

Robotics 311 : How to build robots and make them move


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ROB 311 – Lecture 22

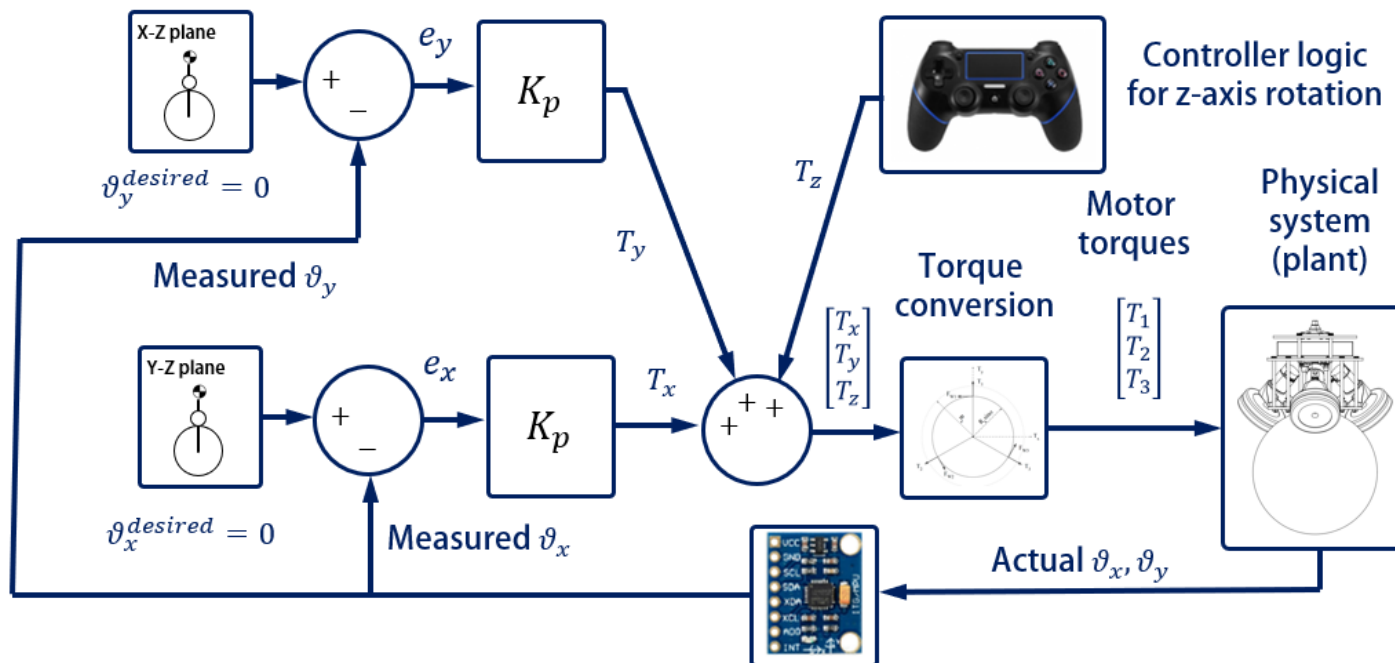
- Today you have time to catch up on your ball-bot
 - Everyone should be able to
 - Balance
 - Rotate
 - Accept PS4 controller commands
 - Save and stream data for plotting
 - Also, everyone should calibrate their IMU
- 
- You should know how to do all of these

Announcements

- HW5 posted today
- You should get midterm grades this week

Balance and Rotation Controller

- Your ball-bot should be able to balance for extended periods of time
- You should be getting a feel for the gains and how they change as your battery voltage lowers
- You should have added the PS4 Controller to your balance controller script
- You can add Integral / Derivative terms to your controller
- You should be plotting your controller effort in real time

