Drone Piloting 101

Description

Drone Piloting 101

I learned the hard way so that you donâ??t have to.

Material is based upon the DJI Mini series.

Intro

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A successful drone mission can involve mitigation of many factors. A single element can be the difference between success and failure.

Mindset

Whether it be drones or general aviation, flying is a perishable skill. Getting out flying regularly is a critical element to build confidence and skills!

Lies youâ??ll tell yourself

- Iâ??m afraid of losing my drone
- The weather isnâ??t nice enough
- Its too cold, too hot
- Iâ??m not good enough
- My drone isnâ??t good enough
- Iâ??m bored of my local area

J*ust get outside and fly!* Even if this means filming a time lapse or going up for 10 minutes to see if thereâ??s anything interesting on the horizon. Half of life is just showing up..

There have been many times Iâ??ve hesitated, only to capture some of my best content. Boredom is a great exercise in working with what you have.

Tips: Finding inspiration

- Bored of your local airspace? Drive a mile away.
- Experiment with difference settings and angles.
- Shoot from ground level.
- Use a drone feature youâ??re unfamiliar with .

Flying

Practice

Find a place where you can practice uninterrupted, away from wires, people, animals and signal interference.

Flight Planning

Prepare for your mission .

- Review maps of the target area (in the USA with AirAware)
- Check for TFRs
- Scan airspace for items of concern (prisons, schools, airports, heliports)
- Clean the lens, filters and sensors
- Calibrate the drone & controllers, if applicable
- Check drone, props, battery for damage.

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Pre Flight

- Get a stable GPS fix! It only takes a few more moments to lock in a few more satellites. Losing control due to lost position is a classic way to crash
- Check for obstacles such as people, wires, cables, vehicles & animals. Use flashlight if necessary. Walk the terrain.
- Prepare takeoff and landing area in an open space
- Tighten control sticks, unfold antenna, unfold the props, clean your lens and filter
- Configure Return-To-Home height (See also: RTH)
- Start screen recording
- Update camera settings, ISO, frame rate, exposure

Wires and Cables

This is a great video about wires and general aviation, however theres a lot to learn here for us as well!

Take off

- Place aircraft on a flat surface, ideally on a landing pad.
- Set flight mode (eg: cinema, normal or sport)
- Look around, did you miss any wires?
- Listen for approaching aircraft
- Confirm recording
- Confirm flight mode
- Start motors
- Take flight

In the air

- Set desired mode. Get out of Sport mode unless you really need to fly fast.
- Check your surroundings again
- Understand the minimum heights for the airspace

Navigation

Its important to avoid spatial disorientation. To help yourself get started, insert a step into every move you make.

Rewire your brain

- Look at the drone.
- Determine which relative direction the aircraft needs to move
- Tell yourself â??move <direction>â?•
- Translate that into controller actions.
- This will become instinct with practice

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Learn to read your instruments

- The center of the crosshair is accurate for determining relative distance between obstacles.
- Altitude and distance controls will ideally be stable when hovering. Rapid fluctuations of altitude and distance can indicate that your footage may be jerky or the winds too fierce for flying.
- Obstacle detection is usually accurate
- Learn how your drone and batteries perform under different conditions

Forward motion

Cinema mode

When filming youâ??ll generally want to fly in Cinema mode. This mode includes obstacle detection and helps to produce smooth footage and minimize mistakes. You can always speed up the footage in post production.

Normal mode

- Includes obstacle detection
- Is a decent tradeoff between Cinema and Sport

Sport mode

- extremely fast
- No obstacle detection!
- Stopping will be degraded with the extra forward motion

Sideways

The goal here is to use subtle sideways controller movements without making the viewer sick.

Backwards

This is dangerous for all drones due to the lack of visibility, especially in those models without rear-facing sensors.

If a scene requires flying backwards, turn around and fly the path in forward to identify any obstacles and get a better feeling for the space youâ??re operating in.

Preventing Crashes

Youâ??re going to crash if you fly enough. Donâ??t let this be a discouragement. You should hopefully crash less and less as your skills progress. Get insurance and move on!

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You cant crash if you dont fly.

