End-of-rotation goals:

1. Create a reproducible environment for simulating physical drone attacks using MATLAB/Simulink
2. Attempt to model a drone takeover attack through IMU spoofing with EMI signal injection
3. Systematize and begin to integrate other physical attack mechanisms (vision, LiDAR, acoustic signals)

Week 1 - Environment Setup & Sensor Modeling (09/17-09/23)

- Goals:
  - Install, setup, and verify functionality of MATLAB/Simulink modules
    - Tools:
      - UAV Toolbox
      - Quadcopter drone model
      - Control System Toolbox
  - Initially, create a minimal quadcopter environment and run baseline simulations without noise or disturbances
  - Then, add IMU and GPS models and integrate closed-loop control with EKF state estimation
    - IMU sensor model ideas:
      - configurable bias, scale factor, noise, and sampling rate
    - GPS sensor model ideas:
      - Configurable position, velocity, noise, and latency
- Deliverables:
  - By the end of this week I plan to have a working MATLAB/Simulink environment
  - To verify functionality, I want to capture localization metrics like attitude and altitude error plots during these simulations

Week 2 - RF Front-End & Attacker API (09/24-09/30)

- Goals:
  - Model full RF transceiver for EMI attacks
    - components: antenna, low-noise amplifier, mixer, filter
  - Define attacker parameter inputs for IMU and GPS sensors
    - parameter ideas: transmission power, distance, antenna gain, waveform type, duration
  - Tools:
    - Communications toolbox
    - Simscape electrical
    - Antenna toolbox
- Deliverables:
  - A configurable RF front-end for EMI attacks

Week 3 - Simulate IMU and GPS Spoofing with IEMI (10/01-10/07)

- Goals:
  - Deliver results from an end-to-end RF simulation where attacker parameters produce realistic GPS/IMU spoofing outcomes
  - Possible attack scenarios:
    - Vary transmission power, distance, waveform, antenna orientations
    - Attacks while the drone is flying
- Deliverables:

  - Attack success metrics from running the proposed simulations
    - GPS spoofing success if vehicle position error > a predefined threshold
    - IMU spoofing success if the IEMI induces instability with the drone

Week 4 - Developing Other Physical Attack Libraries (10/08-10/15)

- Goals:
  - Extend the physical attack API to include possible vision, LiDAR, and acoustic attacks
  - Vision:
    - Generate synthetic scenes and create an injection API that can replace or insert adversarial frames at given times
  - LiDAR:
    - Implement spoofed range readings or adversarial point cloud injection to induce obstacles or false range-to-ground readings
  - Acoustic:
    - Map simulated vibrational input to an induced IMU signal based on its resonant frequency
  - Tools:
    - UAV Toolbox
    - Computer Vision Toolbox
- Deliverables:
  - API's for modeling possible attacks on a drone's vision and LiDAR systems. And an API for attacking IMU sensors with acoustic signals.

Week 5 - Large-Scale Testing and Documentation (10/16-10/22)

- Goals:
  - Run large-scale tests incorporating flight dynamics and attack detection/mitigations
  - finalize environment documentation
- Deliverables:
  - Fully documented and reproducible simulation environment for physical attacks on drones
  - A final report detailing attack methods, required transmission powers and distances, and attack detection performance

Helpful references for myself

- https://www.mathworks.com/discovery/drone-simulation.html
- https://www.mathworks.com/videos/series/drone-simulation-and-control.html
- https://www.mathworks.com/help/sps/ug/quadcopter-drone.html
- https://www.mathworks.com/videos/programming-drones-with-simulink-1513024653640.html
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- https://www.nwengineeringllc.com/article/rf-front-end-design-specifications-and-component-selection.php