : manipulation_module  
[INFO] [01:46]: [12] l_arm_wr_y : manipulation_module  
[INFO] [01:46]: [13] r_arm_wr_p : manipulation_module  
[INFO] [01:46]: [14] l_arm_wr_p : manipulation_module  
[INFO] [01:46]: [15] r_leg_hip_y : none  
[INFO] [01:46]: [16] l_leg_hip_y : none  
[INFO] [01:46]: [17] r_leg_hip_r : none  
[INFO] [01:46]: [18] l_leg_hip_r : none  
[INFO] [01:46]: [19] r_leg_hip_p : none  
[INFO] [01:46]: [20] l_leg_hip_p : none  
[INFO] [01:46]: [21] r_leg_kn_p : none  
[INFO] [01:46]: [22] l_leg_kn_p : none  
[INFO] [01:46]: [23] r_leg_an_p : none  
[INFO] [01:46]: [24] l_leg_an_p : none  
[INFO] [01:46]: [25] r_leg_an_r : none  
[INFO] [01:46]: [26] l_leg_an_r : none  
[INFO] [01:46]: [27] torso_y : manipulation_module  
[INFO] [01:46]: [28] head_y : none  
[INFO] [01:46]: [29] head_p : none  
[INFO] [01:46]: [30] l_arm_grip : manipulation_module  
[INFO] [01:46]: [31] r_arm_grip : manipulation_module  
[INFO] [01:46]: Get mode
```

**Basic Control**

Robot Init Pose, Make PointCloud, FT Air, FT Ground, Apply Init FT, Save FT calibration

Mode Control, Walking, Manipulation, Head Control

**Joint Control**

Manipulation Init Pose, Joint Name (l\_arm\_sh\_p1), Joint Value [deg] (0.00 \*), Get Current Joint Angle, Set Destination Joint Angle

**Forward Kinematics**

left\_arm, Get Current Position

