Unmanned Aerial Vehicle (UAVs)

Hull Design

Flight

- Multi-rotor UAV - Drone
  - VTOL & hover fligth
- Single-rotor UAV - Drone
  - VTOL & hover flight
- Fixed wing UAV - Flight Drone
  - Fast flight speed
  - Large coverage

Size

Category	Size	Maximum Gross Takeoff Weight (MGTW) (lbs)	Normal Operating Altitude (ft)	Airspeed (knots)
Group 1	Small	0-20	<1,200 AGL*	<100
Group 2	Medium	21-55	<3,500	<250
Group 3	Large	<1320	<18,000 MSL**	<250
Group 4	Larger	>1320	<18,000 MSL	Any airspeed
Group 5	Largest	>1320	>18,000	Any airspeed

*AGL = Above Ground Level
**MSL = Mean Sea Level
Note: If the UAS has even one characteristic of the next level, it is classified in that level.
Source: "Eyes of the Army" U.S. Army Roadmap for UAS 2010-2035

Propulsion System

Motors

- Brushed motor - small drones
- Brushless motor - Large drone (higher propulsion)

Propellers

- Rotary motion : Linear thrust / pivot / tilt

Navigation System

Autopilot

- VECTOR-400
  - cutting-edge, robust and dependable autopilot, with built-in physical and logical redundancy.Designed to comply with MIL-STD standards required by many Departments of Defense (DoD)
  - the Flight Control Computer (FCC) of choice for aerial target applications

AHRS-IMU

- POLAR-300
  - high-end, MEMS-based Air Data and Attitude and Heading Reference System (ADAHRS) and Inertial Navigation System (INS).
- POLAR-500
  - Air Data Attitude Heading Reference System (AD-AHRS) for aerial systems. It includes a Dual GNSS Compass and it is capable of providing precise attitude estimation and satellite pointing

Ground control station

- Hardware
  - JY02, an R/C style joystick, for use with its system
  - Twin gimbal joystick with three user-configurable two-position toggle switches on front face, plus one two-position toggle switch on upper left surface for selection of MANUAL mode
- Visionair - GCS Software
  - standard Ground Control Station (GCS) software for UAV missions. It aids in the planning, execution and post-analysis of UAV operations.
- Portable control station

https://www.youtube.com/watch?v=SmAfj16P4MU

Navigation System

Inertial Navigation System (INS).

Table 5.1: Primary functions of a few navigation sensors

| No	Name	Measures	Remarks
1	Accelerometer	Linear acceleration	The linear acceleration is converted to linear velocity.
2	Basic gyroscope	Attitude	Based on gyro law
3	Rate gyro	Angular velocity	The angular velocity can be converted to angular positions.
4	Magnetometer	Attitude	e.g., heading
5	Pitot tube	Altitude, airspeed	Using air pressure
6	Compass	Magnetic north	Heading angle is measure w.r.t. north
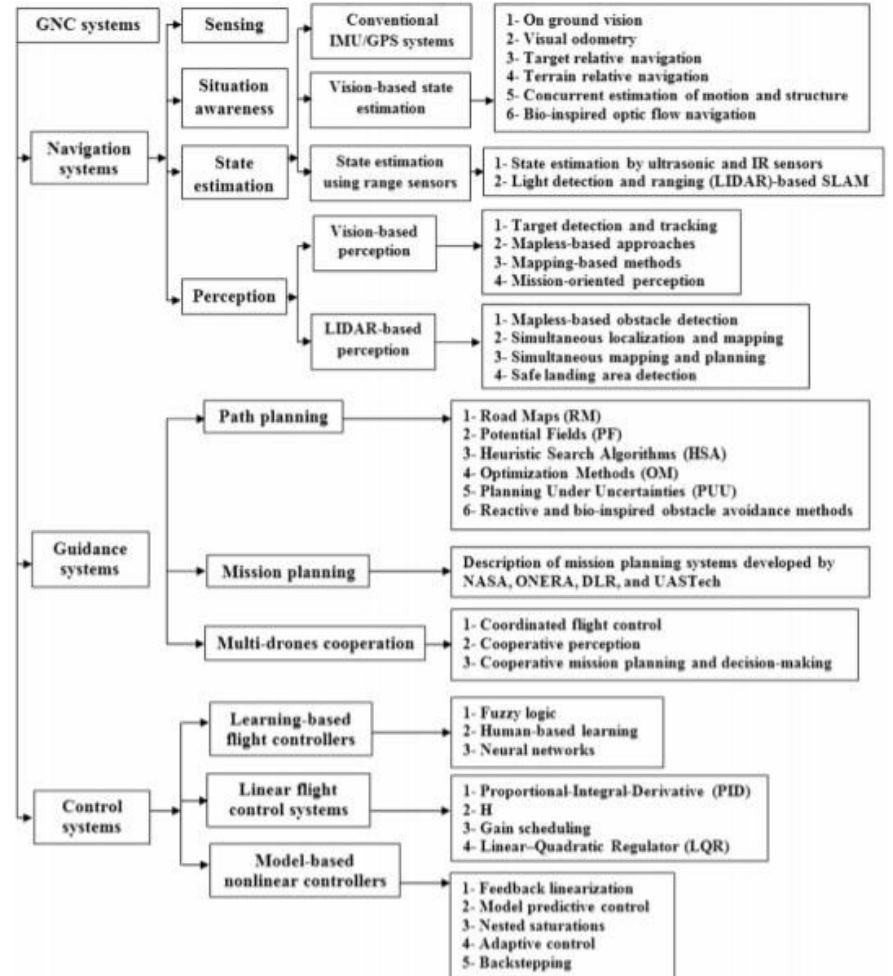
Fig. 29. Classification of GNC systems developed for drones based on Kendoul [373].
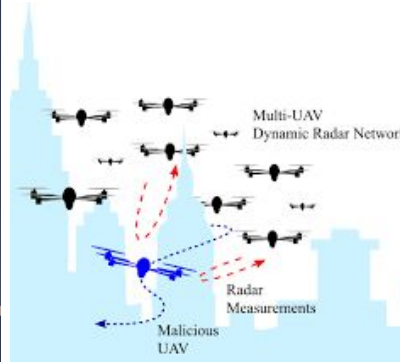
Data Collection

- Camera
  - Surveilance

- Radar (Military specs)
  - Moving object detection

- Thermal sensor (Military specs)
  - Target following

Data Transmission

UAV

- Antennas
  - data recording and transmission purposes, as well as for avionic functions
  - transmit information to and receive information from other systems

Ground station

- Tracking Antennas
  - long-range data transmission
  - Portable tracking antenna works with UAV Factory's digital Airlink IP datalink and can be used for video as well as command and control transmission
- Portable controls station
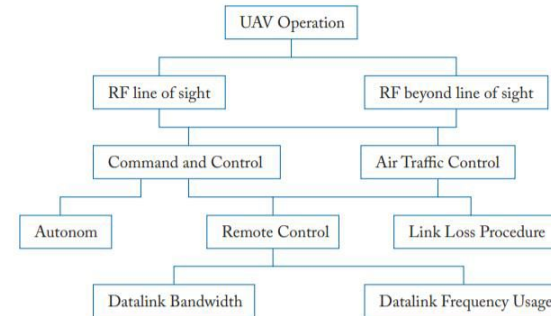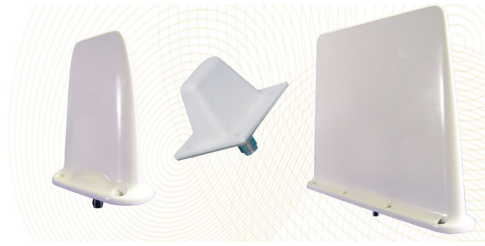- Command control station
- Handheld controller

Figure 8.7: Command, Control, and Communications (C3) model.

Power Management

Supplied

- Battery
  - Li-Po batteries are preferred over most other batteries in portable devices and electric transportation (EV and their hybrid counterparts) due to their superior energy density, power-to-energy balance and long cycle life

Usage

- Motor
- Data Transmission
- Camera
- Sensor
- Radar (Military spec)
- Electronics component