UAV Workshop

Quadrotor Navigation

Prof. Venki Muthukumar, Ph.D.

Basics of UAV Navigation

- GPS (Global Positioning System): Primary navigation tool for UAVs.

- Inertial Navigation Systems (INS): Measures accelerations and angular rates for position estimation.

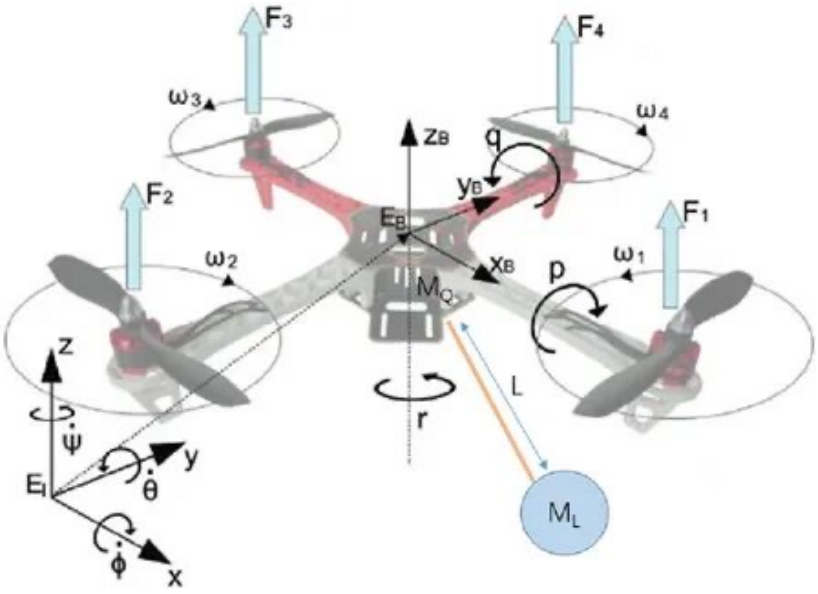
- Barometric Altimeters: Measure altitude using atmospheric pressure.

GPS Navigation

- Utilizes signals from satellites to determine position.
- Provides accuracy within a few meters.
- Vulnerable to signal disruptions in urban canyons or dense foliage.

Inertial Navigation

- Uses accelerometers and gyroscopes for motion sensing.



- INS estimates changes in velocity and orientation.

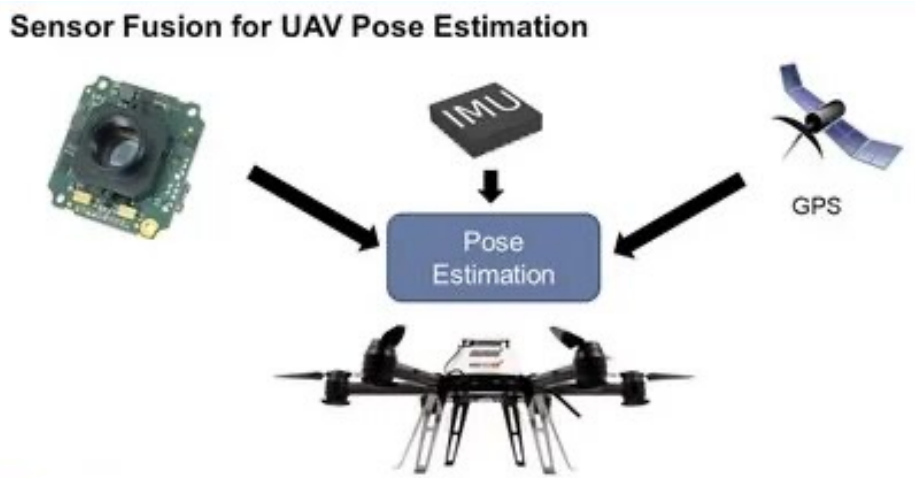
- Drift errors can accumulate over time.

