

# ROS Noetic Assignment 1— DC Motor Simulator and Proportional Controller

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FILES HIERARCHY:

```
neo@neo-VirtualBox: ~/catkin_ws/src/ros1_dcmotor/src
neo@neo-VirtualBox:~$ cd catkin_ws
neo@neo-VirtualBox:~/catkin_ws$ ls
build  devel  src
neo@neo-VirtualBox:~/catkin_ws$ cd src
neo@neo-VirtualBox:~/catkin_ws/src$ ls
CMakeLists.txt  ros1_dcmotor
neo@neo-VirtualBox:~/catkin_ws/src$ cd ros1_dcmotor
neo@neo-VirtualBox:~/catkin_ws/src/ros1_dcmotor$ ls
CMakeLists.txt  include  package.xml  src
neo@neo-VirtualBox:~/catkin_ws/src/ros1_dcmotor$ cd src
neo@neo-VirtualBox:~/catkin_ws/src/ros1_dcmotor/src$ ls
controller.cpp  simulator.cpp
neo@neo-VirtualBox:~/catkin_ws/src/ros1_dcmotor/src$
```

COMPILATION:

```
neo@neo-VirtualBox: ~/catkin_ws
neo@neo-VirtualBox:~/catkin_ws$ cd ~/catkin_ws
neo@neo-VirtualBox:~/catkin_ws$ rm -rf build devel
neo@neo-VirtualBox:~/catkin_ws$ catkin_make
base path: /home/neo/catkin_ws
source space: /home/neo/catkin_ws/src
build space: /home/neo/catkin_ws/build
devel space: /home/neo/catkin_ws/devel
install space: /home/neo/catkin_ws/install
###
### Running command: "cmake /home/neo/catkin_ws/src -DCATKIN_DEVEL_PREFIX=/home/neo/catkin_ws/devel -DCMAKE_INSTALL_PREFIX=/home/neo/catkin_ws/lns
all -G Unix Makefiles" in "/home/neo/catkin_ws/build"
###
- The C compiler identification is GNU 9.4.0
- The CXX compiler identification is GNU 9.4.0
- Check for working C compiler: /usr/bin/cc
- Check for working C compiler: /usr/bin/cc -- works
- Detecting C compiler ABI info
- Detecting C compiler ABI info - done
- Detecting C compile features
- Detecting C compile features - done
- Check for working CXX compiler: /usr/bin/c++
- Check for working CXX compiler: /usr/bin/c++ -- works
- Detecting CXX compiler ABI info
- Detecting CXX compiler ABI info - done
- Detecting CXX compile features
- Detecting CXX compile features - done
- Using CATKIN_DEVEL_PREFIX: /home/neo/catkin_ws/devel
- Using CMAKE_PREFIX_PATH: /home/neo/catkin_ws/devel:/opt/ros/noetic
- This workspace overlays: /home/neo/catkin_ws/devel:/opt/ros/noetic
- Found PythonInterp: /usr/bin/python3 (found suitable version "3.8.10", minimum required is "3")
- Using PYTHON_EXECUTABLE: /usr/bin/python3
- Using Debian Python package layout
- Found PY_en: /usr/lib/python3/dist-packages/en.py
- Using empy: /usr/lib/python3/dist-packages/en.py
- Using CATKIN_ENABLE_TESTING: ON
- Call enable_testing()
- Using CATKIN_TEST_RESULTS_DIR: /home/neo/catkin_ws/build/test_results
- Forcing gtest/gmock from source, though one was otherwise available.
- Found gtest sources under '/usr/src/gtest': gtests will be built
- Found gmock sources under '/usr/src/gmock': gmock will be built
- Found PythonInterp: /usr/bin/python3 (found version "3.8.10")
- Found Threads: TRUE
- Using Python nosetests: /usr/bin/nosetests3
- catkin 0.8.12
- BUILD_SHARED_LIBS is on
- BUILD_SHARED_LIBS is on

--- traversing 1 packages in topological order:
--- - ros1_dcmotor

+++ processing catkin package: 'ros1_dcmotor'
+++ add_subdirectory(ros1_dcmotor)
- Configuring done
- Generating done
- Build files have been written to: /home/neo/catkin_ws/build
###
### Running command: "make -j4 -l4" in "/home/neo/catkin_ws/build"
###
canning dependencies of target controller
canning dependencies of target simulator
25% Building CXX object ros1_dcmotor/CMakeFiles/controller.dir/src/controller.cpp.o
50% Building CXX object ros1_dcmotor/CMakeFiles/simulator.dir/src/simulator.cpp.o
75% Linking CXX executable /home/neo/catkin_ws/devel/lib/ros1_dcmotor/simulator
100% Linking CXX executable /home/neo/catkin_ws/devel/lib/ros1_dcmotor/controller
100% Built target simulator
100% Built target controller
neo@neo-VirtualBox:~/catkin_ws$ source devel/setup.bash
neo@neo-VirtualBox:~/catkin_ws$
```

