UNMANNED AERIAL VEHICLE (UAV)

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History of UAV

Early drones

- The earliest recorded use of an unmanned aerial vehicle for warfighting occurred in July 1849, with a balloon carrier (the precursor to the aircraft carrier) in the first offensive use of air power in naval aviation.
- Significant development of drones started in the 1900s, and originally focused on providing practice targets for training military personnel. The earliest attempt at a powered UAV.

History of UAV

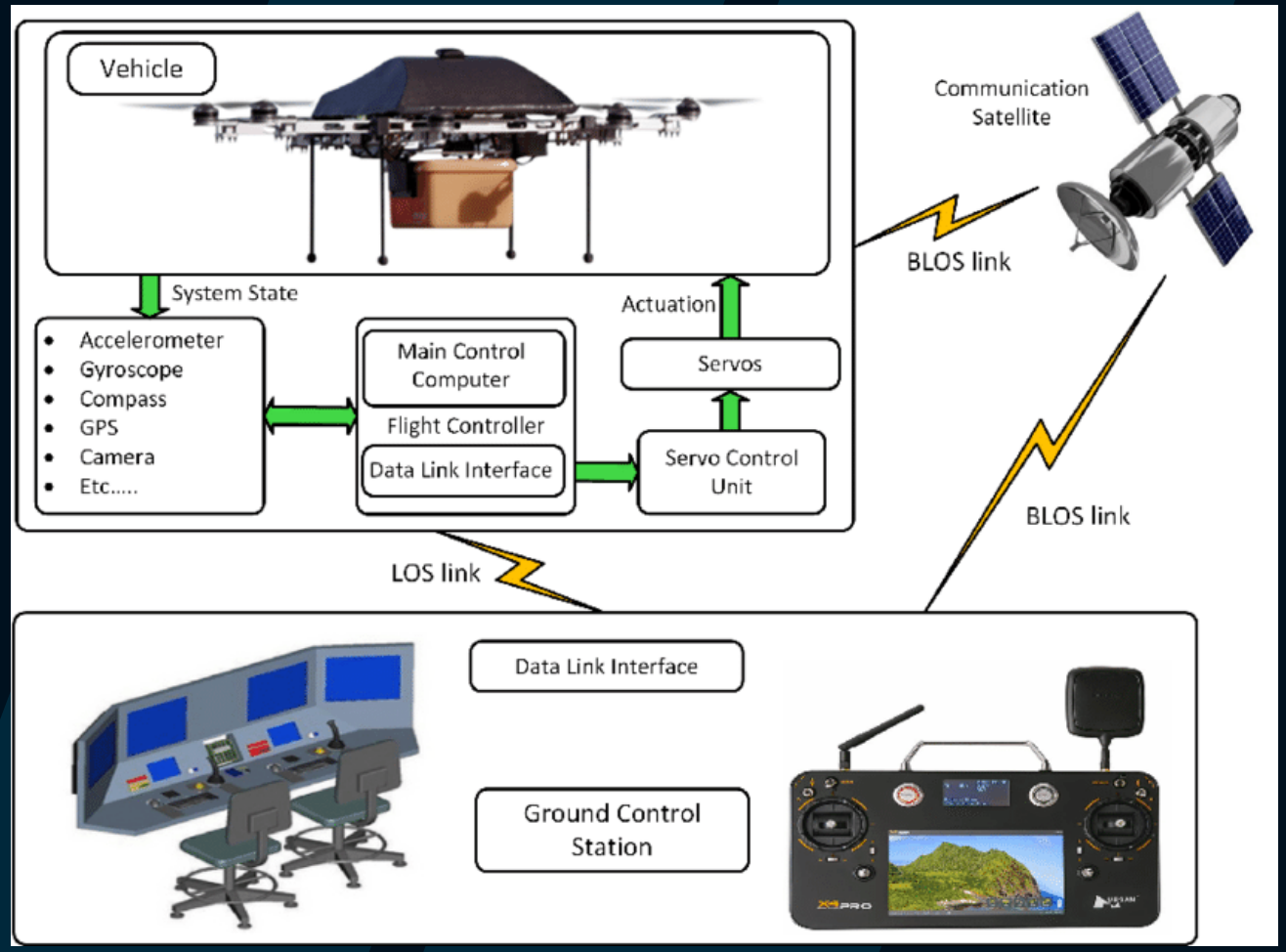
The Israeli Tadiran Mastiff, which first flew in 1975, is seen by many as the first modern battlefield UAV, due to its data-link system, endurance-loitering, and live video-streaming.