Barometric Altitude Measurement

- Measures atmospheric pressure to estimate altitude.
- Affected by weather changes.
- Used as a complementary system for height information.

Sensor Fusion

- Combining data from multiple sensors for improved accuracy.
- Kalman Filtering: A common technique for sensor fusion.
- Integrates GPS, INS, and other sensors for precise navigation.



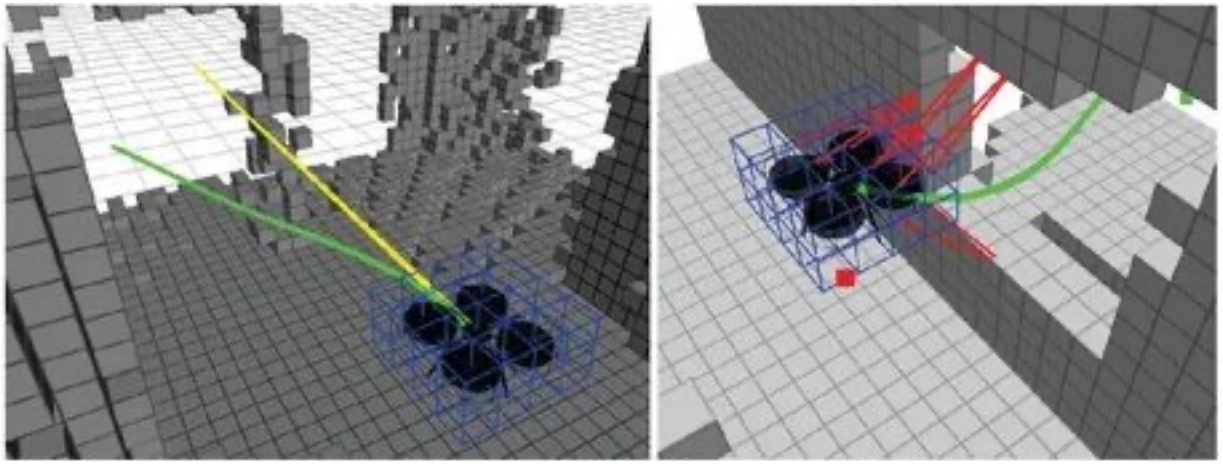
Waypoint Navigation

- Setting predefined GPS coordinates as waypoints.
- UAV autonomously navigates from one waypoint to another.
- Common in surveying, mapping, and surveillance missions.

Obstacle Avoidance

- Sensors such as LiDAR and cameras used for obstacle detection.