**Inverse Kinematics**

position x [m] (0.000 m), orientation roll [deg] (0.000 \*), position y [m] (0.000 m), orientation pitch [deg] (0.000 \*), position z [m] (0.000 m), orientation yaw [deg] (0.000 \*), Set Destination Position

**Gripper**

r\_arm\_grip, ON, OFF

**Figure Demo**

left\_arm, Figure Demo Init Pose, Line, Circle

**1. Select**

**2. Click On or Off**

# Walking Demo



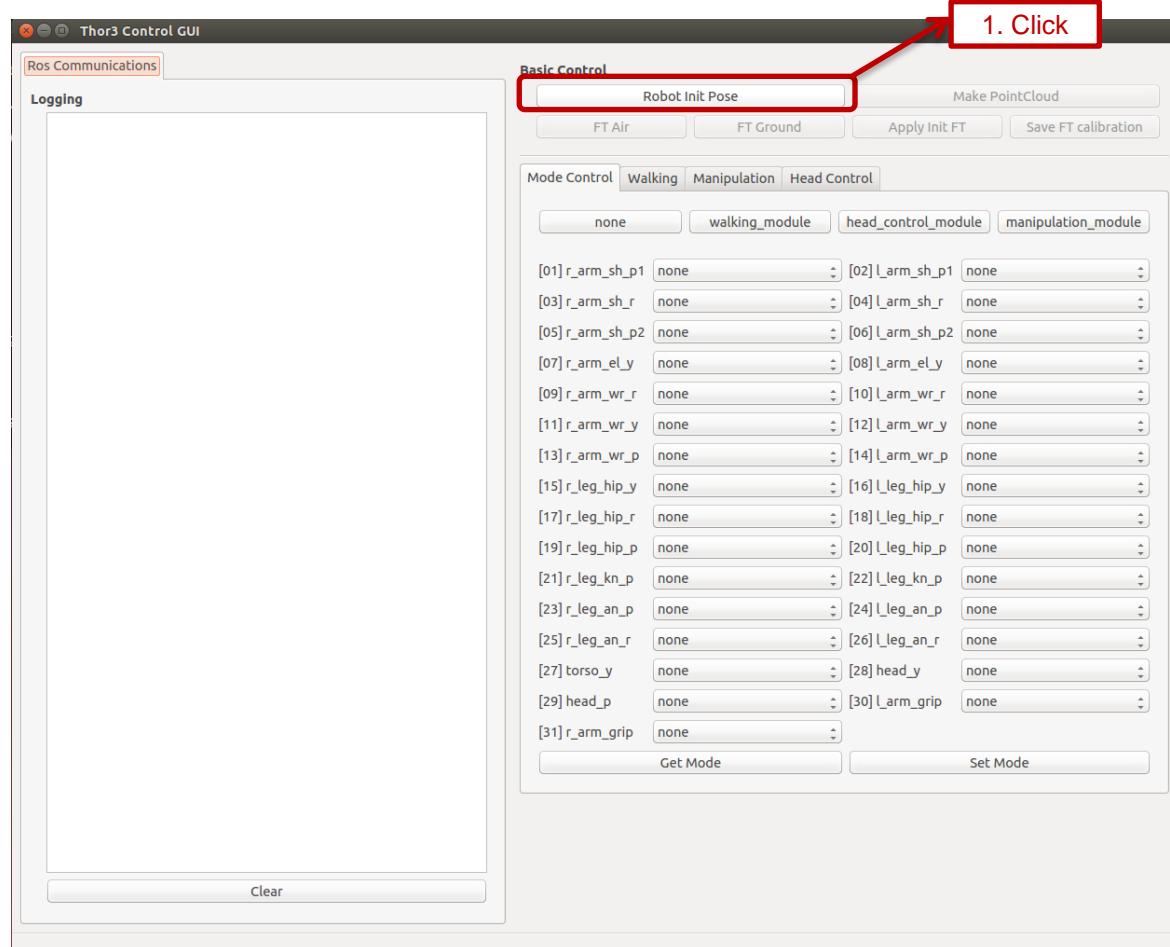
# Walking Demo



## 4. Walking Demo

- Initial Pose

- Before running the Walking Control demo, make the robot move to initial position.





# Walking Demo



## 4. Walking Demo





# Walking Demo



## 4. Walking Demo

- Set Mode

Screenshot of the Thor3 Control GUI showing the Basic Control tab.

The screenshot shows the Thor3 Control GUI window with the "Basic Control" tab selected. On the left, there is a "Ros Communications" panel displaying a log of messages from the "Logging" section. The main area contains several dropdown menus and buttons for controlling the robot's modes and joints.

Annotations with red boxes and arrows indicate the steps for setting the walking mode:

1. Click: A red box highlights the "walking\_module" button in the "Mode Control" section. An arrow points to it from the text "1. Click".
2. Check: A red box highlights the dropdown menu for "r\_leg\_hip\_y" which is set to "walking\_module". An arrow points to it from the text "2. Check".
