MEAM620 - Spring 2015
How Not to Hurt Yourself or the Robots

Prof. Vijay Kumar
kumar@seas.upenn.edu

1 Ground Rules

In this article, we will enlist some of the fundamental safety precautions and procedures you must follow when using the MEAM620 robots at MRSL.

1. Work on the projects **only** in your allotted time-slots, even if you have swipe access to the lab.
2. Safety Goggles (provided) **must** be worn at all times.
3. Log in to **your team** account on the MEAM620 computer.
4. **The quadrotors are very expensive. Handle them with care.**
5. **Do NOT attempt to fly the quadrotors manually.**
6. One team-member must have the Radio-Controller (R/C) in their hands at all times when the robot is flying. This is to turn-off the propellers in case of a crash.
7. The team member running the experiments should be ready to hit the Kill-Switch in case anything goes wrong.
8. Once you have the robot,
   (a) Inspect it for damages.
   (b) Make sure all the propellers are in good condition. Minor dings and dents are OK.
   (c) Finger-tighten the nuts on the propellers to make sure they don't come off during flight.
   (d) Insert a fully charged battery from the "Charged Batteries" bin and secure it in the battery holder underneath the quad.
   (e) After successive flights, place the exhausted batteries ONLY in the "Discharged Batteries" bin.
9. Before every flight, make sure the front of the quadrotor (marked in **GREEN**) is pointing away from your workstation.
10. If the robot starts beeping, its likely exhausted its battery. Land **immediately** and replace it with a charged one. Follow instructions 8d and 8e.
11. In case of a crash inside the net, turn off the propellers **immediately** to prevent further damage.

2 After a Crash

1. **Hit the Kill-Switch immediately**
2. Make sure the propellers aren't spinning.
3. Flip the "Gear/F-Mode" switch on the R/C down or away from you.
4. Hold the "Throttle Lever" (left joystick) to the bottom-right or bottom-left corners till the robot beeps twice.
5. Turn the robot off **before** picking it up from the net.
6. Disconnect the battery and inspect it for damages.

7. It's OK if you crash. **Be responsible, and inform your TA.**
8. If you lose any propellers, refer to the Replace Propellers[3] section.
9. The robots use extremely flammable Li-Po batteries. In case of a fire, use the fire extinguisher placed under the bike rack or one in the hallway outside the lab.

3 Replacing Propellers

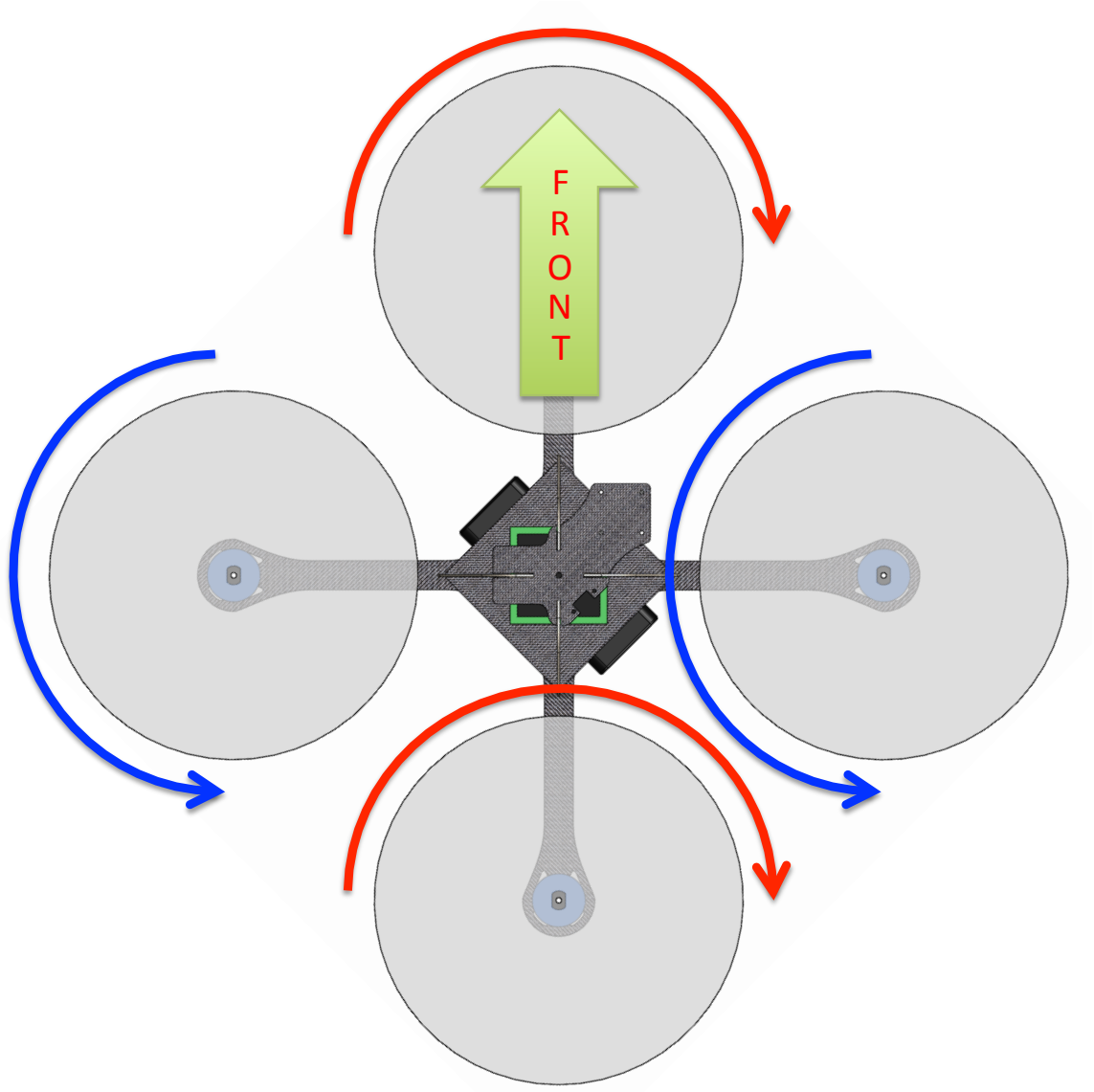
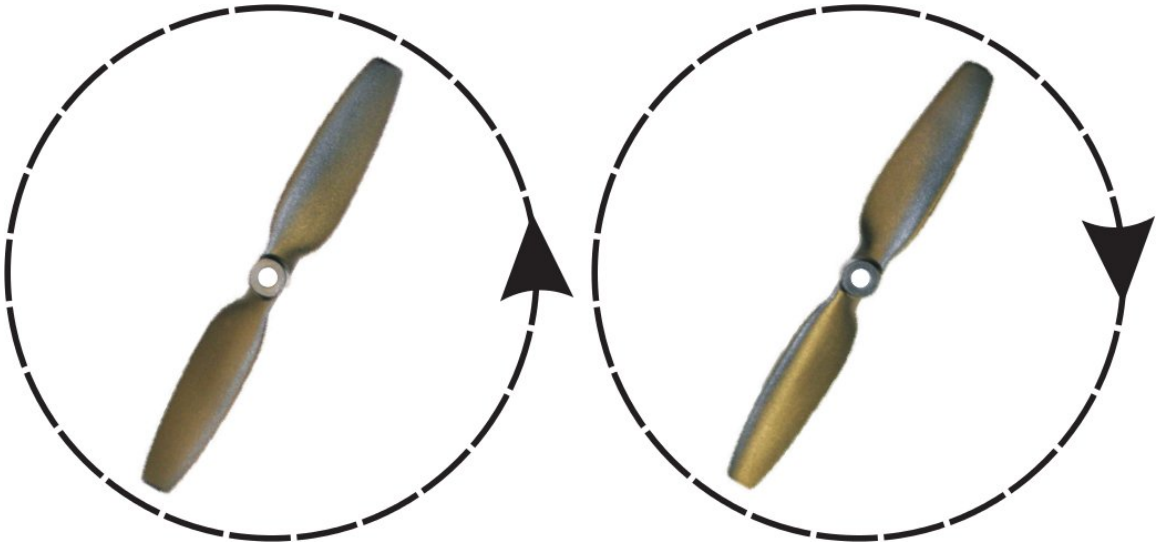
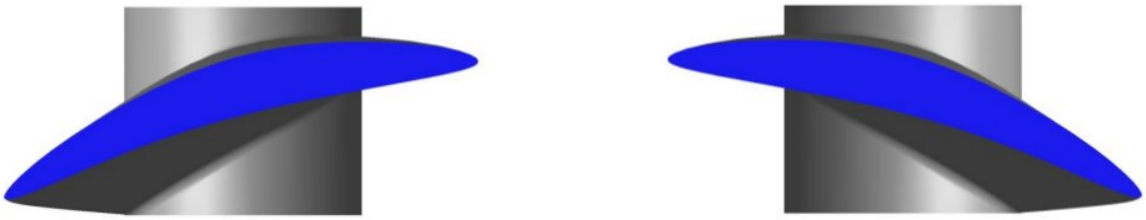


Figure 1: Orientation of Propellers on the Quadrotors (Top-Down View)



(a) Top-Down View of Counter-Clockwise (CCW) and Clockwise (CW) Propellers



(b) Cross Sectional Front-View of Counter-Clockwise (CCW) and Clockwise (CW) Propellers

Figure 2: Identification of Propellers

1. Unscrew the nut on the motor. (Keep it in a safe place. You need it again.)
2. Remove the broken propeller and beware of sharp edges.
3. Identify the direction of rotation of the broken propeller - Clockwise (CW) or Counter-Clockwise (CCW).
4. Pick out the correct propeller from the bins on your work bench.
5. Secure it on the motor with the nut, making sure it is finger-tight.
6. Spin the propellers on **IDLE** throttle and confirm your selection of the propeller. If you need help or are getting confused, always ask!