NODES TO BE IMPLEMENTED:

## simulator.cpp

- Subscribes to topic: /motor\_voltage
- Publishes to topic: /motor\_speed
- Current and Speed calculated according to motor dynamics equations.
- speed in rad/s is converted to rpm and then published

## controller.cpp

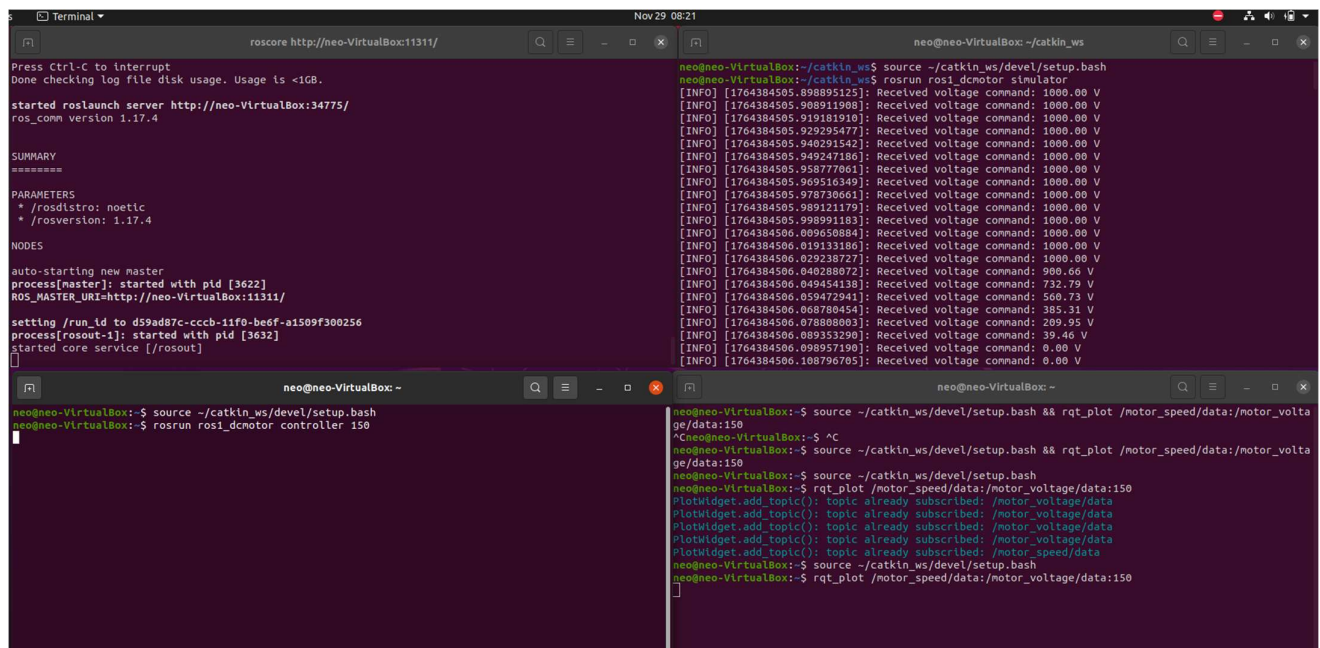
- Subscribes to topic: /motor\_speed
- Publishes to topic: /motor\_voltage
- The desired speed is supplied via command line argument.
- The actual speed in rpm is received as msg from the subscribed topic and difference between desired and actual speed is calculated and the proportional error voltage computed, and is published to the topic motor\_voltage.

## EXECUTION OF THE NODES AND OBSERVATION:

1. The ROS MASTER was made to run with command roscore.
2. The **simulator.cpp** node was then made to run in another terminal - it listens to the motor\_voltage node for voltage commands and publishes the motor speed value to motor\_speed topic.
3. The **controller.cpp** node is then made to run in another terminal - with command line argument 150 rpm - desired\_speed.
4. The controller.cpp node listens to the motor\_Speed terminal to which the simulator publishes - takes that msg stores it in actual\_speed- calculates error voltage with proportional gain Kp.
5. This voltage is published in the motor\_voltage topic and the corrective action in motor speed takes place.