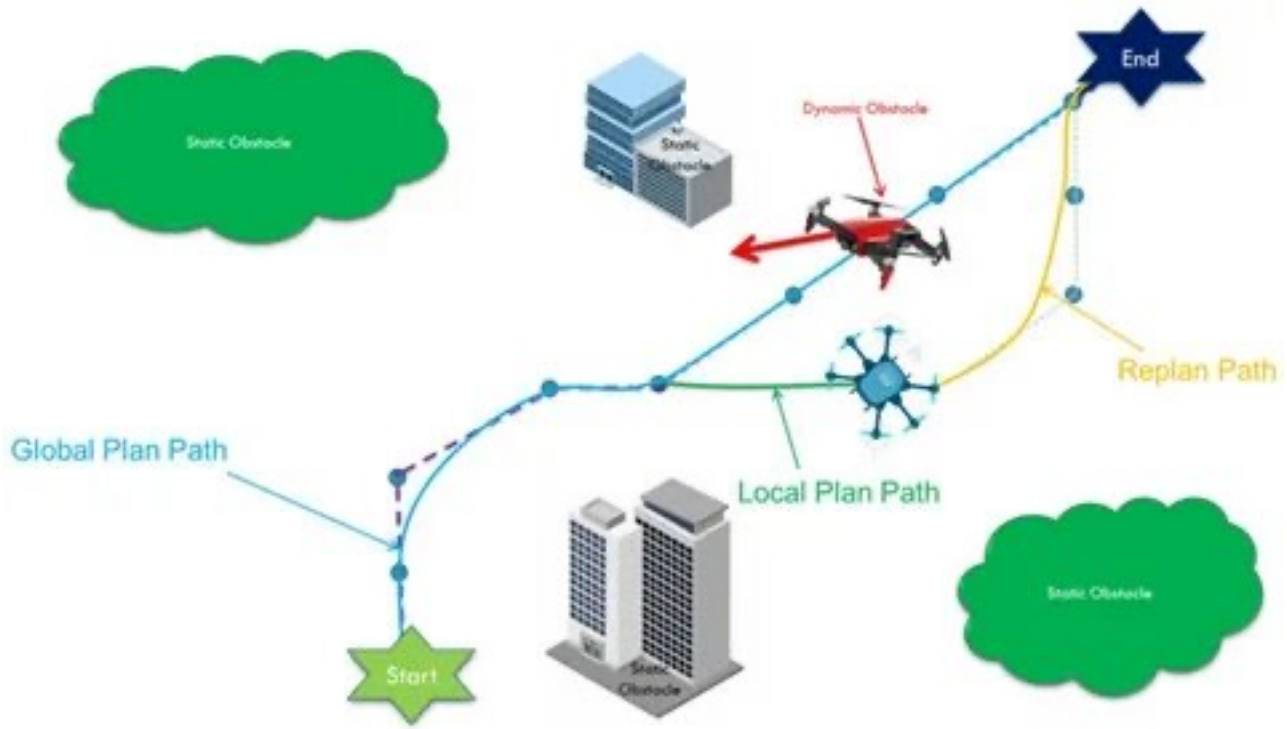
- Enables real-time adjustments to the flight path to avoid collisions.



Mission Planning

- Planning routes, waypoints, and actions before flight.

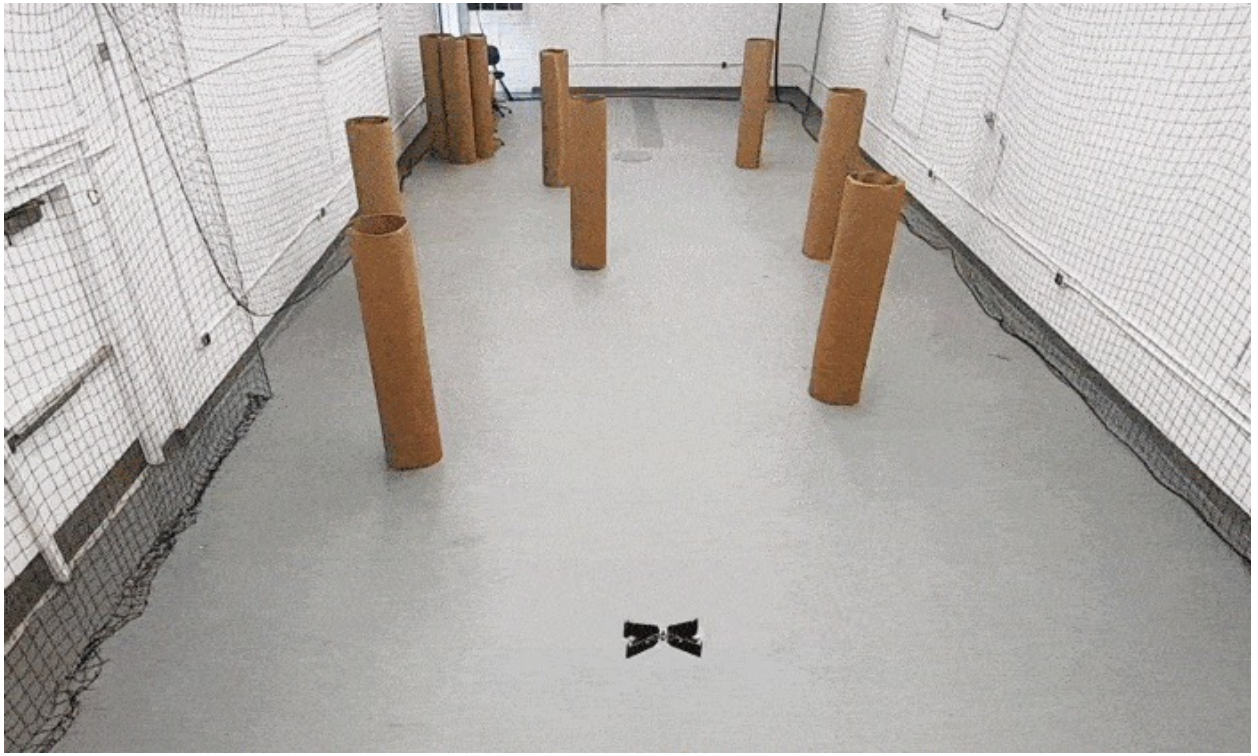
- Incorporates factors like battery life, wind conditions, and airspace regulations.