â??A superior pilot uses their superior judgment to avoid situations which require the use of their superior skillâ?• â?? NASA astronaut Frank Borman

Tips: How not to crash

- Dont fly when youâ??re tired or distracted or otherwise impaired
- Avoid night flying
- Donâ??t squeeze in that final flight of the day.
- Donâ??t panic, if youâ??re confused take your hands off the controls
- Leverage RTH when it helps to reduce workload
- Know where you are and be aware of nearby obstacles!
- Fly directly overhead to limit the risk to people and property
- Donâ??t catch the drone with your hands unless its an emergency
- Get yourself in the takeoff & landing areas to better understand the space

Batteries

Batteries are extremely important when it comes to drones. Your foremost task will be managing, charging and cursing batteries.

<inspect battery for fit, does it feel firm in the drone? are any of the clips damaged/cracked?

<How to view cycle count, various messages: too many cycles>

Battery Lifetime

After about 200 flights the controller will warn that youâ??re approaching EOL for the battery. These batteries will continue to work but are getting to a point where they probably shouldnâ??t be trusted . â??

Older Batteries

Batteries with high cycle counts can be kept as backups or be used in the smart charger to power devices on the ground. Batteries appearing swollen are a fire hazard and should be discarded.

Tips**: **Batteries

- Label your batteries with a permanent marker!
- Lion Batteries are programmed to discharge over time . Always pre-charge all of your batteries before a mission to bring them to 100%! Never assume your batteries are fully charged.
- Number your batteries and write their cycle count on the shell from time to time.
- Stripe your battery usage across your batteries with a goal of keeping the cycle count uniform.
- The clips on some batteries are prone to crack. Examine them pre-flight.

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Other Equipment

Controllers

RC vs RC2, RC3 . Both work fine. You canâ??t load 3rd party software onto a RC2 or RC3 controller. Youâ??ll need to load that software onto a dedicated android app and use a usb cable to connect to the â??headlessâ?? controller.

Landing pad

This is something that sounds optional but is actually pretty important! Ensure that your landing pad is level, especially when the ground is wet, dirty or snow covered. You donâ??t want your drone sliding sideways upon landing. Donâ??t find yourself like me in a damp forest trying to find a suitable takeoff location.

I really like this LED landing pad for day and night use.

Lanyard

Your hands are going to be full as a pilot. Your drone is expensive and much more fragile than the contoller and youâ??ll want your free hands dedicated to that. Youâ??re also less likely to bump the sticks during a long shot if you arenâ??t touching the controller! This is a cheap item to purchase well worth the money.

Props

Props are easily damaged so always have a spare set on hand. This holds especially true in extreme colds where plastics become brittle. The tip of each screw thread should have a tiny dab of blue thread-locker. Iâ??ve never personally seen these screws loosen on their own.

Aftermarket props more durable but dont let them get too banged up. The DJI OEM props have batch numbers engraved on each and should be installed together from the same batch.

The OEM props are a bit more delicate than those sold by Master Airscrew, but also more forgiving in terms of injury. The props can easily draw blood from your fingers..

Tips: Prop installation

- Be careful not to cross thread the hardened steel screws into the soft aluminum drone body. If you feel any resistance youâ??re likely doing something wrong!
- Each prop should have a tiny dab of blue thread locker on the end.

Filters

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Youâ??re going to read a lot about ND filters, for some its a religion.

Know why youâ??d want ND filters.

Whatever filters youâ??re using, make sure that the filters and lens are clean!Getting into the air with dirty filters is disheartening .

Weather

Wind

The wind is a major factor in flying any aircraft.

Its important to trust your gut. Donâ??t fool yourself. When in doubt, donâ??t fly! This is a great general aviation video demonstrating when to trust you gut .

Tips: Windy Days

- Look to weather forecasts, flags, treetops and other visual indicators for cues
- Donâ??t forget satellite maps along with radar. This is especially useful for predicting cloud cover.
- Before and after storms is often the most beautiful time to fly, so be ready for small windows even if the forecast isnâ??t great!
- Fly into the wind in extreme conditions to ensure your ability to RTH
- Some areas such as beaches may have high winds only at the surface.
- Wind speeds often increase at higher altitudes.
- Conditions can change quickly, your pre-flight may not be enough

- High winds can impact the ability of the gimbal to maintain a stable view. In these cases use the controller alone and visual cues to bring the aircraft down safely

Moisture

Despite your best intentions, your drone will eventually encounter some moisture.

Tips: Drying your drone

- Run the props as much as possible in the weather, including before takeoff and after landing
- Wipe surfaces with a clean, dry microfiber cloth.
- Remove the battery and SD card and set them aside
- Use cotton swabs for sensors and hard to reach areas
- Run a hair dryer on **cool** mode to blow away remaining moisture
- Set the aircraft away in a dry, safe location for several hours

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Snow

Flying in the snow is beyond the scope of this document.

(See our advanced guide)

Loss of signal

You generally lose video signal before the control channel. This is an early warning sign to get back closer to home or away from whatever is blocking the radio path.

If this happens dont panic, hit the return to home button and let the aircraft get closer to you.

Flying higher will generally give you a better signal path around hills, trees and obstacles.

Finding your Lost drone

Sooner or later you will lose your drone nearby, but finding it isnâ??t always as simple as it seems.

(More information available in the 102 Advanced Course)

Return to home

DJIâ??s Return to Home (RTH) brings your drone back to its takeoff point automatically in emergencies or manually when triggered. .

Set the RTH altitude above the height of the tallest obstacle in your flight area!

To determine this number in a new environment, perform a pre-mission flight and use your instruments to measure the height of obstacles. This is also useful for generating content above the tree canopy with less risk of running into something.

To avoid accidents, always preset the RTH altitude higher than the tallest obstacle in your area (e.g., trees, buildings) and ensure the Home Point GPS is locked before takeoff. If you move away from the takeoff point youâ??ll want to reset your home point. This is especially important for boats or when in movement.

While RTH can be a great tool for CRM, youâ??ll almost always want to cancel RTH when out of trouble and hand fly the landing. RTH is not perfect and can land your drone upon landing if youâ??re not careful.

Photography

Exposure

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How the drones fixed aperature works. Basic photo stuff with iso, aperature, shutter speed and references.

ISO

ISO is a fundamental camera setting that controls the sensorâ??s sensitivity to light, directly affecting image brightness, quality, and noise. A lower ISO (e.g., 100-200) is used in bright conditions for maximum image quality, while a higher ISO (e.g., 1600+) enables shooting in low-light environments but introduces digital noise or â??grainâ?•.

Auto Mode

In auto mode the ISO and shutter speed are controlled automatically by the camera. This approach generally produces good results, but itâ??s important to understand the limitations.

When your camera is in â??Autoâ?• mode, its internal light meter calculates the exposure by scanning the scene and mathematically averaging the brightness of all pixels to a â??middle grayâ?• (about 18% gray). It essentially adjusts your cameraâ??s settings to achieve this standard, balanced brightness across the entire frame. â?? https://www.youtube.com/watch?v=H1l7mV2y-zI&t=65s

In a way, auto mode can rob your content of its highs and lows as it constantly tries to even everything out.

When to use auto mode

- Short clips,
- Fast subjects
- Rapidly changing light

When results might be less ideal

- Snow
- Reflections on glass or water
- When the frame moves rapidly between the ground and sky .
- Fog, Mist

Pro Mode

There are times when you donâ??t want the camera averaging everything together.

When using a fixed shutter speed you may encounter situations where you settings end up with either blown out or underexposed content before the recording ends. Sunrises and sunsets are the primary consideration.

FOCUS

How to focus manually.

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Light

(Sun intro, sunset, sunrise, reading the sun.)

When in doubt, underexpose. You can always brighten the footage later but you wonâ??t be able to add lost detail if the scene is too bright.

Avoid shooting into the sun if you can avoid it. When necessary use ND filters to darken the view, but this doesnâ??t mean you still canâ??t get blown out footage.

Use satellite radar and cloud cover in an attempt to predict what the sun will do next.

Composition

This part is actually pretty important. You can always adjust lighting and color values in the editor, but if you donâ??t have the right stuff in the frame youâ??re going to have a bad time.

Fill the frame!

Ask yourself, what is it that youâ??re attempting to showcase? The barn in the field? The clouds? The entire overall scene?

Thereâ??s always a compromise..

Want to show the whole scene? Youâ??re potentially not filling the frame with whats important? Want to focus on one element? Youâ??re missing the whole scene.

Sometimes you want to be at either extreme, sometimes you want to be right in the middle. Thereâ??s no right or wrong, just be aware of the reasons behind your decision.

The Rule of 3rds

The rule of thirds is a fundamental composition guideline that divides your frame into a (3Ã?3) grid with two horizontal and two vertical lines. By aligning your subject along these lines or at their intersections, you create dynamic, visually balanced images that naturally draw the viewerâ??s eye.

(Tips: Composition: enable grids crosshairs, this helps with tight navigation as well.

AEB

Auto Exposure Bracketing (AEB) is a camera feature that automatically captures three (or more) consecutive images of the same scene at different exposure levels â?? typically one under-exposed, one properly exposed, and one over-exposed. It is essential for creating high-dynamic-range (HDR) images in tricky lighting, allowing photographers to select the best shot or blend them later to capture highlights and shadows

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Panoramas

Itâ??s not hard to shoot a few panorama photos along with video. This is something to do at the end of a session to maximize your last few minutes of battery life.



Videography

(Intro)

- Cinema mode for smoothness and safety
- Smooth movements
- Motion blur
- Donâ??t make the viewer sick

Tips: Filming video

- Always be recording!
- Stop and start recording in between major scenes. This will begin a new file and help you later when it comes time to edit. This also helps to prevent corrupt files
- Are you really recording? Itâ??s easy for recording to stop or never be restarted!

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Gimbal Control

Manipulating the gimbal is one of the more challenging aspects of filming drone video.

Use very subtle gimbal movements, it helps to lock your left index finger firmly on the dial and pull down or up ever so slightly. Itâ??s easy to abuse the controls, leading to jerky footage.

The wind can impact the gimbals ability to stabilize the camera enough to safely fly via the controller screen. In these circumstances it is best to not panic and fly the drone visually without use of the screen.

These drones can handle some relatively strong winds, but when the gimbal starts jerking around its generally time to get home. **See also: Wind**

Common Photography Mistakes

- Using auto exposure and not properly lighting the subject
- Jerky, sickening movements that include more than 180 degrees of movement
- No basic post processing. Not every video needs to be cinema but at least tweak the basic values
- No editing. A lot of flying is boring and people have limited time and attention spans. Nobody is going to watch a video longer than 5 minutes.
- Content shot from far away. Just because youre in the air doesnâ??t mean you always need to be at 399 feet!

Workflow

Understanding the best practices for handling operating system files is probably the last things youâ??re worried about right now. Its easy to generate ~ 40GB of media per flight. Multiply that by weeks and months and youâ??re into terabytes of storage.

(See our advanced workflow material)

Tips: Files and housekeeping

Prune junk footage early in the process before itâ??s needlessly replicated to across your storage. These are photos and videos that you donâ??t want to save, obvious junk, poorly exposed footage, uneventful takeoffs and landings.

Files

Files are found in the `DCIM` folder on the SD card. There are differences in the way files are generated between the Mini3, Mini4 and Mini5 Pro models.

The Mini3 & Mini4 generate fixed size files (typically in ~ 3GB chunks). For these drones the amount of footage per file is determined by video quality, frame rate, etc.

The Mini5 creates a single huge continuous file which is advantageous for a few reasons. First you have fewer moving parts and clips to deal with when editing. Next, you can shoot longer videos in auto mode without annoying flashes in between files.

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The negative is that your software systems need to support such large files.