## EXECUTION STEPS :

- Starting the ros master
- Running the SIMULATOR node
- Running the CONTROLLER node with command line argument desired\_speed =150 rpm



```
roscore http://neo-VirtualBox:11311/
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.
started roslaunch server http://neo-VirtualBox:34775/
ros_comm version 1.17.4

SUMMARY
=====
PARAMETERS
 * /roscdirsto: noetic
 * /rosversion: 1.17.4

NODES
auto-starting new master
process[master]: started with pid [3622]
ROS_MASTER_URI=http://neo-VirtualBox:11311/

setting /run_id to d59ad87c-cccb-11f0-b6ef-a1509f300256
process[roscout-1]: started with pid [3632]
started core service [/roscout]

neo@neo-VirtualBox:~/catkin_ws$ source ~/catkin_ws/devel/setup.bash
neo@neo-VirtualBox:~/catkin_ws$ roslaunch rosi_dcmotor simulator
[INFO] [1764384505.898895125]: Received voltage command: 1000.00 V
[INFO] [1764384505.908911908]: Received voltage command: 1000.00 V
[INFO] [1764384505.919181910]: Received voltage command: 1000.00 V
[INFO] [1764384505.929295477]: Received voltage command: 1000.00 V
[INFO] [1764384505.940291542]: Received voltage command: 1000.00 V
[INFO] [1764384505.949247186]: Received voltage command: 1000.00 V
[INFO] [1764384505.958777061]: Received voltage command: 1000.00 V
[INFO] [1764384505.969516349]: Received voltage command: 1000.00 V
[INFO] [1764384505.978730861]: Received voltage command: 1000.00 V
[INFO] [1764384505.989121179]: Received voltage command: 1000.00 V
[INFO] [1764384505.998991183]: Received voltage command: 1000.00 V
[INFO] [1764384506.009650884]: Received voltage command: 1000.00 V
[INFO] [1764384506.019133186]: Received voltage command: 1000.00 V
[INFO] [1764384506.029233972]: Received voltage command: 1000.00 V
[INFO] [1764384506.040288072]: Received voltage command: 980.66 V
[INFO] [1764384506.049454138]: Received voltage command: 732.79 V
[INFO] [1764384506.059472941]: Received voltage command: 560.73 V
[INFO] [1764384506.068780454]: Received voltage command: 385.31 V
[INFO] [1764384506.078888003]: Received voltage command: 209.95 V
[INFO] [1764384506.089353298]: Received voltage command: 39.46 V
[INFO] [1764384506.098957190]: Received voltage command: 0.00 V
[INFO] [1764384506.108796705]: Received voltage command: 0.00 V

neo@neo-VirtualBox:~/catkin_ws$ source ~/catkin_ws/devel/setup.bash
neo@neo-VirtualBox:~/catkin_ws$ roslaunch rosi_dcmotor controller 150

neo@neo-VirtualBox:~/catkin_ws$ source ~/catkin_ws/devel/setup.bash && rqt_plot /motor_speed/data:/motor_volt
ge/data:150
^Cneo@neo-VirtualBox:~/catkin_ws$ ^C
neo@neo-VirtualBox:~/catkin_ws$ source ~/catkin_ws/devel/setup.bash && rqt_plot /motor_speed/data:/motor_volt
ge/data:150
neo@neo-VirtualBox:~/catkin_ws$ source ~/catkin_ws/devel/setup.bash
neo@neo-VirtualBox:~/catkin_ws$ rqt_plot /motor_speed/data:/motor_voltge/data:150
PlotWidget.add_topic(): topic already subscribed: /motor_voltge/data
PlotWidget.add_topic(): topic already subscribed: /motor_voltge/data
PlotWidget.add_topic(): topic already subscribed: /motor_voltge/data
PlotWidget.add_topic(): topic already subscribed: /motor_voltge/data
neo@neo-VirtualBox:~/catkin_ws$ source ~/catkin_ws/devel/setup.bash
neo@neo-VirtualBox:~/catkin_ws$ rqt_plot /motor_speed/data:/motor_voltge/data:150
```

- ROS INFO in Simulator window displaying voltage value received as msg in motor\_voltage topic
- ROS TOPIC data of /motor\_speed topic

ROSTOPIC LIST:

```

neo@neo-VirtualBox: ~
neo@neo-VirtualBox:~$ source ~/catkin_ws/devel/setup.bash
neo@neo-VirtualBox:~$ rostopic list
/motor_speed
/motor_voltage
/rosout
/rosout_agg

```

ROSTOPIC INFO:

```

neo@neo-VirtualBox:~$ rostopic info /motor_speed
Type: std_msgs/Float32

Publishers:
 * /simulator (http://neo-VirtualBox:42135/)

Subscribers:
 * /controller (http://neo-VirtualBox:45303/)

neo@neo-VirtualBox:~$ rostopic info /motor_voltage
Type: std_msgs/Float32

Publishers:
 * /controller (http://neo-VirtualBox:45303/)

Subscribers:
 * /simulator (http://neo-VirtualBox:42135/)

```

RQT PLOT GRAPHS:

