FLIGHT VEHICLE VISUALIZATION

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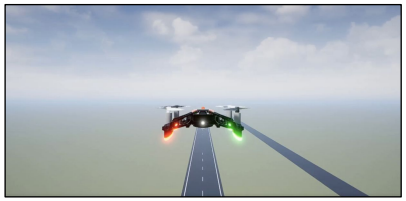
GENERAL DYNAMICS

Project Overview

- Drone visualization using real and simulated telemetry
- Full pipeline from flight data to 3D animation
- 6DOF drone simulation model
- Standardized telemetry processing
- MATLAB / Simulink interface
- Simulated vs. real flight comparison
- Demo and promotional visualization support

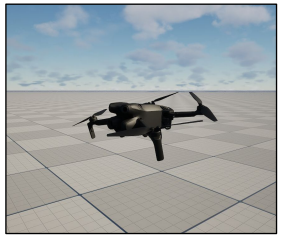


Simulation Software

- Processes GPS, altitude, and telemetry data from drone flights
- Filters duplicate data points for smoother motion and playback
- Generates timestamped 3D velocity vectors for flight modeling
- Transfers simulation outputs directly to the animation system
- Supports telemetry and coordinate data from multiple sources

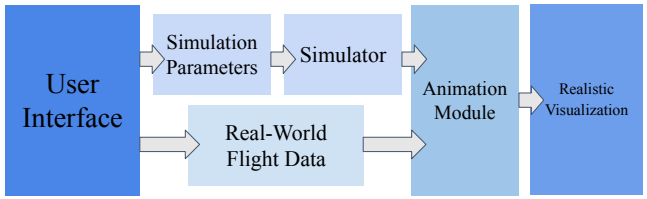
Animation Software

- Simulink-driven animation system
- Uses telemetry and simulation outputs
- Imported custom Blender drone model into Unreal Engine
- Rigged skeletal mesh for rotor motion
- Multiple camera views and terrain options

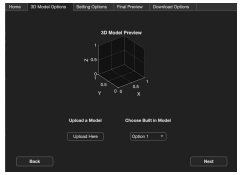


Integration

- Integrated the flight simulation and animation into one MATLAB app
- Connected processed telemetry data to drive the drone's flight path
- Added app controls to load data, run the simulation, and view the animation
- Working on linking simulation outputs directly to the 3D visualization
- Made the workflow easier by combining scripts, simulation, and animation in one place



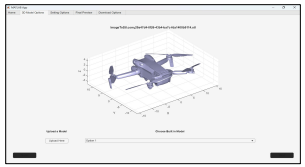
User Interface



- Tab-based MATLAB app interface
- Controls for loading data and running simulation
- File input selection areas
- Organized simulation and visualization layout
- 3D model preview feature

Final Application, Results and Future Work

- Goal: generate realistic RD53A data representative of LHC detector outputs
- Analyzed real LHC data using image processing techniques
- Testing showed detector data is dominated by simple shapes and tracks
- Generated pseudo-random hit patterns through Aurora lane outputs
- Sample image demonstrates a representative generated hit pattern



Future Work

- More customizable options
- Incorporate different drone options
- Front end branding and design

Hardware & Testing

Purpose

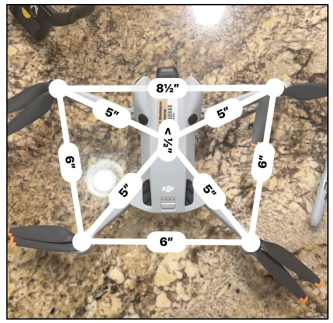
- Collect real-world telemetry data to validate the simulation.

Hardware System

- Representative drone platform
- ROS2 compatible environment
- Onboard telemetry logging

Testing Goals

- Compare simulated flight data with real drone behavior
- Validate position, velocity, and orientation accuracy
- Ensure simulation reflects real flight conditions



Project Requirements

Functional Requirements

- ❑ Developed a 6DOF flight simulation that includes realistic environmental disturbances such as wind and noise
- ❑ Built a telemetry-driven animation pipeline that converts flight data into smooth and realistic drone motion
- ❑ Added user controls for adjusting camera views, playback speed, and zoom during visualization
- ❑ Implemented functionality to export flight simulations as video demonstrations for presentations and promotional use

Non-Functional Requirements

- ❑ Ensured reproducibility through the use of a standardized telemetry data format
- ❑ Designed the visualization system to balance realistic motion with computational efficiency
- ❑ Used a modular system architecture to simplify future expansion, testing, and maintenance

References & Acknowledgments

References

[1] The MathWorks Inc., "MATLAB," version R2026a (9.XX), Natick, MA, 2026. [Online]. Available: https://www.mathworks.com.

Acknowledgments::

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