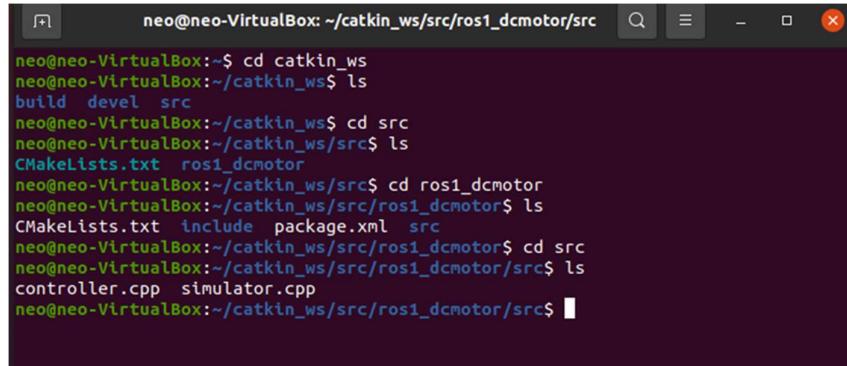


# ROS Noetic Assignment 1— DC Motor Simulator and Proportional Controller

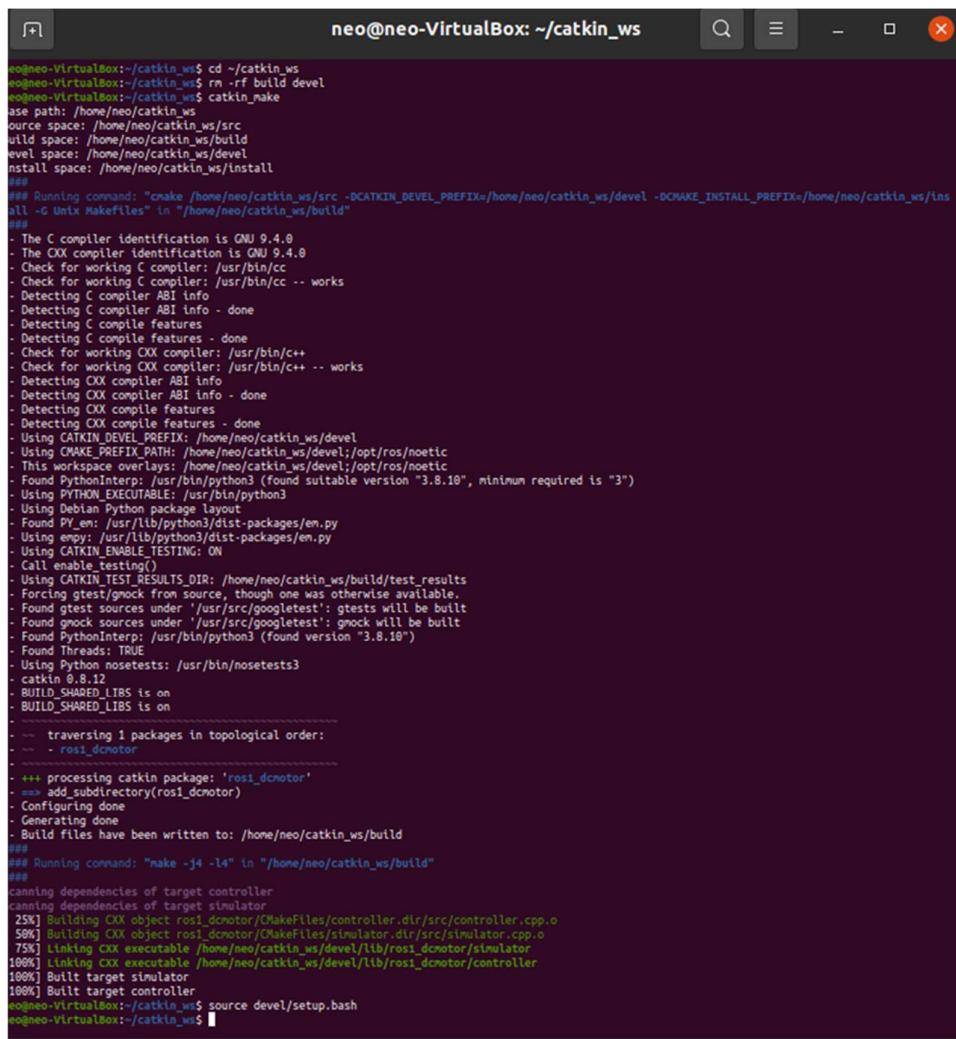
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## FILES HIERARCHY:



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

## COMPILATION:



```
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/install"
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_venv: /usr/lib/python3/dist-packages/venv.py
Using empy: /usr/lib/python3/dist-packages/empy.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/googletest': gtests will be built
- Found gmock sources under '/usr/src/googletest': 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:
-     - rosl_dcmotor
...
## processing catkin package: 'rosl_dcmotor'
## add_subdirectory(rosl_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 rosl_dcmotor/CMakeFiles/controller.dir/src/controller.cpp.o
[ 50%] Building CXX object rosl_dcmotor/CMakeFiles/simulator.dir/src/simulator.cpp.o
[ 75%] Linking CXX executable /home/neo/catkin_ws/devel/lib/rosl_dcmotor/simulator
[ 100%] Linking CXX executable /home/neo/catkin_ws/devel/lib/rosl_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

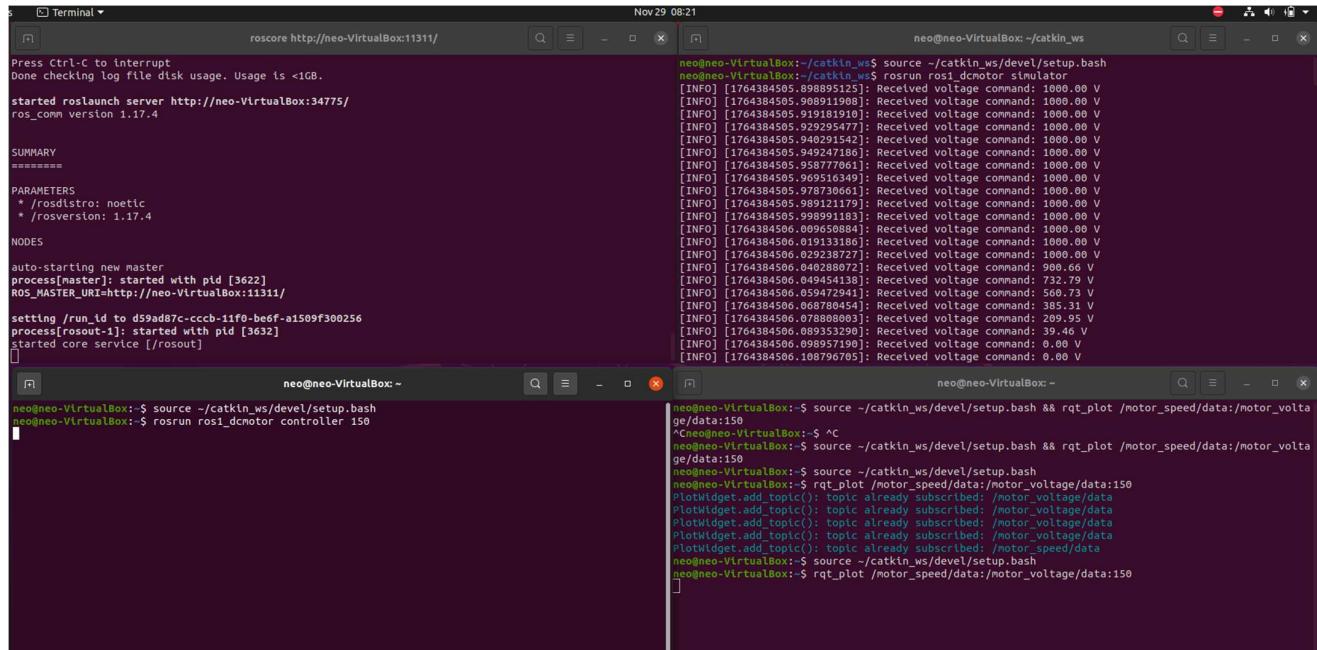
- Subscribes to topic: /motor\_speed
  - Publishes to topic: /motor\_voltage
  - The desired speed is supplied via command line argument.
  - The actual speed in rpm is received as msg from the subscribed topic and difference between desired and actual speed is calculated and the proportional error voltage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



- 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:~$ 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:

