Aircraft General Knowledge

Iain Darby
NAPC/PH-NSIL

IAEA
International Atomic Energy Agency

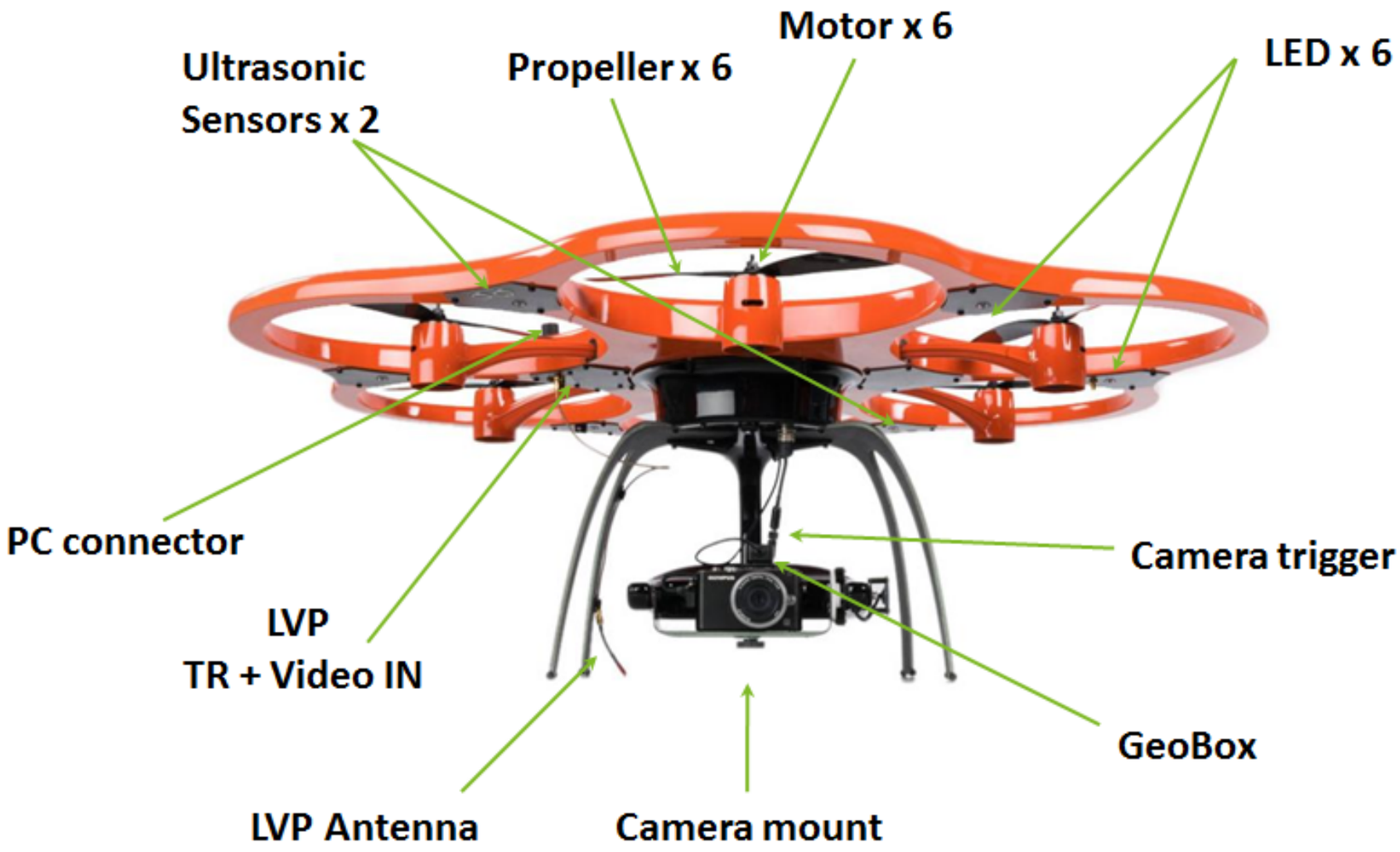
Remotely Piloted Aircraft System RPAS

- Remote Pilot must be able to intervene at any moment for the sake of safey
- RPA - the remotely piloted aircraft
- RPS - the remote pilot station, where the pilot is
- Control link - provide critical information
- Communication link - data / payload control

