

01. Introduction

Robot Operating System (ROS) introduction

The definition of robot

- **Joseph Engelberger, pioneer in industrial robotics:** *"I can't define a robot, but I know one when I see one."*
- **Wikipedia:** *"A robot is a machine—especially one programmable by a computer— capable of carrying out a complex series of actions automatically. Robots can be guided by an external control device or the control may be embedded within. Robots may be constructed on the lines of human form, but most robots are machines designed to perform a task with no regard to their aesthetics."*
- **ISO 8373:2012 Robots and robotic devices - Vocabulary, FDIS 2012:** *"A robot is an actuated mechanism programmable in two or more axes with a degree of autonomy, moving within its environment, to perform intended tasks."*
- **Rodney Brooks, Founder and CTO, Rethink Robotics:** *"A robot is some sort of device, wich has sensors those sensors the world, does some sort of computation, decides on an action, and then does that action based on the sensory input, which makes some change out in the world, outside its body. Comment: the part "make some change outside its body" discriminates a washing machine from e.g. a Roomba."*
- **Tamás Haidegger, Encyclopedia of Robotics:** *"A robot is a complex mechatronic system enabled with electronics, sensors, actuators and software, executing tasks with a certain degree of autonomy. It may be pre-programmed, teleoperated or carrying out computations to make decisions."*

What is ROS?



- Open-source, robotics themed middleware
- Modularity, reusability (drivers, algorithms, libraries, ...)
- Hardware abstraction, ROS API
- C++ és Python support
- Ubuntu Linux (except ROS 2)
- Great community



History

- Mid 2000s, Stanford: robotics themed, flexible, dynamic framework for prototype development
- 2007, Willow Garage: incubation, the core of ROS under BSD license
- Spread in robotics reserach, PR2
- 2012: Industrial robotics, ROS-Industrial
- 2017: ROS 2

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Development system build -- homework

Recommended environment:

- Ubuntu 20.04
- ROS Noetic
- *IDE: QtCreator*

1. ROS

```
sudo sh -c 'echo "deb http://packages.ros.org/ros/ubuntu $(lsb_release -sc) main" > /etc/
apt/sources.list.d/ros-latest.list'
sudo apt-key adv --keyserver 'hkp://keyserver.ubuntu.com:80' --recv-key
C1CF6E31E6BADE8868B172B4F42ED6FBAB17C654
sudo apt update
sudo apt install ros-noetic-desktop-full
source /opt/ros/noetic/setup.bash
```

The command `source` is responsible for setting environmental variables, and it has to be executed every time a new terminal window is opened. Alternatively, this command can be copied to the end of the file `~/.bashrc`. This script runs automatically every time when a terminal window is opened. To do that, type:

```
echo "source /opt/ros/noetic/setup.bash" >> ~/.bashrc
source ~/.bashrc
```

2. ROS dependencies

```
sudo apt install python3-rosdep python3-rosinstall python3-rosinstall-generator
python3-wstool build-essential
sudo rosdep init
rosdep update
```

Then test our ROS install by typing:

```
roscore
```

3. Further packages

The following packages are also going to be needed during the course, so it is recommended to install them:

```
sudo apt install libxml2-dev libraw1394-dev libncurses5-dev qtcreator swig sox espeak
cmake-curses-gui cmake-qt-gui git subversion gfortran libcppunit-dev
```

```
libqt5xmlpatterns5-dev python3-catkin-tools python3-osrf-pycommon libasound2-dev  
libgl1-mesa-dev xorg-dev
```

4. QtCreator

For the purpose of the development of ROS packages QtCreator is one of the best IDEs, a ROS plugin is also available for that. The one for Ubuntu 18.04 also works on 20.04, thus one can use the Bionic **Offline** Installer. It can be downloaded from the following link:

https://ros-qtc-plugin.readthedocs.io/en/latest/_source/How-to-Install-Users.html

After the installer is downloaded, the IDE can be installed by the following command (important to navigate to the location of the download using `cd` :

```
sudo ./qtcreator-ros-bionic-latest-online-installer.run
```

When the installer asks for a location to install, modify it to the `/home/<USER>/QtCreator` folder, and not to root. After installing, the IDE can be find with the name "Qt Creator (4.9.2)"

Suggestion

Install **Terminator** terminal emulator:

```
sudo apt update  
sudo apt install terminator
```

Links

- <https://www.ros.org/>
- <https://www.ros.org/install/>
- <http://wiki.ros.org/ROS/Tutorials>
- Markdown Cheatsheet
- Online MD editor: HackMD
- QtCreator + ROS plugin
- IROB virtual tour

- ROS 10 years montage