Introduction to Aerial Robotics
Lab Tutorial

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Linux Basis

- Be familiar with command line and some common commands and tools.
- Be familiar with the package management system and the file management system on Linux
- Install ROS and configure the environment on your laptop(go through with the tutorial on http://www.ros.org)

Suggest software tool: terminator, vim, ssh, htop

ROS Basis

- The Robot Operating System (ROS) is a set of software libraries and tools that help you build robot applications. From drivers to state-of-the-art algorithms, and with powerful developer tools, ROS has what you need for your next robotics project.
- ROS is a open source communication framework with many useful tools.

About the 1st lab session

- Each group will be equipped with a Jetson TX2 computer, which can be mounted on the quadrotor. The computer is running a Ubuntu OS and has all necessary packages such as ROS or Eigen.

- The TX2 is connected with the router in the lab through an Ethernet cable. You can use “ssh XXX(host name)@xxx.xxx.xxx.xxx(host IP)” to remote login on TX2 form your laptop.

Project 1 Phase 4

- Assemble quadrotor
- First flight of quadrotor
  - Flying under manual control
- Hovering automatically
  - Write your controller
- Following trajectory automatically
  - Write your trajectory generation

Assemble quadrotor

- Assemble quadrotor

4 legs
4 motors
4 propellers
4 electric speed controllers
Flight controller
Receiver
Battery

Quadrotor Equipment

- Main Elements List

Element	Number	Manufacturer	Price (HKD)	Reference Link
F330 structure	1		50	
N3 flight controller	1	DJI	2,999	www.dji.com/n3
Lightbridge 2	1	DJI	7,759	www.dji.com/lightbridge-2
mvBlueFOX MLC200wg	1	MATRIX VISION	3,500	www.matrix-vision.com/USB2.0-single-board-camera-mvbluefox-mlc.html
Jetson TX2	1	NVIDIA	3,588	www.nvidia.com/object/embedded-systems-dev-kits-modules.html
TX2 carrier board	1	DJI	2,400	
E310 Motors, ESCs	4	DJI	1,154	www.dji.com/e310

Be careful during your experiments because your robot cost more than **HK$ 21,000** !!!

Setup your TX2

1. Follow: https://github.com/gaowenliang/TX2-TX1-setup
   flash the system

README.md

1. flash the TX2

1.1 download jetpack L4T 3.0

Provided by TA: JetPack-L4T-3.0-linux.run

put it in a new folder. Run:

`chmod +x JetPack-L4T-3.0-linux.run`

`sudo .JetPack-L4T-3.0-linux.run`

Warning:

- do not run the script in sudo mode when installing host components
- do not install OpenCV4Tegra V2.4 for TX2, we will use OpenCV3
- for TX2 you may need to flash it tiwce, one just flash the OS, the other install cuda
- if the tx1/tx2 cannot boot the GUI, but shut down after finish loading BIOS, try to change a more powerful power source

After flash, the system can be launch.

username: nvidia password: nvidia

2. Install basic tools

connect to lab WiFi: indigo or indigo5G,install arp-scan and run: `sudo arp-scan --interface=eth0 192.168.1.0/24 | grep NVIDIA' find your TX2 device.

ssh to your TX2 and run:

`sudo apt-get install git`

Setup your TX2

2. Follow: https://github.com/gaowenliang/installROSTX2
   install ROS

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Coding your controller

3. Coding your controller:
   One ros node

   subscribe message: Robot_1/pose
   type: geometry_msgs/PoseStamped

   publish message: ctrl
   type: sensor_msgs::Joy

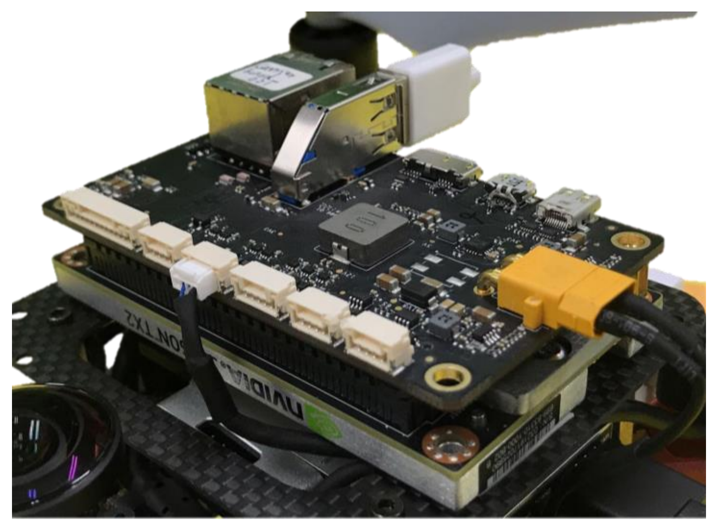
Coding your controller

```
void DjiRos::control_callback(const sensor_msgs::JoyConstPtr &pMsg) {
  if (pMsg->header.frame_id.compare("FRD") == 0) {
    last_ctrl_stamp = ros::Time::now();

    uint8_t flag = 0;
    if (pMsg->axes[4] > 0) {
      flag = 0b00100010;  // 0b00100000, mode 13
      if (pMsg->axes.size() > 5 && pMsg->axes.at(5) > 0.5) {
        flag = 0b00101010; // 0b00100000, mode 14
      }
    } else {
      flag = 0b00000010;  // 0b00000000, mode 1
    }

    DJI::OSDK::Control::CtrlData ctrl_data(flag, pMsg->axes[0], pMsg->axes[1], pMsg->axes[2], pMsg->axes[3]);

    vehicle->control->flightCtrl(ctrl_data);

    // if (pMsg->buttons.size()) {
    //     ros::Time feedback_stamp;
    //     feedback_stamp.sec = pMsg->buttons[1] * pMsg->buttons[0] + pMsg->buttons[2];
    //     feedback_stamp.nsec = pMsg->buttons[3] * pMsg->buttons[0] + pMsg->buttons[4];
    //     ROS_INFO("curr: %.3f fbk: %.3f dt=%.3f", last_ctrl_time.toSec(),
    //     feedback_stamp.toSec(),
    //              (last_ctrl_time - feedback_stamp).toSec());
    // }
  } else {
    ROS_ERROR("[djiros] input joy_msg.frame_id should be FRD!!!");
  }
}
```

Assemble quadrotor

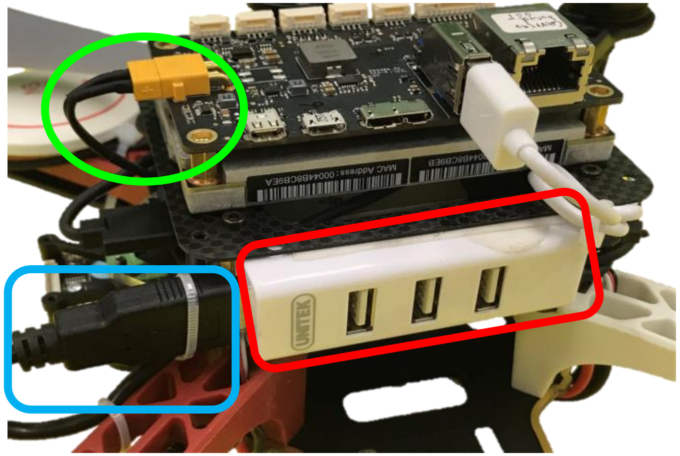
4. Assemble TX2 module.
   Copper pillars
   Skew: M3

5. Assemble TX2 on the top of quadrotor, with a carbon fiber slice.
   3M Double-sided adhesive



Assemble quadrotor

6. Assemble necessary tools and connections:
    - USB2.0-miniUSB cable
    - USB hub
    - power support cable

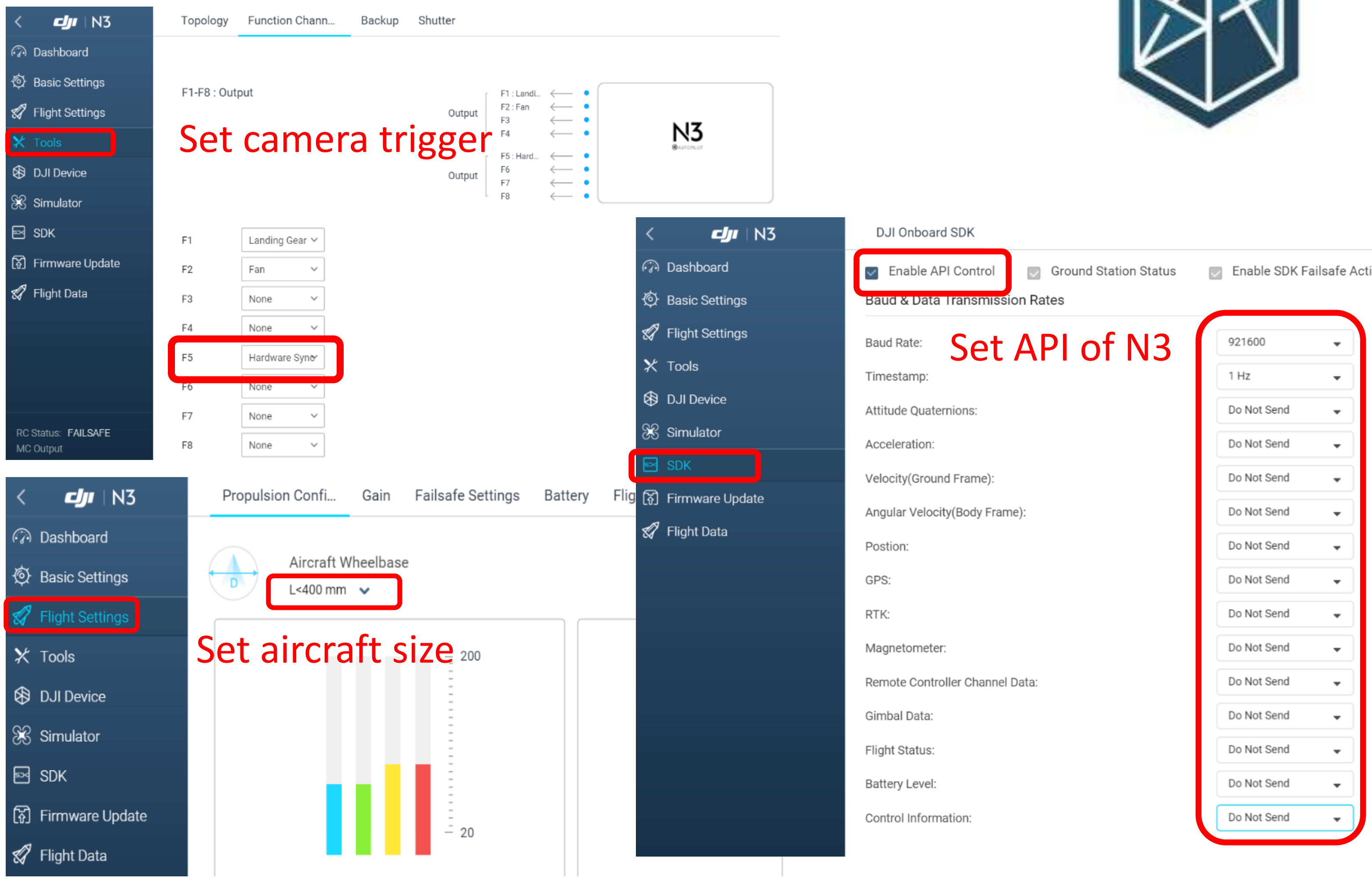


7. Fix all of cables.
    - nylon tie

Do **not** install propellers!