Autonomous Navigation

- UAVs capable of autonomous flight based on pre-programmed missions.

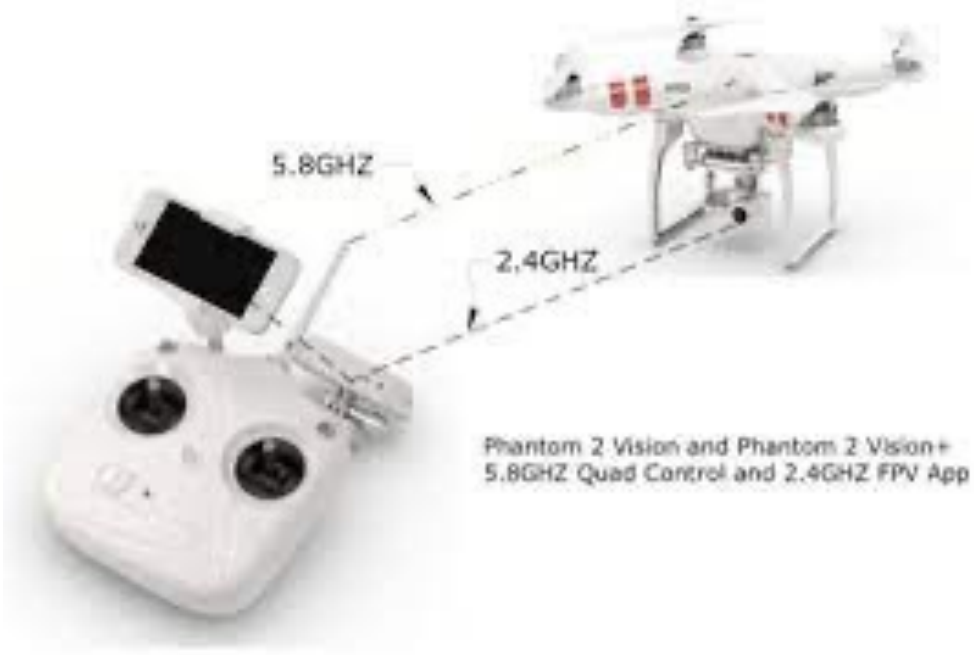
- Includes takeoff, navigation, and landing without human intervention.



Communication Systems

- Data links for real-time communication between ground control and UAV.

- Critical for receiving commands, updates, and sending telemetry data.



Safety Measures

- Geo-Fencing: Virtual boundaries to restrict UAV movement.

- Return-to-Home (RTH) feature for safe landings in case of signal loss or low battery.

Future Trends

- Integration of AI and machine learning for adaptive navigation.
- Advanced sensor technologies for improved precision.
- Continued development of regulations for safe UAV navigation.

Conclusion

- UAV navigation is a critical aspect of unmanned aerial systems.
- Continuous advancements in technology contribute to safer and more efficient operations.
- Ongoing research and development to address challenges and enhance capabilities.