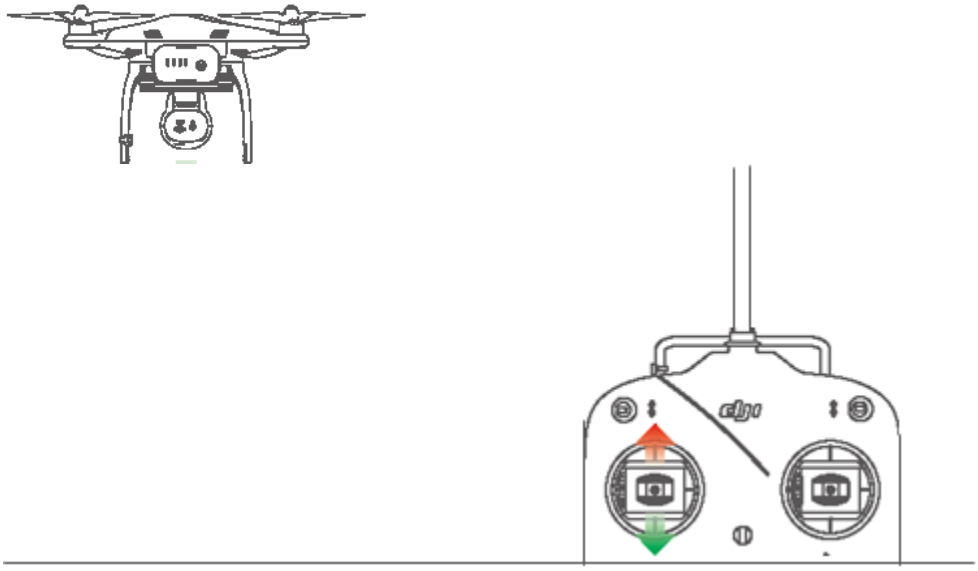
Last update: 21 Aug 2019

ABILENE JROTC (TX-081)

MULTICOPTER TRAINING EXERCISES

Exercise 1: Takeoff and Landing



Always confirm that the conditions for flying are safe and you have a qualified observer (no people entered the flying area without you noticing as you were focused on the model, nose of model is pointing away from you and into the wind, nothing hanging loose from the model)

If the flying conditions are still OK, switch the motor on, do not use auto-take-off for this exercise. Increase the throttle stick until the model gets light on its feet. Increase the throttle stick a little bit faster so that the Phantom quickly lifts off. You want it to go to an altitude of 3 feet or more to get out of ground turbulence caused by the downward airflow from the propellers. Once you are at 5-10ft, GRADUALLY reduce the throttle to slow down the ascent, and GRADUALLY decrease it further to descend slowly land again. Do NOT suddenly decrease the throttle or you will crash. If you start descending too quickly, increase the throttle a little bit to slow down the descent.

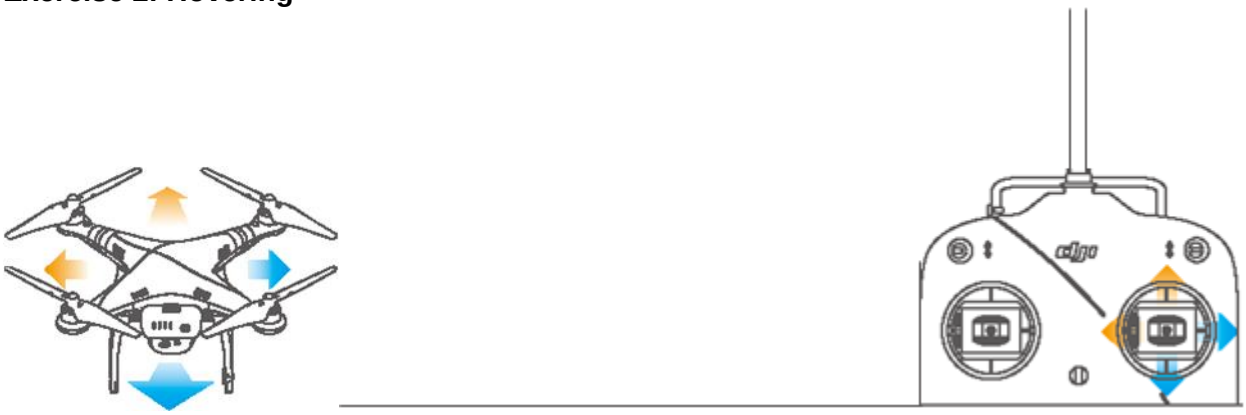
If the copter drifts a bit during this phase, just re-position it on the ground between take-offs. Don't try flying it back to its starting position. Practice lift-off and landing repeatedly until you can fully control it and landings are soft and smooth. Reduce the throttle to idle between landings and recheck the environment!

If for some reason something goes wrong and the copter lands on its side or upside down, IMMEDIATELY turn off the motors (throttle stick full down) to avoid unnecessary damage to ESCs, propellers or motors. Reposition it, and check for damage. Reposition yourself and recheck the environment. Restart the motors and restart lift-off and landing practice.

Remember: *Small stick movements!*

If you can't get the Phantom back to its starting position, it is safer for both the copter and yourself to land, manually reposition it and restart, rather than to continue to try and correct drift which could lead to disorientation followed by crashing the model into the ground or yourself.

Exercise 2: Hovering



P-GPS mode-Once you are comfortable with takeoff and landing, it's time to practice one of the important maneuvers, hovering. With the Phantom pointed away from you and at chest height to avoid ground effect, hold the aircraft in a hover. This is called nose-out flying and is the easiest way for new pilots to get a good feel for the aircraft. With the nose continuing to point away from you, lightly maneuver roll left and right, and pitch fore and aft. Practice this for 10 minutes.

Hovering an UAV means that in addition to the self-stabilization by the flight controller you provide some additional (but minimal in P-GPS mode) control inputs to keep the copter over the same spot on the ground at the same altitude. Carefully combing the roll, pitch, yaw and throttle inputs to correct drift in any of these four axes, trying to keep the model in a stable hover at between 1 and 2 meters above its take-off position. If the craft moves too far out of the hover area, just land and reposition it.

Hovering is a very critical flying skill so practice it extensively. It may require several hours of practice under different conditions to master it to such a degree that even in some wind you can keep the model within 20cm of its intended hovering position. If you can do this well, you will most likely be able to get out of trouble during other maneuvers by going into a hover quickly, reassessing the situation, and flying to a safer position or landing spot.

At first, just practice over the general area of your starting point. Later consider marking a point on the ground (e.g. a helipad made from plywood or canvas, or a pylon or plastic bottle) and hover exactly above that point. You may be surprised how difficult it can be to stay correctly above a clearly marked spot for several minutes.

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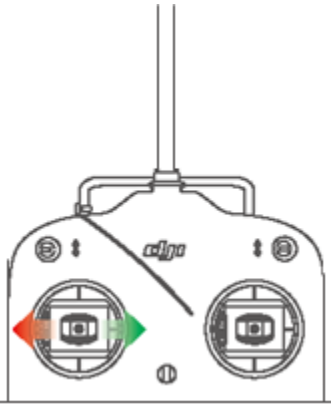
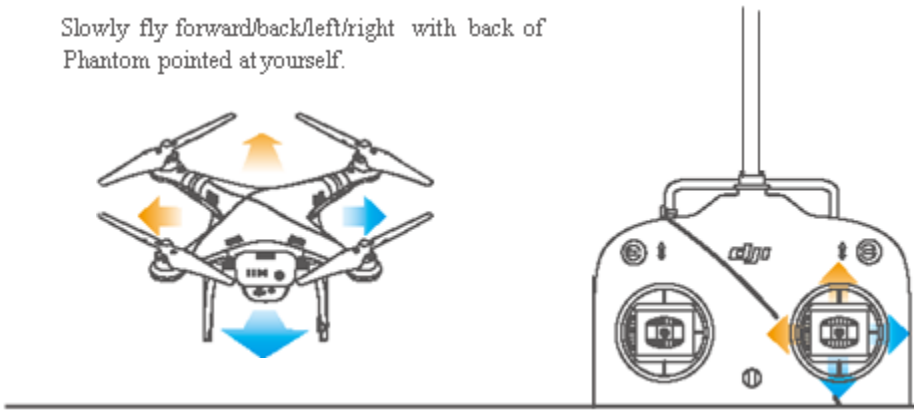


Once you can control the Phantom left/right and forward/backward, do some practice on rudder / yaw. From a hover position, carefully move the rudder stick to turn the nose of the copter approx. 45 degrees to the left or right, and then yaw back. You do not yet want to go further than 60-70 degrees because you will quickly run into control reversal with the nose pointed at you and become disoriented.

Exercise 3: Forward/Back/Strafe (*sideways movement using roll*)

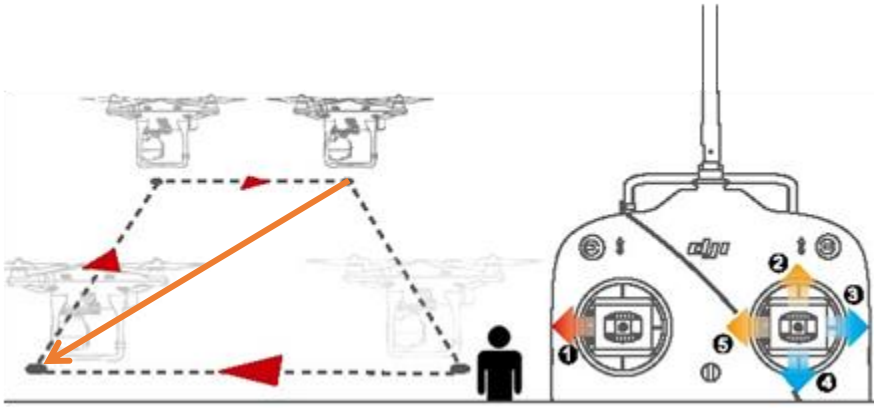


While maintaining altitude and keeping the rear of the aircraft facing the pilot, using the right stick gradually move the PHANTOM forward a few feet, then back to the starting position, then move laterally left and right a few feet (strafe). Do this repeatedly until you can do it easily, ending the movement over a pre-determined spot on the ground. Once you are comfortable, increase the distance until you have reached 50 feet away in every direction, always ended at the starting point. Finally, mark spots 50, 80, and 100 feet away. Fly to those spots, land, take-off and return to the starting point, fly to the next spot, repeat several times until comfortable. Work towards increasing forward speed, while stopping over the spot, on subsequent flights.

Exercise 4: House pattern

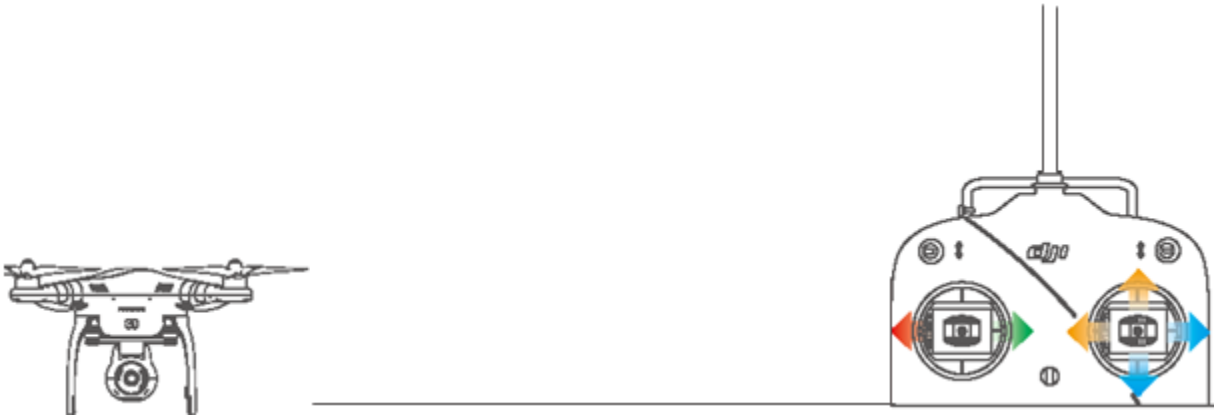
A typical flying maneuver is the "house." Lift-off, at about chest height hover for about 5 seconds, then fly 3-4 meters sideways, again hover for about 5 seconds and land. T hen do the same in opposite direction. Keep the nose pointing away from you (tail-in).

Exercise 5: Square-Flying



Start with battery facing the pilot go into a hover. Then rotate the PHANTOM 90 degrees left and fly a four-point 10 foot square pattern going clockwise. Fly along the borders of a square and break at the corners, do not overfly the corners, for about 5 seconds. The nose always points away from the pilot's position. Repeat this exercise for 5-10 minutes. Then repeat going to the right, counter-clockwise. Be sure to maintain altitude. For a variation of this exercise, add in pre-planned diagonals from corner to corner. As you advance, try increasing airspeed.

