

PRG Safety Manual: Aerial Robotics

IRB Brin Lab



Perception and Robotics Group
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1 Protocol Zero: Ground Rules

In this document, we will lay down the elementary precautions, procedures and rules you **MUST** abide while working at **Brin UAV Lab (IRB 0108)** for your own safety, safety of others around you and the robots itself.

1. Work **ONLY** on the projects allocated to you. **DO NOT** touch any equipment that does not belong to your project. If you need it, kindly ask the individual who owns/using it. If you have any doubts regarding any equipment, please contact the authors of this safety manual.
2. **ALWAYS** wear full toed shoes while working in the lab.
3. **DO NOT** wear loose clothing which can get stuck in moving parts and equipment.
4. Tie/Cover any loose hair so that they do not get stuck in moving parts and equipment.
5. **The quadrotors are very expensive and delicate. Handle them with care.**
6. **NEVER** attempt to fly the quadrotor outside the netted area.
7. **NEVER** attempt to fly the quadrotor while anyone is inside the netted area. Make sure there is nothing inside the area except the quadrotor. Expensive equipments such as Vicon cameras and LIDAR must be stored/mounted at least 3-4 ft. away from netted area.
8. Our primary aim is to make quadrotors fly autonomously in an unknown environment. Using transmitters/controllers for manual flight is **NOT** allowed unless you have an RC license. Please contact the authors of this article if you need to control it manually, especially for tuning the gains for your autonomous controller.
9. **NEVER** fly the quadrotor alone. Make sure a lab-mate is ready to hit the Kill-Switch in case anything goes wrong.

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10. Before every flight, make sure the forward direction of quadrotor is facing away from you and your lab-mates.
11. **NEVER** fully drain the battery. For a LiPo cell or 1S battery:
 - Fully Charged: 4.20V
 - Nominal (half-charged): 3.70V
 - Fully Discharged: 3.00V

Equivalently, a typical 3S (or 3 cells) LiPo battery is fully charged at 12.60V and fully discharged at 9.00 V. **NEVER** discharge the battery completely. The voltage (for 3S) **MUST** remain above 10.20V. It is recommended that you monitor the voltage of the battery in your code and land it as soon as the battery drops below 9.5V for a 3S battery or equivalent.
12. Charging the battery: **NEVER** charge the battery more than the ‘fully charged’ mentioned above. While charging the battery, the charging current rate **MUST** be under the limit, i.e., 1.0-2.0A for a 1500mAh battery (recommended). Refer to the battery datasheets for safe charging current.
13. Always keep the battery in the LiPo sack while charging the batteries. These LiPo sack **MUST** also be used to store the batteries. **NEVER** keep it connected to the quadrotor for long durations.
14. If the battery is not be used for a long duration, keep it at the nominal voltage charge to ensure longevity of the battery and store it in a LiPo sack.
15. Safety Goggles and Earmuffs **MUST** be worn at all times.
16. Before every flight, check that the nuts/propellers are *finger-tightened* properly so that they don’t come off during the flight. Losing propellers from the quadrotor during the flight can result in **FATAL accidents**.
17. If the quadrotor starts beeping, **land it immediately**. Most likely, the battery is almost exhausted or it has gone to failsafe mode.
18. In case of a crash, first disarm the quadrotor from the transmitter and then remove the battery before inspecting anything.
19. You **MUST** assign a digital switch on your transmitter to ARM/DISARM the quadrotor. Never use the analog joystick to disarm.

2 After a Crash

Follow the underlying instructions in the order mentioned below:

1. **Hit the Kill-Switch immediately**. And DISARM the quadrotor from the transmitter as well using the digital switch assigned for ARM/DISARM.
2. Make sure the propellers aren’t spinning.
3. Make sure the ‘throttle stick’ (usually the left-joystick) is set to minimum.
4. Wear the gloves.

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5. Hold the quadrotor from below (away from the propellers) and disconnect the battery plug from the quadrotor.
6. Inspect for damages
7. Once the quadrotor is inspected, remove the propellers and try to ARM it once and check for any abnormalities. If there are none, put back the propellers (make sure the battery is not connected).
8. Make sure the propellers are finger-tightened properly before you fly again.

Aerial robots use extremely flammable Li-Po batteries. In case of fire, use the fire extinguisher placed outside the netted area. DO NOT use water or any liquid to extinguish the fire. In case of any injuries, please use the medical kit placed next to the entrance door or call 911.

I have read the aforementioned instructions and I will abide the set guidelines.

Name

Signature

Date



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