Modern UAVs

- With the maturing and miniaturization of applicable technologies in the 1980s and 1990s, interest in UAVs grew within the higher echelons of the U.S. military.
- In the 1990s, the U.S. DoD gave a contract to AAI Corporation along with Israeli company Malat. The U.S. Navy bought the AAI Pioneer UAV that AAI and Malat developed jointly.
- UAVs demonstrated the possibility of cheaper, more capable fighting-machines, deployable without risk to aircrews. Initial generations primarily involved surveillance aircraft, but some carried armaments

Robot Architecture

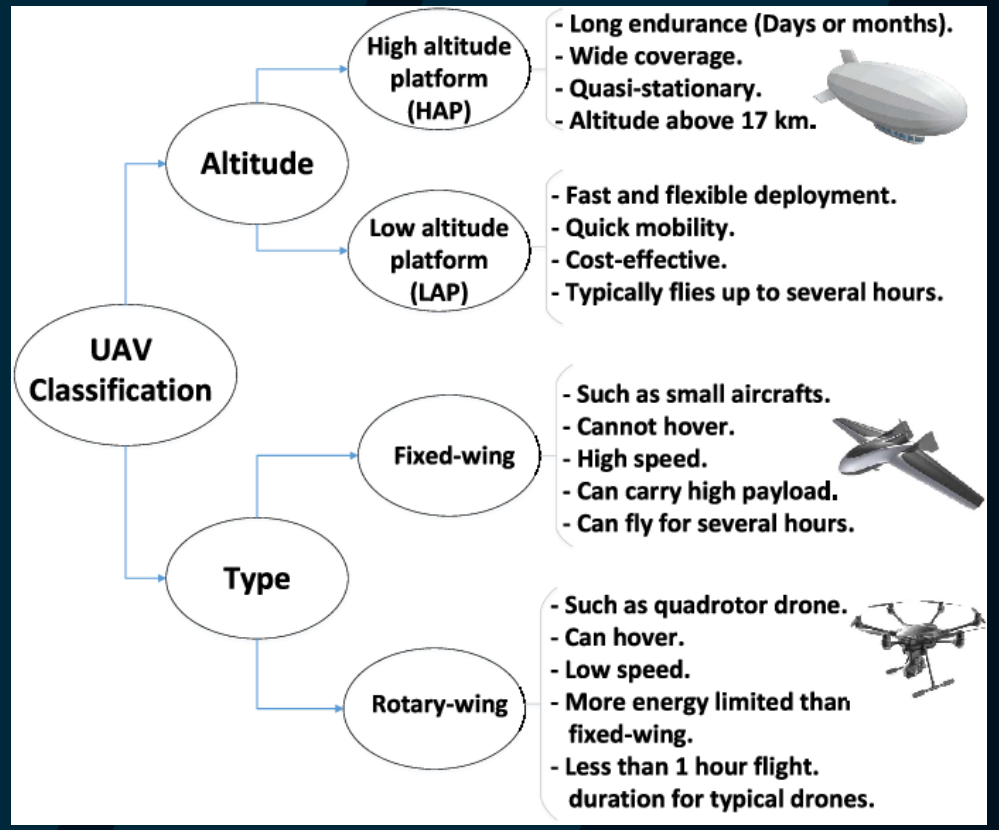
- High level architecture of a UAV system.
- Consist of three main elements which are the unmanned aircraft, the ground control station (GCS), and the communication data link.



Robot Architecture

Even though reliable autopilots exist, the main selected software application architecture and purpose of the UAV is the actual mission that the architecture of the communication should execute with its required payload (sensors, mechanisms inside the UAV, and between UAV etc.)

Robot Design and Task



Tasks

UAVs perform wide variety of functions. There are numerous civilian, commercial, military, and aerospace applications for UAVs. Example:

- GENERAL: Recreation, Disaster relief, conservation of biodiversity and habitat, law enforcement, crime, and terrorism.
- COMMERCIAL: Aerial surveillance, filmmaking, surveying, cargo transport, forestry and agriculture.
- MILITARY: Unmanned combat aerial vehicle, miniature UAV and target drone.

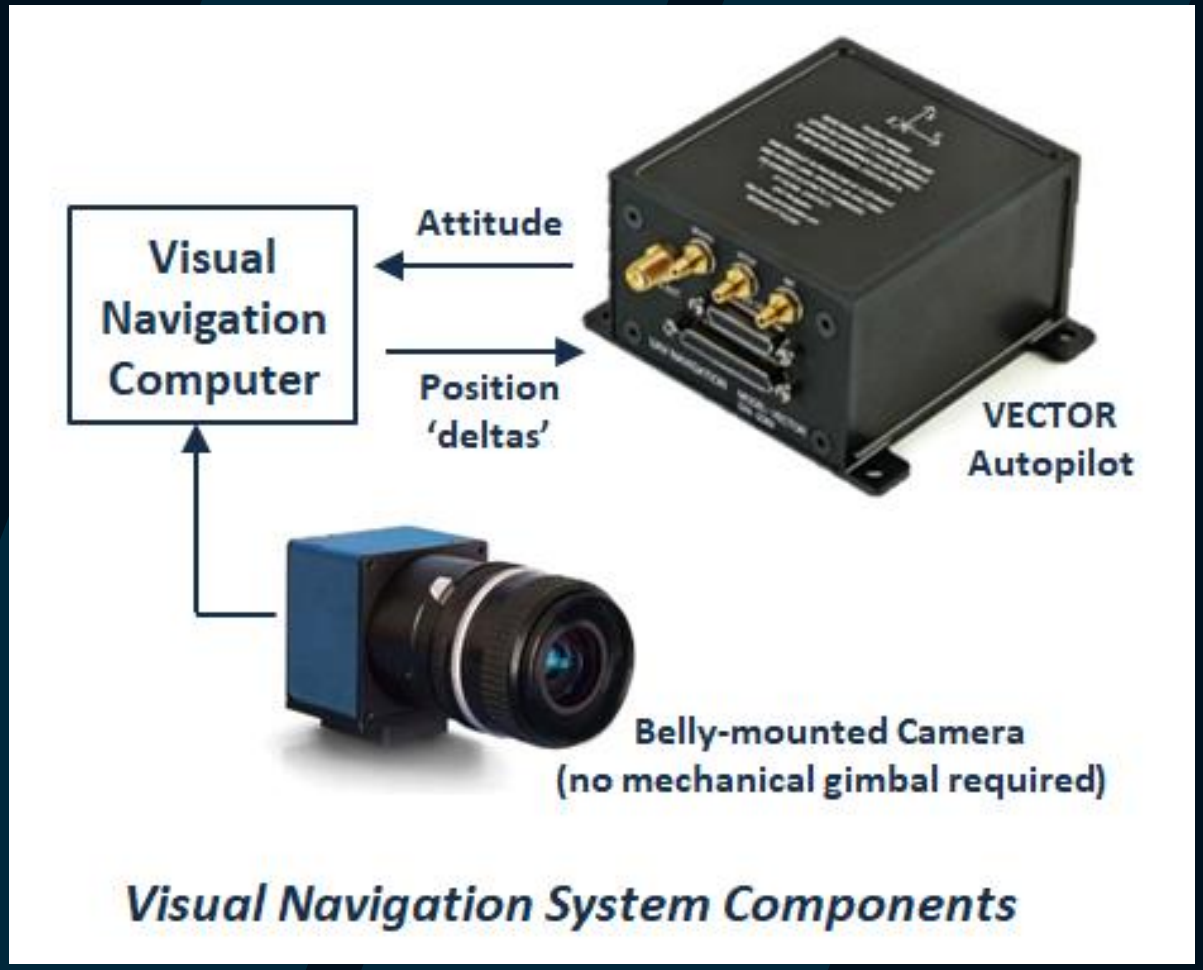
Actuator and Locomotion

Brushless actuator

Servo Cylinder Actuator

Navigation System and Controller

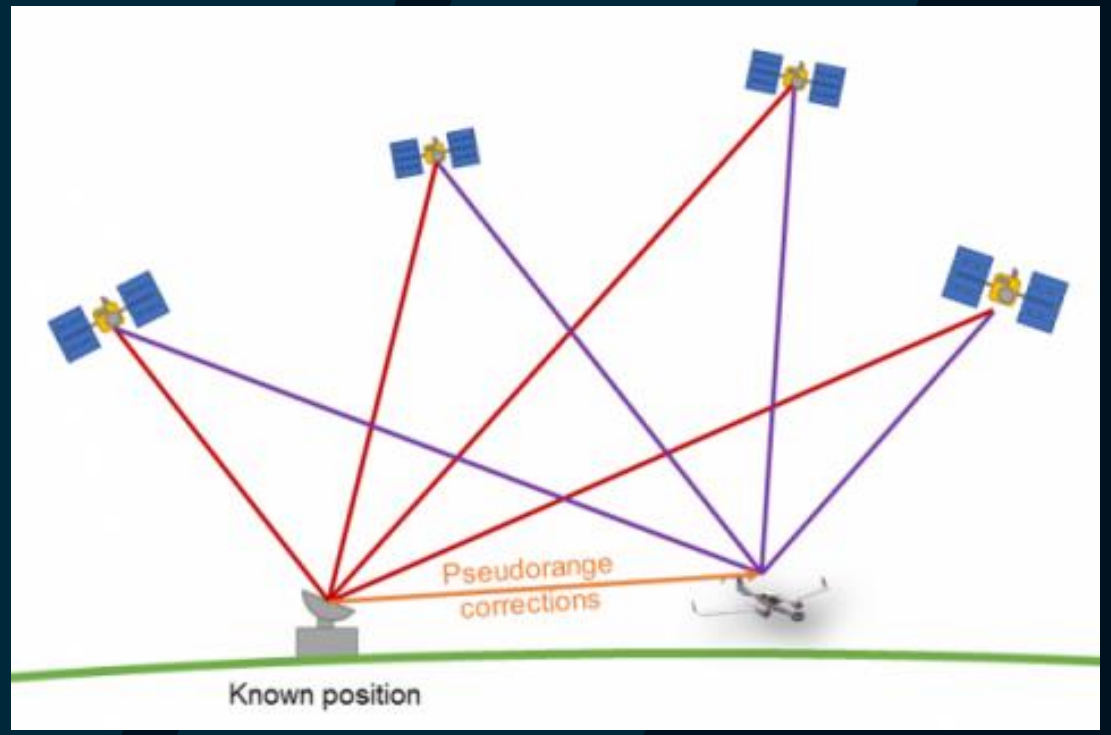
- Autopilot executes the flight completely automatically, from take-off to landing. The operator is able to define the operation and execute it autonomously but can also modify the operation in-flight.
- Visual Navigation System (VNS) largely reduces the accumulated positional error during Dead-Reckoning Navigation.
- The VNS leverages "Visual Odometry" techniques to determine the position and orientation of the aircraft. This is done through a camera that is installed under it and captures images that are then analysed and processed.



Visual Navigation System Components

Radio controller

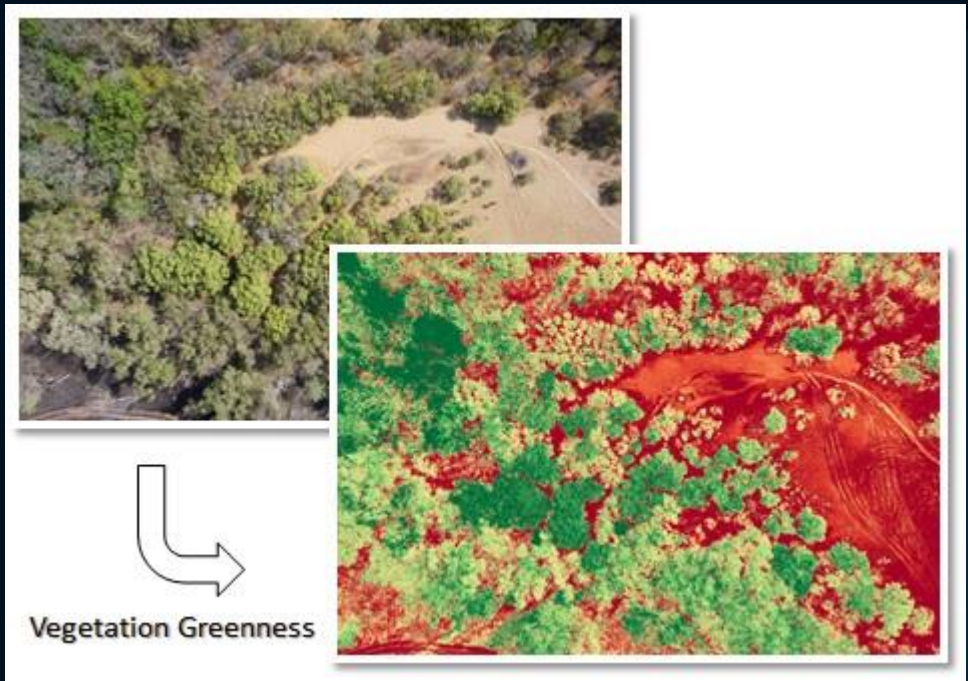
Global navigation satellite system (GNSS)



Data Collection

Remote Sensing:

- hyperspectral, thermal and photogrammetric cameras



Sony α7R
36.8 megapixel
Full frame
35 mm

Headwall
Nano Hyperspec
400 – 1000 nm
5 nm resolution

FLIR A65
-25 – 135°C
640 x 512 pixels
200 g

Data Collection

ISR System:

Small gyro-stabilized electro-optical four-sensor payload for UAVs for military applications, order control, and civil uses.