Iain Darby i.darby@iaea.org

Hexacopter

System overview – Aibot X6 V2



5

Multicopter System parts

- Energy - LiPo batteries
- Motors - brushless electric
- Propellors
- Transmitters
- Receivers
- Electronic Speed Controllers - control motor speed
- Flight Control Unit - accelerometers and gyros
- Orientation lights
- GPS and other antennae

Airworthiness

- At present time there is no ICAO Airworthiness requirement standard.
- Patchwork of others

Airframe

- The aircraft should always be landed carefully to avoid any damage
- When the structure of the airframe is damaged this can easily lead to a misaligned frame that is not visibly noticeable
- Damage can also lease to an imbalance and the shocks of heavy landing can damage electronics
- One heavy landing doesn’t mean damage occurs but fatigue also occurs in some materials and is cumulative

Operating Modes

- Manual / Direct control
  - continuous intervention of the pilot to maintain flight
- Stabilised / Flight Assist Mode
  - automatic stabilisation to help pilot
    - aircraft hard to handle otherwise
    - navigation still controlled by pilot
- Pre-programmed / Waypoint Flight
  - requries GPS and/or inertial navigation sensor
- Independent / Autonomous
  - Possible but usually not allowed

Command Override & Failsafe

- An override capability when operating in Waypoint Flight is required
- Needed to effect control of the aircraft should there be a malfunction
- A mechanism that will cause the aircraft to land in the event of disruption or failure of a system is usually referred to as a failsafe mechanism

Instruments

- Instruments provide the pilot with needed information about the behaviour and status of the aircraft
- X6 case this includes
  - battery voltage
  - flight time
  - altitude
  - distance from takeoff location
  - GPS satellites in view

GNSS - GPS

- RPAS community relies on GPS
- However, manned flight is not allowed to rely solely on GPS!
- Poor reliability and ease of disruption
- GPS - 24 satellites, normally 4 in view from anywhere
- Since 2011, actually 27 satellites in baseline
- About 8 satellites will give accuracy of few metres
- GLONASS, Galileo, BeiDou may provide future enhancements

GPS Altitude

- GPS zero height defined by WGS84 World Geodetic System 1984 (2004 revision)
- Take care: in Europe WGS84 ellipsoid is 30m above sea level (Mean Sea Level, recall AMSL)
- GPS precision is also usually quoted for horizontal accuracy
- Vertical accuracy is usually much worse.

Batteries - Lithium Ion / Lithium Polymer

- High Power density
- Capacity - the specific energy in ampere-hours (Ah)
- 1000mAh = 1Ah = 1 Ampere x 1 hour
- C-rate: measure of the batteries current handling
  - It is the constant charge and discharge rate the battery can sustain for 1h hour.

LiPo Batteries

- During extreme use abnormal crystal growth can occur forming particles which cause a short circuit.
- When this occurs the cell temperature rises quickly and approaches the melting point of Lithium
- Causes thermal runaway, aka venting with flame
- Explosion - take care, 3cells will mean 3 explosions

LiPo Batteries

- LiPo discharges to 3.0V/cell
- Lowest low-voltage is 2.5V/cell
- During prolonged storage self-discharge causes the voltage to drop further
- This will cause protection circuit to kick in and “put the battery to sleep”
- Cannot be recharged

