Introduction to Drone Technology 2024 list of topics

This document lists the overall topics that we have worked with in the IDT course. The list is not necessarily complete. Please review the learning goals and note that you may receive questions in both the presented theory and the conducted exercises.

Module 1

- UAV attitude
- Inertial Measurement Unit (IMU)
- gyro, accelerometer, magnetometer, barometer, functionality, output, accuracy (noise, bias) use for drones
- Low pass filtering
- Kalman filter algorithm, reuirements, function, experiments

Module 2

- Geographical coordinates, decimal degrees, minutes and seconds
- Universal Transverse Mercator (UTM) projection, accuracy
- Datums
- GPS/GNSS architecture
- GNSS signal propagation
- GNSS error sources
- NMEA data format
- Dilution of Precision (DOP)
- SPS, DGPS, RTK
- Great circle distance calculations

Module 3

- Radio wave propagation
- Polarization
- Radio frequency spectrum
- Antennas, inverse square law, propagation pattern, gain
- Antenna types: isotropic, half wave dipole, quarter wave ground-plane, yagi-uda
- Free space path loss
- Near field obstacles
- Polarization
- Radio link budget
- Signal to Noise Ratio (SNR)
- Fresnel zones
- Radio propagation simulation

Module 4

- Procedures, checklists
- Open Category rules
- Specific Category overview
- The Specific Operations Risk Assessment (SORA) steps

Module 5

- Pixhawk Flight Cotroller initialization, configuration, sensor calibration
- Telemetry link, configuration
- ROS2 mavros interface

Module 6

- Parachute Recovery Systems
- F3322-22 Standard
- PX4 log file analysis
- UAV failure detection algorithms

Module 7

- The steps of recording track to generate route plan
    1. Position logging
    2. Coordinate conversion
    3. Outlier removal
    4. Simplification algorithms presented and used
    5. QgroundControl test

Module 8

- Standing Wave Ratio theory and measurement
- Dipole antenna design and construction
- Near field obstacle test
- Range test

Module 9-12

- Quadrotor design
- Principal components and electrical diagram
- Motor control
- Battery type, charging, safety
- Command and Control (C2) link (transmitter/receiver)
- Flight tests
- Flight safety
- Drone piloting
- Autonomous flight