3. Click: A red box highlights the "Set Mode" button at the bottom right of the control panel. An arrow points to it from the text "3. Click".

Below the "Set Mode" button, there is a "Get Mode" button.

Log output (Ros Communications):

```
[INFO] [00:34]: [23] r_leg_an_p : walking_module
[INFO] [00:34]: [24] l_leg_an_p : walking_module
[INFO] [00:34]: [25] r_leg_an_r : walking_module
[INFO] [00:34]: [26] l_leg_an_r : walking_module
[INFO] [00:34]: [27] torso_y : base_module
[INFO] [00:34]: [28] head_y : base_module
[INFO] [00:34]: [29] head_p : base_module
[INFO] [00:34]: [30] l_arm_grip : base_module
[INFO] [00:34]: [31] r_arm_grip : base_module
[INFO] [00:34]: set mode
[INFO] [00:35]: [01] r_arm_sh_p1 : base_module
[INFO] [00:35]: [02] l_arm_sh_p1 : base_module
[INFO] [00:35]: [03] r_arm_sh_r : base_module
[INFO] [00:35]: [04] l_arm_sh_r : base_module
[INFO] [00:35]: [05] r_arm_sh_p2 : base_module
[INFO] [00:35]: [06] l_arm_sh_p2 : base_module
[INFO] [00:35]: [07] r_arm_el_y : base_module
[INFO] [00:35]: [08] l_arm_el_y : base_module
[INFO] [00:35]: [09] r_arm_wr_r : base_module
[INFO] [00:35]: [10] l_arm_wr_r : base_module
[INFO] [00:35]: [11] r_arm_wr_y : base_module
[INFO] [00:35]: [12] l_arm_wr_y : base_module
[INFO] [00:35]: [13] r_arm_wr_p : base_module
[INFO] [00:35]: [14] l_arm_wr_p : base_module
[INFO] [00:35]: [15] r_leg_hip_y : walking_module