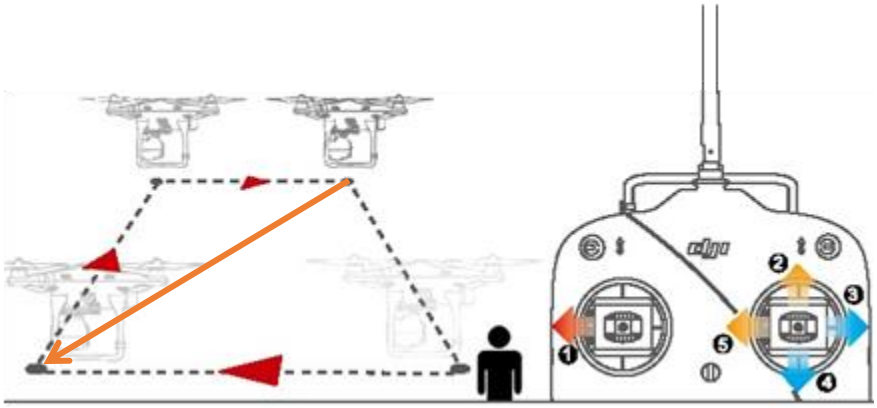
Exercise 6: Reverse Command flying



Perform the basic maneuvers with the camera facing the pilot. Starting with takeoff, then landing and proceeding to hovering, forward/back, strafe and house pattern until comfortable. Basic competence is reached when the instructor calls out a maneuver and the student reacts instantly and correctly, there is no hesitation while the student mentally “turns the picture around.” Proceed with caution, move slowly, this is the phase were most accidents occur.

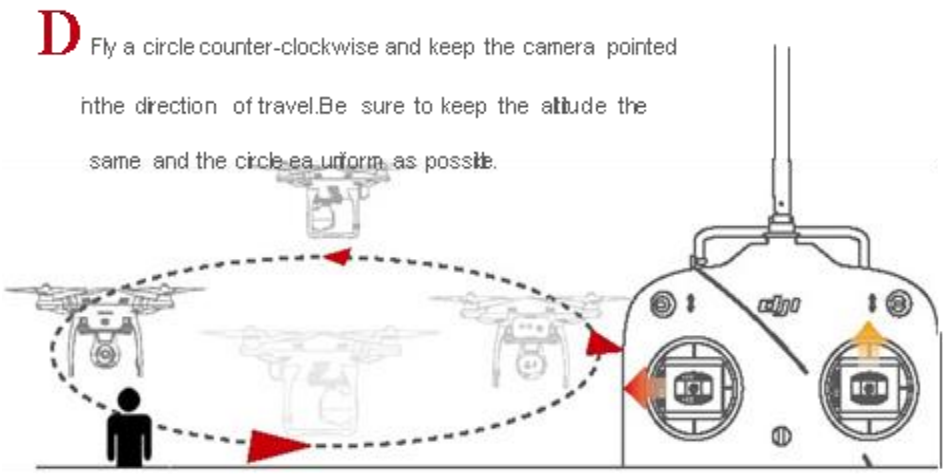
Once the basic maneuvers are mastered face-in, the student is ready to move to Advanced Flying.

Exercise 7: Advanced Square-Flying



Same as Square Flying except keep the PHANTOM camera facing the pilot to practice reverse commands.

Exercise 8: Circles

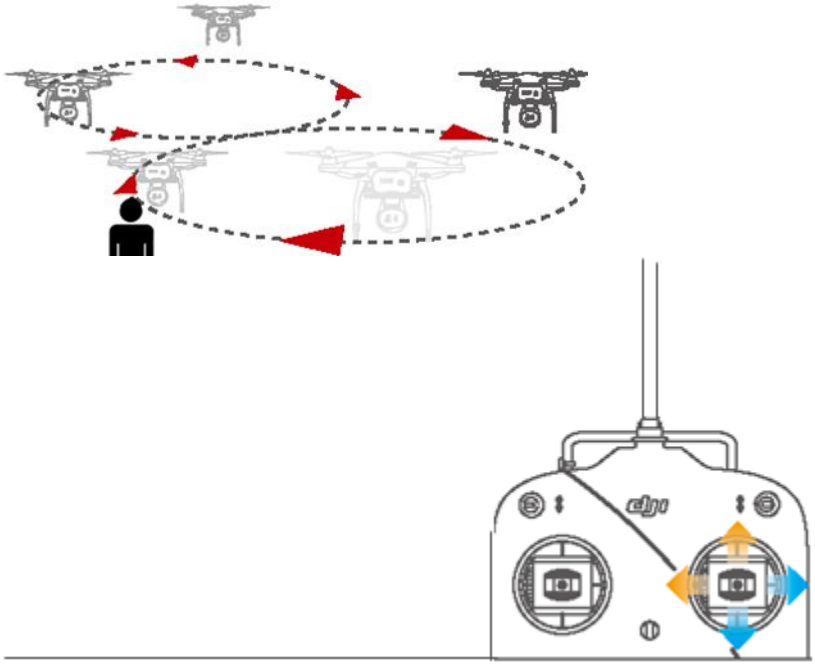


Plot out or envision a 50 ft circle on the ground. Take off and fly the circle, keeping the nose pointed in the direction of travel, alternating clockwise and counter clockwise. Maintain altitude and constant airspeed, keeping the circle uniform. Practice with nose-out and nose-in. Advanced versions are to increase airspeed and decrease the radius of the circle. Next, fly the circle with the camera pointed at the pilot standing outside the circle.

Exercise 9: The circle me

For the circle me, the intent is to fly a full circle around yourself, or another given target, at a fixed distance and yawing at a same angular rate as the craft is moving through the circle. So if you fly it tail-in, the craft should be looking straight out from the circle (and if shooting video this would result in a wide panorama). If flying nose-in it should be looking you at all times. Maintain a constant altitude during this exercise.

Exercise 10: Figure Eight



1. Fly a figure 8 without rotating the Phantom. Be sure to keep the altitude the same and the circle as uniform as possible.
2. Fly a Figure 8with the camera of the Phantom pointed in the direction of travel. Be sure to keep the altitude the same and the circle as uniform as possible.
3. Fly Figure 8patterns while experimenting with different orientations. For example, camera always pointed in a given direction or opposite/left/right the direction of travel, etc. Be sure to keep the altitude the same and the circle as uniform as possible.

Exercise 11: The walk-along

For the walk-along you walk along a path with the PHANTOM tagging along at a fixed position in front, or next to you. If you reach a corner, yaw the PHANTOM to be tail-in or nose-in or sideways again, whichever mode of flying you want to practice. The change in relative positions between you and the model forces you to focus on the model and not orientate your control movements to the position of the model relative to its surroundings.

Exercise 12: Circle Me

For the circle me, the intent is to fly a full circle around yourself, or another given target, at a fixed distance and yawing at a same angular rate as the craft is moving through the circle. If you fly it tail-in, the craft should be looking straight out from the circle (and if shooting video this would result in a wide panorama). If flying nose-in it should be looking you at all times. Maintain a constant altitude during this exercise.

Exercise 13: Return to Home (RTH)

Smart RTH – *Requires GPS fix before takeoff and functional GPS and compass in-flight.* Test RTH by using the RTH button on the controller (the button will flash) or in the GO app. Press the RTH controller button once to take control. When RTH is initiated, the P3 will climb to RTH altitude and return to last recorded Home Point. You may use the controller sticks to change altitude or fly around an obstacle while in RTH. ***CAUTION*** - *Make sure the RTH altitude defined in the GO app is correct; the P3 will not automatically avoid obstructions during RTH!*

Failsafe RTH – Test Failsafe by turning off the controller for more than three seconds. *Proceed with caution; make sure you first completely understand Failsafe behavior*. Failsafe is triggered in two circumstances, one being when the battery is drained to a point that may affect the safe return of the aircraft, as determined by the aircraft's altitude and distant to the Home Point. The low battery warning is displayed on the GO app. Failsafe is automatically triggered if no action is taken within 10 seconds of the warning. ***CAUTION*** - *The aircraft will land immediately if the current battery level is critical and can only support a descent from altitude, even it is over water*.

The instance that Failsafe is triggered is when the remote controller signal is lost for more than three seconds. The aircraft will climb to RTH altitude and proceed to Home Point. If the aircraft is within 65 feet of Home Point when Failsafe is triggered, the aircraft will descend and land immediately.