SDK set of quadrotor

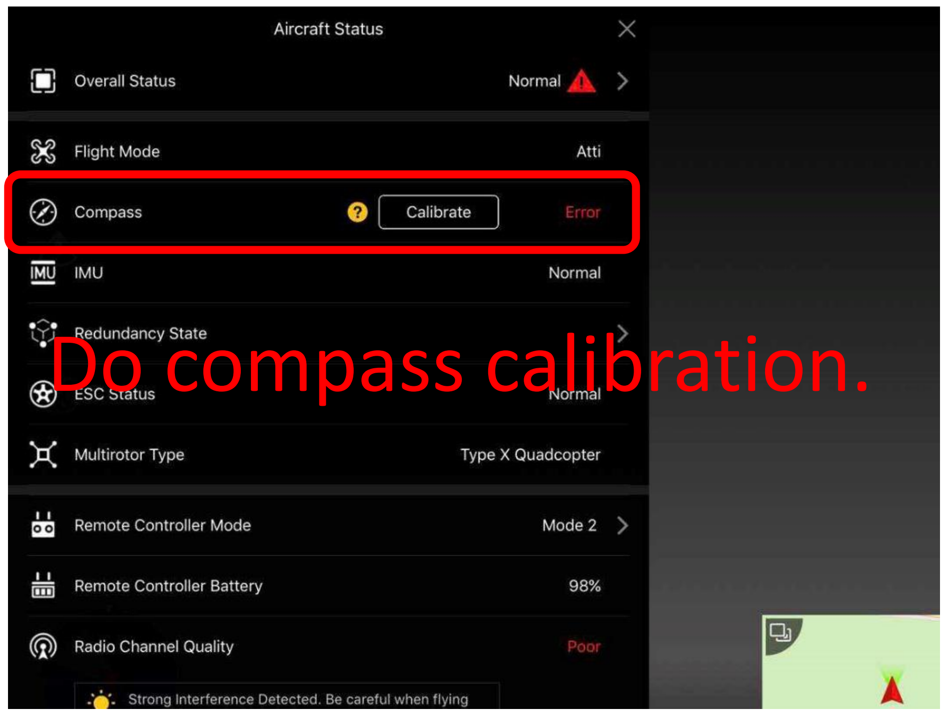
1. Setup and check your aerial robot.



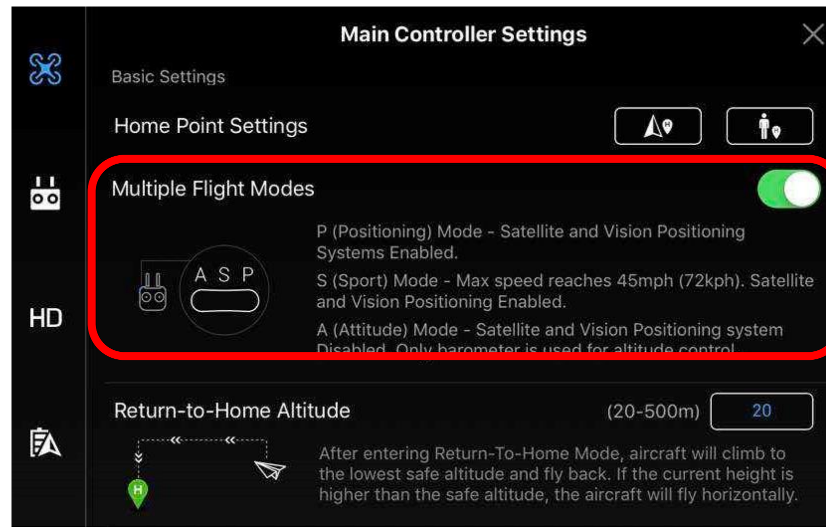
SDK set of quadrotor

2. Setup and check your aerial robot.
   Your Mobile device, both IOS and Android are suitable
   DJI GO

Now you can install propellers.



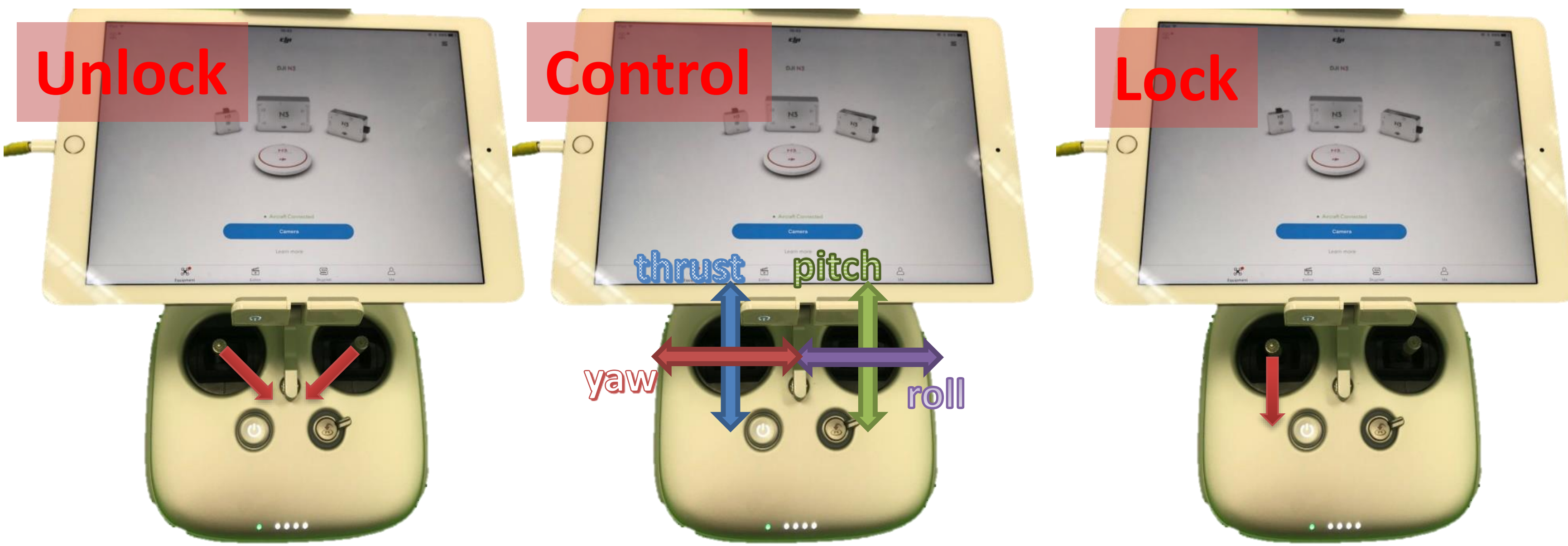
Do compass calibration.



First flight of quadrotor

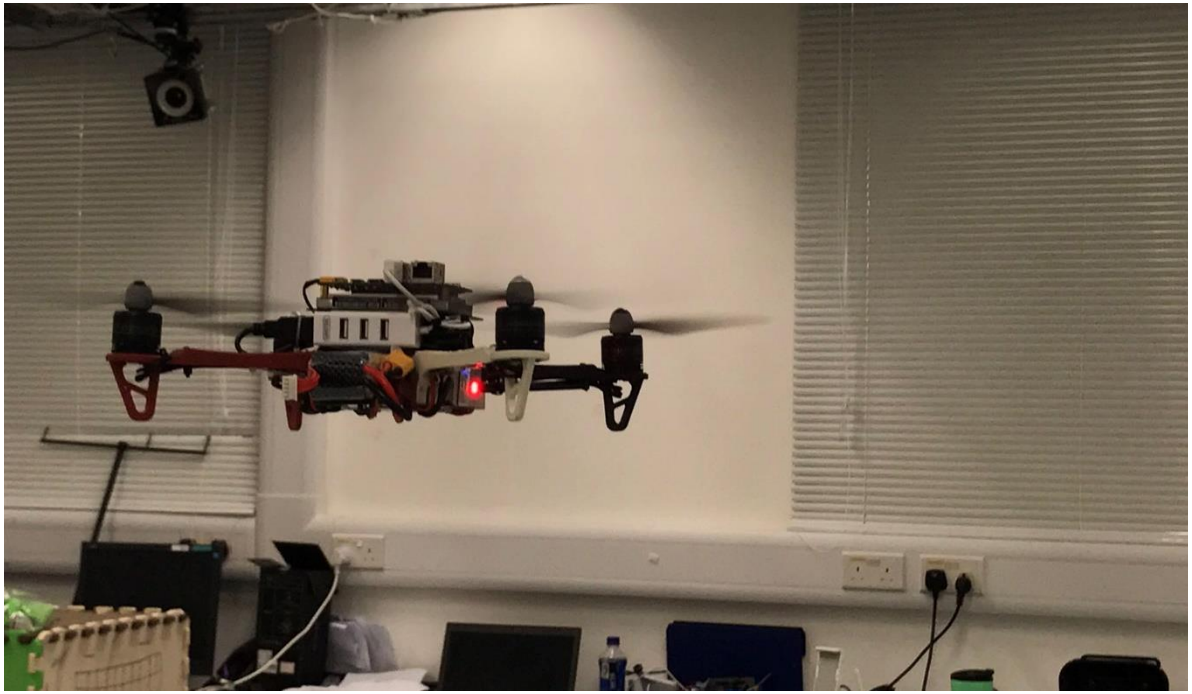
3. Unlock the quadrotor.

4. Control and have fun.



First flight of quadrotor

Enjoy it~



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