Tips: File naming

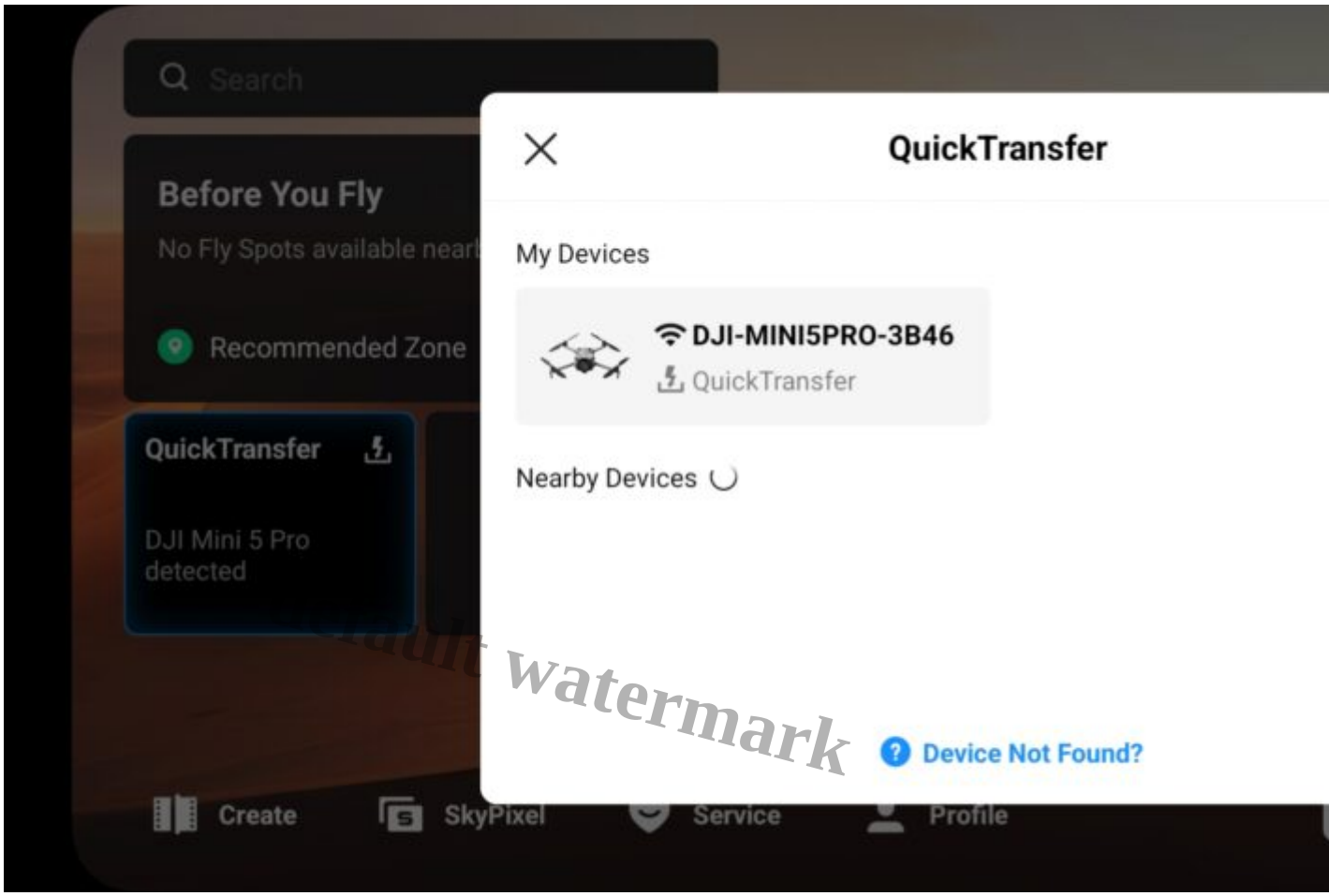
- Do not completely rename files. If you really need to change a filename, leave the original filename in the new name. For example **DJI_2023XXX.jpg** might become Nice_Clouds_**DJI_2023XXX.jpg**
- Use a consistent, date based naming format for everything you do. Begin all filenames with YYYYMMDD. This will help you to sort and locate content in the future.
- Do not use spaces and special characters in path names.