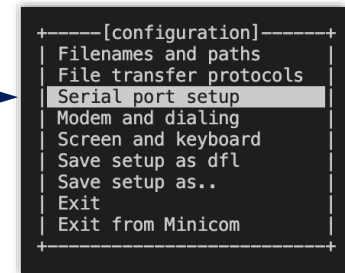


IMU Calibration

- Using your SSH connection to your RPi, type `sudo apt-get install minicom`
- Minicom allows us to read data being sent from the Pico and display on your RPi
- First, we need to create a new firmware file to flash to the Pico
- Download `test_dmp.c` from Canvas
- Replace the existing `test_dmp.c` script in `~\rob311\mbot-omni-firmware\src\test_dmp.c`
- Change directory to `~\rob311\mbot-omni-firmware\build\` and execute
 - `cmake ..`
 - `make -j4`
- Change directory to `~\rob311`
- Type `sudo nano picoload` to edit the picoload bash script
- Edit line 4 from:
`sudo cp /home/$USER/rob311/mbot-omni-firmware/build/src/bballbot.uf2 /mnt/pico/`
- To:
`sudo cp /home/$USER/rob311/mbot-omni-firmware/build/src/test_dmp.uf2 /mnt/pico/`

IMU Calibration

- Put the Pico into bootloading mode
 - Press and hold white reset button when
 - plugging in micro-USB
- Run picoload from the `~/rob311` directory
`./picoload /dev/sda1`
- You should see 'Loaded UF2!' with no errors
- Next, we need to edit the minicom configuration
- `sudo minicom -s` will open the minicom setup
- Enter serial port setup and press 'A'
- Change A- Serial Device to:
`/dev/ttyACM0`
- Press enter
- Select 'save setup as dfl'
- Then select 'Exit from Minicom'



```
+-----[configuration]-----+
| Filenames and paths          |
| File transfer protocols      |
| Serial port setup            |
| Modem and dialing            |
| Screen and keyboard          |
| Save setup as dfl            |
| Save setup as..              |
| Exit                         |
| Exit from Minicom            |
+-----+-----+

```

A blue arrow points from the text 'Enter serial port setup and press 'A'' to this screenshot.

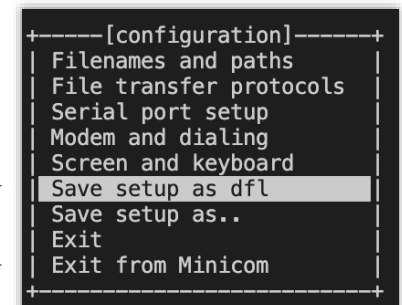


```
A - Serial Device      : /dev/ttyACM0
B - Lockfile Location  : /var/lock
C - Callin Program     :
D - Callout Program    :
E - Bps/Par/Bits       : 115200 8N1
F - Hardware Flow Control : Yes
G - Software Flow Control : No
H - RS485 Enable       : No
I - RS485 Rts On Send  : No
J - RS485 Rts After Send : No
K - RS485 Rx During Tx : No
L - RS485 Terminate Bus : No
M - RS485 Delay Rts Before: 0
N - RS485 Delay Rts After : 0

Change which setting? █

```

A blue arrow points from the text 'Change A- Serial Device to: /dev/ttyACM0' to this screenshot.



```
+-----[configuration]-----+
| Filenames and paths          |
| File transfer protocols      |
| Serial port setup            |
| Modem and dialing            |
| Screen and keyboard          |
| Save setup as dfl            |
| Save setup as..              |
| Exit                         |
| Exit from Minicom            |
+-----+-----+

```

Two blue arrows point from the text 'Select 'save setup as dfl'' and 'Then select 'Exit from Minicom'' to this screenshot.

IMU Calibration

- Run minicom from the command line
`minicom`
- Unplug and re-plug the Pico USB from the RPi
- It will print calibration instructions to the terminal through minicom

```
Welcome to minicom 2.8


OPTIONS: I18n
Port /dev/ttyACM0, 15:48:33

Press CTRL-A Z for help on special keys

Initializing...
Calibrating Gyro... Please Hold Still!
Gyro Cal Complete!

Orient Z pointing up and hold as still as possible
When ready, press any key to sample accelerometer
█
```

Walk through 6
different orientations
and save the
calibration file



- When it finishes, your IMU is calibrated and will save its data automatically
- Re-flash your Pico with your original firmware bballbot.UF2
 - Edit Picoload script and put your Pico in boot loading mode