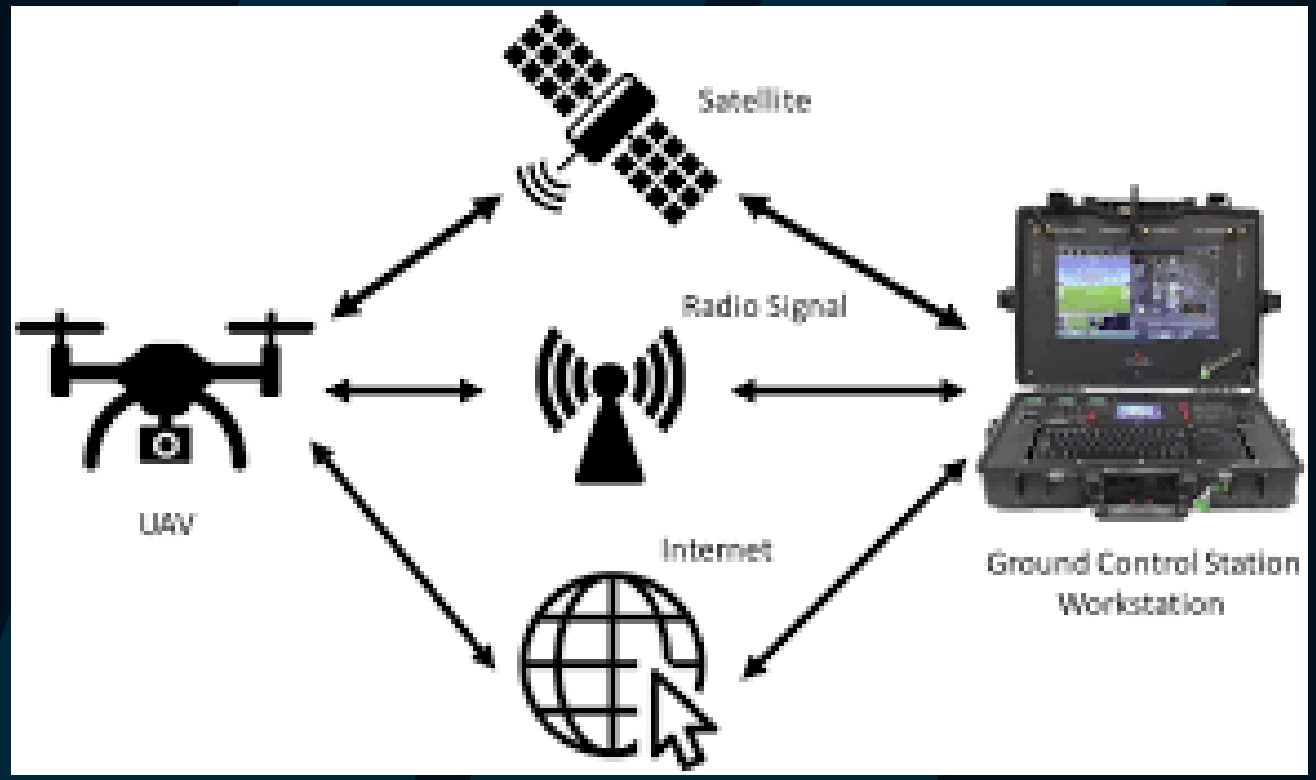
Radar:

On board firmware compresses real-time SAR data and transmits it to a ground station that generates and archives the imagery.

Data Transmission

Mobile network systems:

- ad-hoc network (FANET)
- satellite communication systems
- antenna design.



Data Transmission

Wireless Data Transmission Module for UAV:

- Radio Transmission Module
- Log Periodic Dipole Antennas
- Micro USB cable
- Data Cable

Power System Management

UAV Engine with Electronic Fuel Injection

Drone Battery