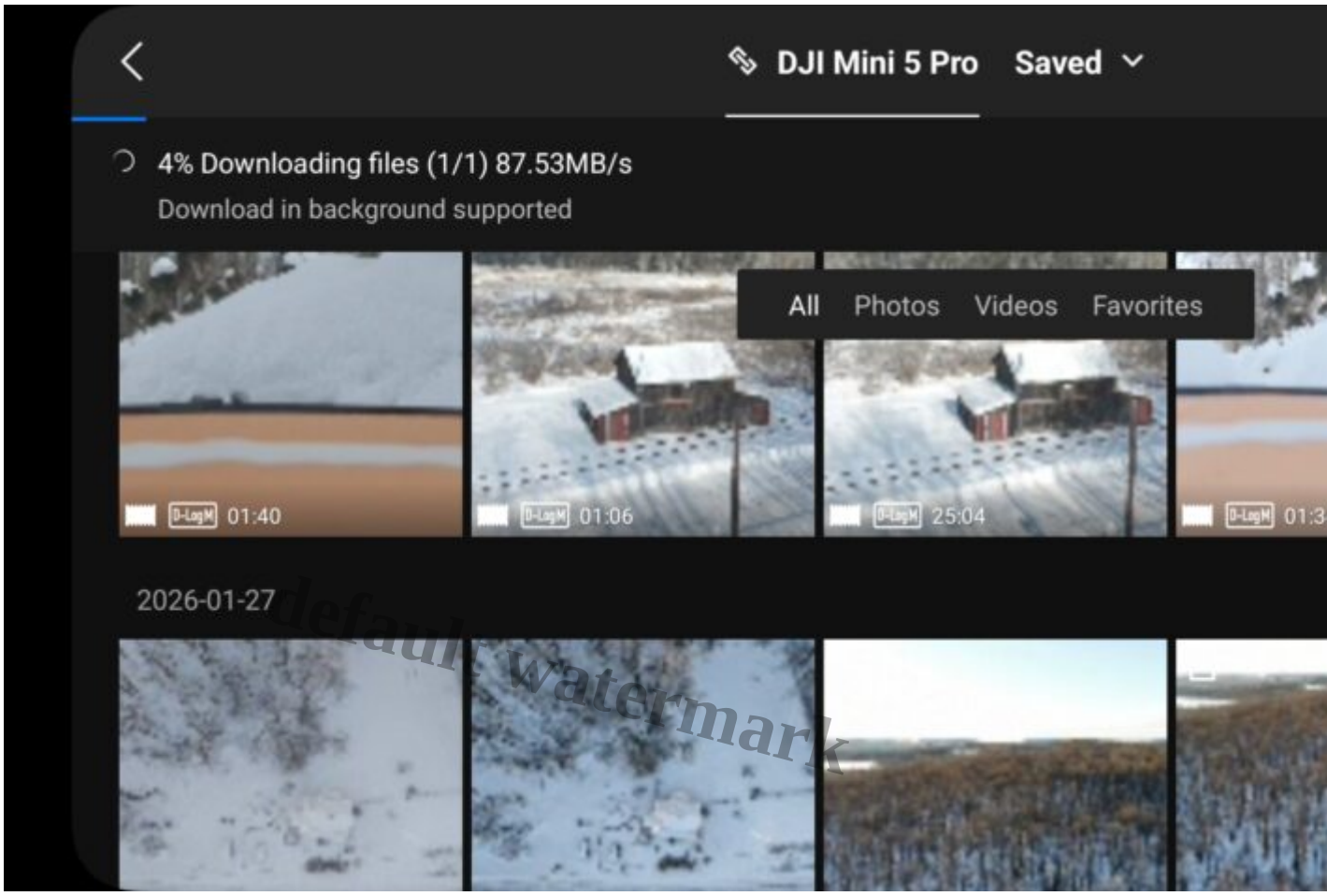
Wireless Transfer

DJI Quick Transfer is a fast way to copy content directly off of your drone. This is especially useful in the field, giving you immediate access to your content. The software uses Bluetooth and WIFI to transfer files using the DJI Fly app.

Note that youâ??ll need to dedicate your WIFI and Bluetooth connections to Quick Transfer while in use. If you rely upon wifi calling your mobile device will go offline.

DJI has more information available about exporting files.


Search
Before You Fly
No Fly Spots available near
Recommended Zone
QuickTransfer
DJI Mini 5 Pro detected
QuickTransfer
My Devices
DJI-MINI5PRO-3B46
QuickTransfer
Nearby Devices
Default watermark
Device Not Found?
Create
SkyPixel
Service
Profile



Time Lapse Video

(See time lapse tips in our advanced course)

Time lapse video is a fun way to capture the changing environment. I find that shooting about 15 minutes of a scene is generally enough, though it never hurts to have extra footage in the editing room.

Sound

These drones do not record sound, but you can add some to your videos using a device such as the DJI MIC .

Choosing copyright free audio is virtually impossible on platforms like YouTube where cover free works are illegally claimed.

Wildlife

Birds

Birds are always a factor while flying. My primary flight environment is rural and hosts thousands of local and migratory birds. The animals (especially hawks) are curious but Iâ??ve had no incidents to

date. When in doubt, use your cameraâ??s zoom function to get footage without disturbing anything.

Ascend quickly and straight up to flee from any birds that are at risk of impacting your flight. There is some unscientific indication that red reflective tape will also ward away birds.

Dogs

Dogs & coyotes are especially sensitive to drone noise. If theres a dog nearby it would probably be a bad idea to land anywhere an animal can attack. Your vehicleâ??s roof may be a good option here if you have that available.

People

People are going to play a big role in your day to day flying.

The average person does not appreciate nor understand drones.

Having uninvolved people nearby is also a distraction as well as a potential safety risk.

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Tips: Flying near people

- If they canâ??t see you they canâ??t complain.
- Do your planning ahead of time.
- Keep it quick. Get in and out!
- Avoid flying over uninvolved parties
- Give yourself more landing time just in case a random person or vehicle wanders into the landing area, maybe you need time to replan the touchdown



About the author

Michael Jastremski is a Part 107 certified drone pilot in North East Pennsylvania. He has been involved with photography for over 30 years and drones for 8.

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