LiPo Charging

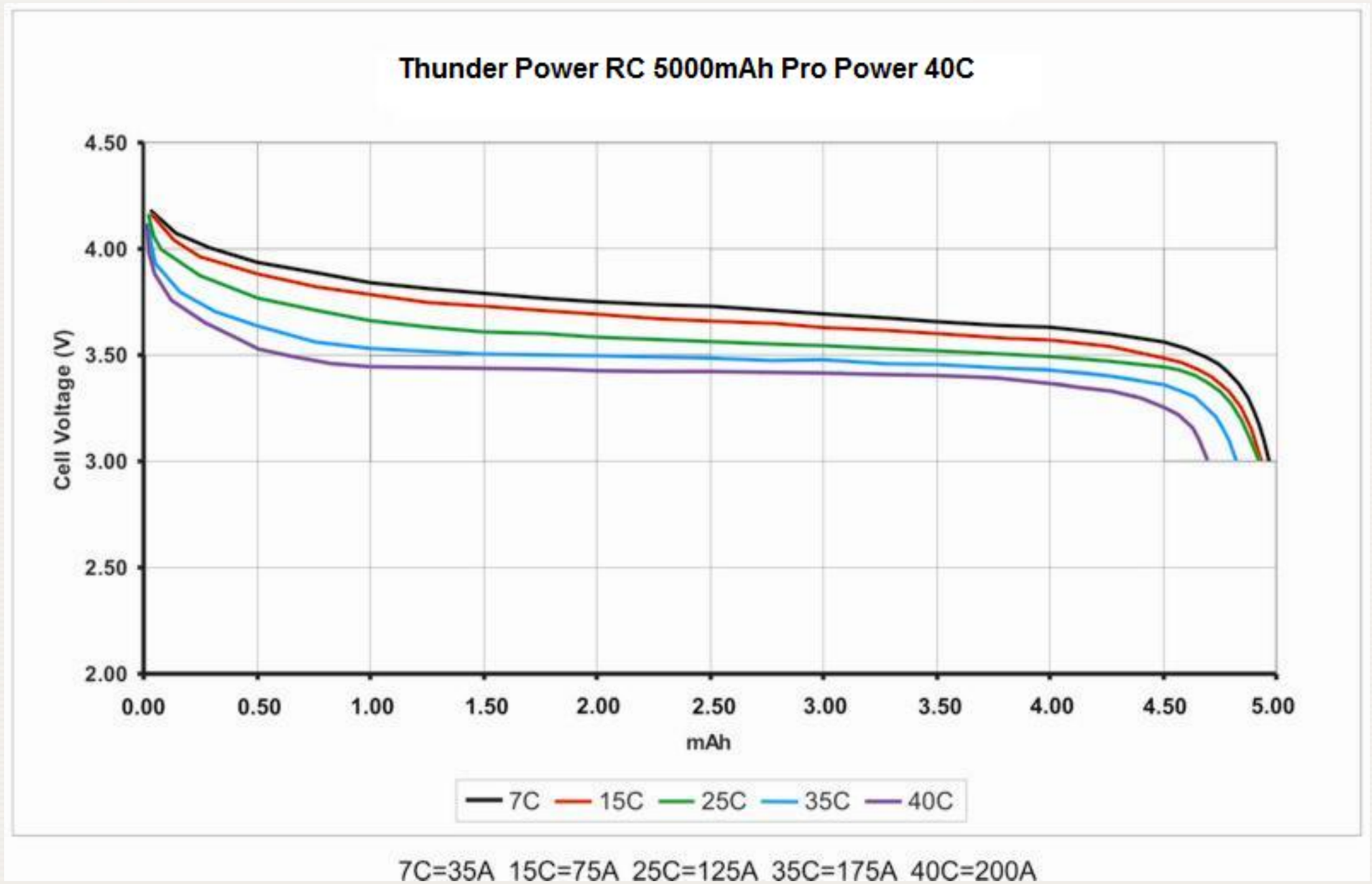
- This is the most dangerous part of using LiPo batteries
- Do not leave unattended
- Advisable to use a safe charging bag
- Ensure to use an appropriate charger
- Check charging rate is suitable for battery
- Recommend is 1C i.e. 5Ah charge at 5A
- Use balance mode

LiPo Usage

- If battery is in an accident then remove it and put it aside for at least 30mins
- If it doesn’t get hot or become misshaped then check it and continue
- Do not use a pack that has become misshaped

Iain Darby i.darby@iaea.org

LiPo Usage



7C=35A 15C=75A 25C=125A 35C=175A 40C=200A

Iain Darby i.darby@iaea.org

LiPo Storage

- Ideally stored in Safe Bag (or other secure container)
- between -20degC - +30degC in a dry place
- Store at just above 60% capacity
- Self discharge between 8-20% capacity

Iain Darby i.darby@iaea.org

END
of
AIRCRAFT GENERAL KNOWLEDGE

IAEA
International Atomic Energy Agency