Drone overview

Tomas Gustafsson
tomas.c.gustafsson@afconsult.com

Objectives

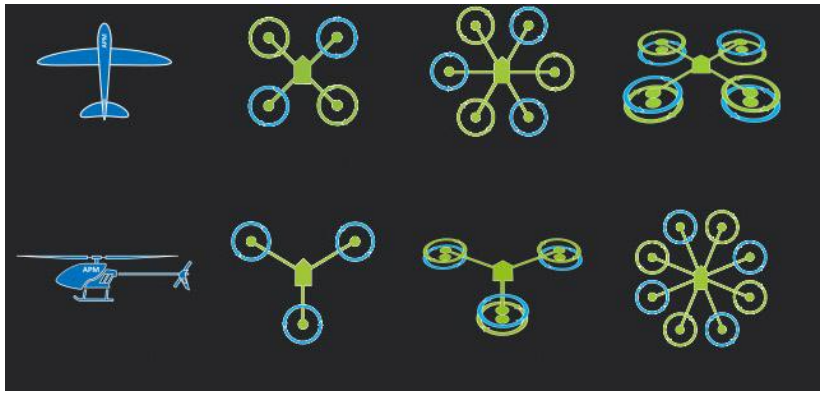
This session will give you

- Basic understanding of drones
- A briefly overview of some of the most common drone types
- Basic understanding of the relation between price, features and performance between different drones
- Some examples of what type of drone to procure
- Some knowledge about the security considerations that might affect the use of drones

Objectives

Three types of drones including two types of rotor crafts

- Single rotor (helicopter)
- Fixed-wing (airplane)
- Multicopter (multirotor)



Different type of drones

Single rotor helicopter

- Single lifting rotor with two or more blades.
- Traditional manned helicopter.
- Strong, fast and efficient.
- The directional control is maintained by varying blade pitch via servo-actuated mechanical linkage.
- A single rotor helicopter is generally more difficult to fly.

Different type of drones

Fixed-wing aircraft

- Must have air moving over their wings to generate lift
- This means they must stay in forward motion
- Cannot hover in one spot in the way a helicopter can.
- Cannot provide the same level of precise positioning
- Lightweight, less energy consuming, generous flight time
- Commonly used for 3D mapping, agriculture survey

Different type of drones

Multicopter

- An aircraft with more than one rotor, generally 4-8 rotors.
- Utilize differential thrust management of independent motor-prop units to provide lift and directional control.
- The motors are controlled by an automatic flight controller
- Takes input from the operator and different sensors to provide a semi or fully automatic and stable flight.
- Ideal for precise missions when accuracy is of importance.
- A multicopter is fairly easy to fly.

Different type of multicopters

Quadcopter

- Cheap, simple and easy design. Fairly efficient.
- 4 rotors, opposite spin directions than its neighbours
- The airframe can be designed in different setups.
- X configuration commonly used for aerial photography
- 4 rotors will not give any redundancy.

Hexacopter

- 6 rotors in X, Y or + configuration. X most commonly used.
- More payload capacity that quadcopters
- 6 rotors will give redundancy. Will easily continue fly with 5 rotors.
- More expensive and less efficient than a quadcopter

Octocopter

- Heavy lifters but less efficiency than a quadcopter
- Different configurations, X or + configuration
- X8 = 2 motors per arm (a quad with 8 motors)
- Will continue to fly with as many as four rotor failures
- More complex design, more motors and hardware will lead to a higher price

Drone technology

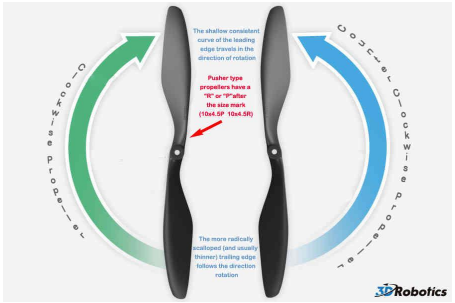
Components

- A multicopter needs a flight controller, a fixed-wing can do without but will usually have one
- Flight controller contains several internal and external sensors such as barometers (altimeters), gyroscope, compass, temperature, GNSS, etc.
- Logs from sensors can be used in post evaluation and research.
- Brushless motors (modern motors with high efficiency)
- Propellers with correct size and pitch
- Batteries - lithium ion polymer

Peripherals

Some other things we need in our field usage.

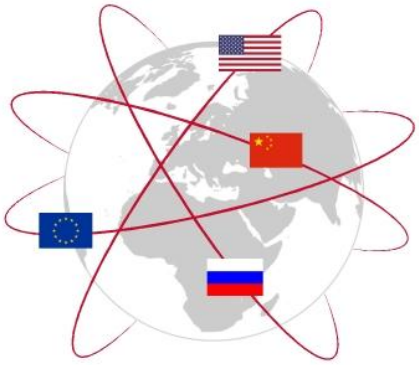
- Transceiver (transmitter and receiver) to control the drone
- Monitors or FPV googles (if using a camera)
- Sensors to be carried by the drone
- Chargers for batteries
- Emballage for transportation
- Spare parts (propellers, landing gears, etc)
- Catapult or ramp if using fixed wing



Drone technology

Navigation

- Accelerometer, gyroscope, compass, magnetometer will assist with the navigation
- GNSS (GPS, Glonass, Galileo, Beidou) will give the position and exact location
- A barometer will increase the accuracy of the height
- All these sensor data can be used for post processing of the mission in combination with external sensors used
- Navigation might be affected in Arctic regions due to magnetic variations and interference, positioning of the magnetic north pole and weak GNSS signals



Power sources

Lipo batteries

- Cold batteries will give you reduced power and can be potentially dangerous in case of voltage drop
- Flying in cold climate is usually no problem as long as you can provide warm batteries on take off
- A mobile telephone with bad battery will stop working. A drone with bad battery will fall down
- Charging must be performed with a specific charger
- Never leave fully charged batteries in storage (applies to no “smart batteries”)
- “Smart batteries” will take care of charging, monitoring, discharging and temperature control

Safety and warnings

Lipo batteries

- High energy, can be extremely flammable
- Never charge without monitoring the batteries
- Batteries need to be transported according to IATA rules which will limit to total energy content. The ***Watt Hour Rating*** will decide
- Usually batteries, even small batteries, need to be carried in the hand luggage

IATA

http://www.iata.org/whatwedo/cargo/dgr/Documents/LithiumBattery_PassengerFlyer.jpg

IATA rules for batteries

IATA

What's your type?

Information for Airline passengers on **Lithium Batteries**

For more information contact your airline or visit:
www.iata.org/dangerousgoods

Whether a lithium battery can be carried by air or not depends on its configuration and either Watt-hour (Wh) rating (for rechargeable) or Lithium Content (LC) (for non-rechargeable).

Use the following table to determine if your battery is acceptable:

Watt Hour Rating (Wh) or (Li Content)	Configuration	Carry-on Baggage	Checked Baggage	Operator Approval
≤100 Wh (2g)	In Equipment	Yes	Yes	No
	Spares	Yes (No Limit)	No	
>100 to ≤160 Wh	In Equipment	Yes	Yes	Yes
	Spares	Yes (Max 2)	No	
>160 Wh	Must be presented and carried as Cargo in accordance with the IATA Dangerous Goods Regulations			

To convert Amp-hours (Ah) to Watt-hours (Wh) multiply Ah x Voltage

The terminals of all spare batteries must be protected from short circuit by; enclosing them in their original retail packaging or taping over the terminals or separate plastic bags for each battery.

Spare batteries may not be placed in checked baggage.

Batteries contained in equipment such as laptop computers, cameras, mobile phones, etc must be switched off and measures taken to ensure that they cannot be accidentally activated when placed in checked baggage.

Examples of Lithium Batteries

Small Lithium Batteries and Cells include mobile phone batteries, watch batteries, MP3 player batteries and most original laptop batteries. The maximum rating for these batteries is 100 watt-hours (Wh).

Medium Lithium batteries and cells include larger batteries and cells – examples include some extended life batteries for laptop computers, and batteries used by audiovisual professionals. A "medium" battery provides between 100 and 160 watt-hours of power.

Large lithium batteries and cells are primarily those used in industry. A large rechargeable battery provides over 160 watt-hours of power. Large batteries may be found in some electric and hybrid vehicles, as well as mobility devices and scooters.

Note: Other commercially available types of batteries such as Ni-Cad, (nickel cadmium), and alkaline can be carried safely in either checked or carry-on baggage provided they are adequately protected against short circuit.

Payload

Payload

- Payload will affect flight time of the drone.
- For a multirotor aircraft 1 gram extra will reduce 1 second
- Custom payload will often require custom drones which will increase the price
- Higher price will not increase simplicity but for sure increase complexity

When to choose what?

Consider a multirotor if you…

- Want a cheap, simple and portable unit for taking basic pictures
- Want high quality, high resolution pictures
- Will do precise inspections or measurements
- Will carry any kind of sensors or payload
- Want something that is fairly easy to fly

Consider a fixed wing if you…

- Require a long flight time
- Will do mapping and survey of large areas
- Already know a bit of flying or can deal with a bit of a learning curve
- Don't mind carrying around a fixed wing (some might be lightweight but bulky)
- Can spend a bit more $$$ from your budget
- Want to use sensors that doesn't care about moving around in the air all the time

Objectives

Actors and market

- Multirotor - DJI world market largest manufacturer for amateurs and professionals
- Small nisch actors will serve the rest of the professional market for multirotors
- Fixed wing – recreational use (DIY) or professional market high end, small nisch actors

Comparsion DJI basic

MAVIC PRO
STARTING AT $749

PHANTOM 4 ADVANCED/+
STARTING AT $1,199

PHANTOM 4 PRO/+
STARTING AT $1,499

	Mavic Pro	Phantom 4	Phantom 4 Pro
Sensor Size	1/2/3"	1/2.3"	1/2.3"
Film Rate	12.35 MP and 4K Video	12 MP and 4K Video	20 MP and 4K Video
Shutter Type	Electronic	Electronic	Mechanical
Aperture Range	F2.2	F2.8 at ∞	F2.8-F11
Max Video Bitrate	60 Mbps	60 Mbps	100 Mbps
Camera Image			

Comparsion DJI basic

MAVIC PRO
STARTING AT $749

PHANTOM 4 ADVANCED/+
STARTING AT $1,199

PHANTOM 4 PRO/+
STARTING AT $1,499

- Operational out of the box
- Very easy to transport and to carry
- Everything you need included (except ipad or telephone)
- Focus amateur or semi professional video production, ok for photography
- Possible but not recommended for 3D mapping

DJI mid range

INSPIRE 1

INSPIRE 2

- Operational almost out of the box
- Fairly easy to transport
- Dual operator
- Detachable/replaceable cameras
- Focus on semipro or professional video production
- Starts at US$ 3000

DJI high end

DJI MATRICE 200 SERIES COMPARISON

Matrice 200	Matrice 210	Matrice 210 RTK

- High end series. Starting at US$ 10 000.
- Modular with cameras for inspection, thermal camera.
- Additional precise positioning with RTK
- Focus: professional survey and inspection

Other brands

https://sensefly.com/

http://www.trimble.com/

https://leica-geosystems.com

http://smartplanes.com/

Where to start?

Start with a Hubsan X4, $40

If you can fly this one – you can fly anything…

Thank you

Any questions?