# UAV Strategic Deconfliction System

Developed as part of FlytBase Robotics Assignment 2025  
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## Overview

This project implements a pre-flight UAV conflict detection system that evaluates the safety of a drone mission by checking:  
- Spatial Conflicts (3D distance threshold)  
- Temporal Conflicts (within specified time range)  
- Visualization of Conflicts in interactive 3D space

## Features

- 3D spatial proximity checks using Euclidean distance  
- Temporal proximity checks with adjustable thresholds  
- Support for custom JSON mission formats  
- Visualization using Plotly 3D  
- Conflict explanation logs and summaries  
- Modular, testable, and scalable architecture

## Folder Structure

project/  
├── conflict\_checker.py # Core logic  
├── visualization.py # 3D plotting using Plotly  
├── test\_basic\_conflicts.py # Testing & demo runner  
├── data/  
│ ├── primary\_mission.json  
│ └── simulated\_drones.json  
├── README.md # This file  
└── output/ # Visualizations or logs

## Input Format

primary\_mission.json:

{  
 "time\_window": ["2025-05-29T10:00:00", "2025-05-29T10:20:00"],  
 "waypoints": [  
 {"x": ..., "y": ..., "z": ..., "timestamp": "..."},  
 ...  
 ]  
}

simulated\_drones.json:

[  
 {  
 "drone\_id": "Drone-1",  
 "waypoints": [  
 {"x": ..., "y": ..., "z": ..., "timestamp": "..."},  
 ...  
 ]  
 },  
 ...  
]

## Conflict Criteria

- Spatial Threshold: ≤ 5.0 units (meters)  
- Temporal Threshold: ≤ 2.0 seconds

## Testing

Used a combination of:  
- Isolated test scenarios: Head-on, crossing, overtaking, vertical, diagonal  
- Complex hybrid test case: 15 drones with mixed conflict & non-conflict patterns

## Visualization

- Red markers = detected conflicts  
- Green/Orange = start/end points  
- Interactive 3D plot rendered using Plotly

## Future Improvements

- Use KD-Trees for fast nearest-neighbor queries  
- API/GUI for mission upload & result visualization  
- Real-world integration with UAV telemetry streams