[INFO] [00:35]: [16] l_leg_hip_y : walking_module
[INFO] [00:35]: [17] r_leg_hip_r : walking_module
[INFO] [00:35]: [18] l_leg_hip_r : walking_module
[INFO] [00:35]: [19] r_leg_hip_p : walking_module
[INFO] [00:35]: [20] l_leg_hip_p : walking_module
[INFO] [00:35]: [21] r_leg_kn_p : walking_module
[INFO] [00:35]: [22] l_leg_kn_p : walking_module
[INFO] [00:35]: [23] r_leg_an_p : walking_module
[INFO] [00:35]: [24] l_leg_an_p : walking_module
[INFO] [00:35]: [25] r_leg_an_r : walking_module
[INFO] [00:35]: [26] l_leg_an_r : walking_module
[INFO] [00:35]: [27] torso_y : base_module
[INFO] [00:35]: [28] head_y : base_module
[INFO] [00:35]: [29] head_p : base_module
[INFO] [00:35]: [30] l_arm_grip : base_module
[INFO] [00:35]: [31] r_arm_grip : base_module
[INFO] [00:35]: Get mode
```

Buttons in the "Basic Control" tab:

- Robot Init Pose
- FT Air
- FT Ground
- Apply Init FT
- Save FT calibration
- Mode Control (Buttons: none, walking\_module, head\_control\_module, manipulation\_module)
- Walking
- Manipulation
- Head Control
- Get Mode
- Set Mode

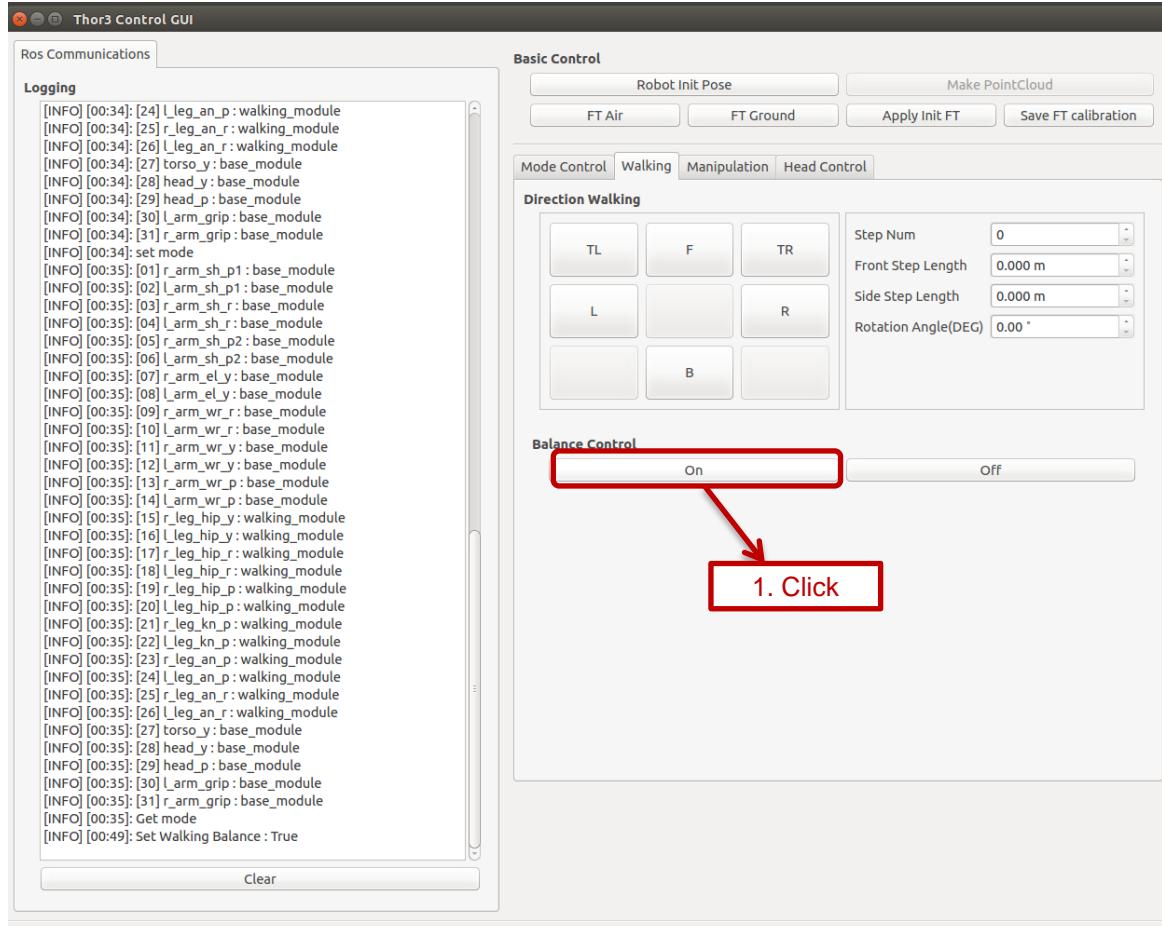


# Walking Demo



## 4. Walking Demo

- Balance THORMANG



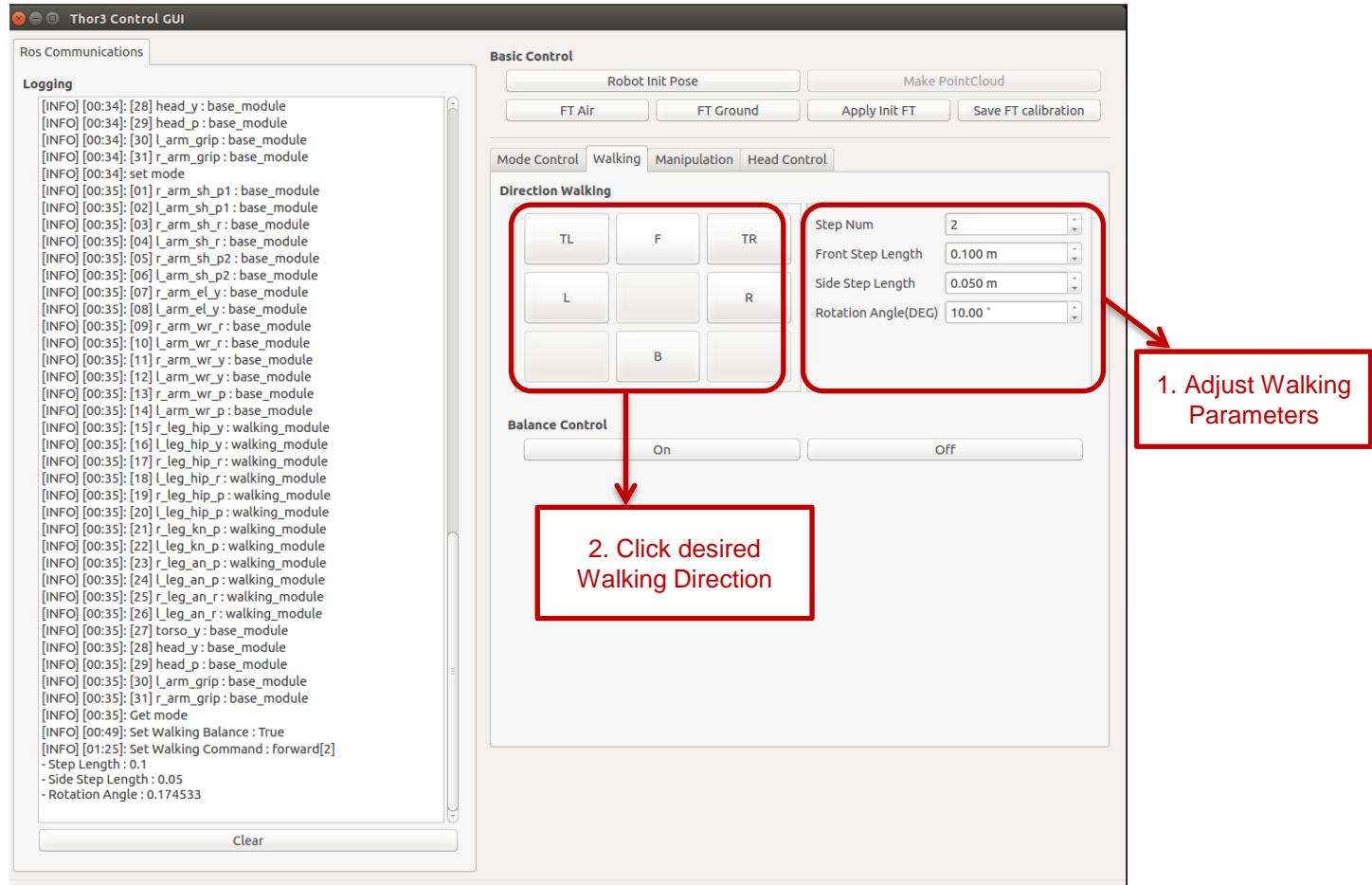


# Walking Demo



## 4. Walking Demo

- Adjust Walking Parameters and Choose Walking Direction





# Walking Demo



## 4. Walking Demo

