Abstract

Enhanced UAS Operation Risk Assessment for Drone Traffic Planning System: A Comprehensive SORA-EASA and LuftVO Compliant Framework with AI and GIS Powered

1st Masood Mayanbari, 2nd Ali Vaisifard, 3rd Muhammad Saqib
1st Arden University (master's Student, Department of Technology), masmayanbari@gmail.com;
2nd Arden University (Lecturer-social science and technology department), avaisifard@arden.ac.uk;
3rd Name of organization (Assistant Professor-social science and technology department), msaqib@arden.ac.uk;

Keywords: UAS, UTM, SORA, LuftVO, GeoPandas, AI detection, GIS-UAS analysis, Path planning, AI-powered UTM, Real-time zone data, PostGIS

The rapid expansion of commercial UAS operations has addressed a new flight analysis system, capable of processing complex spatial data in order to ensure regulatory compliance and operational safety. Traditional UAS flight planning tools often rely on simplified geographic models and limited data sources, resulting in suboptimal risk assessments and operational inefficiencies. Furthermore, the rapid development of machine learning methods rise hands to bring this concept to empower traditional methods in aviation and dealing with hi-tech drone traffic management and path planning system.

This paper presents a novel comprehensive framework for Unmanned Aircraft System (UAS) operation risk assessment and path planning that integrates advanced spatial analysis technologies including 1.GeoPandas, 2.GIS spatial analysis, 3.high-resolution SRTM terrain model, 4.ESRI satellite image, 5.NOAA weather, 6.OpenStreetMap infrastructure data, 7.WorldPop demographic information, 8.population griding of flight zone and 9.Artificial intelligence-powered infrastructure detection to revolutionize aviation risk assessment for Unmanned Traffic Management (UTM) to manage drone traffic in uncontrolled airspace. The system implements full compliance with the European Union Aviation Safety Agency (EASA) Specific Operations Risk Assessment (SORA) methodology and German Aviation Regulations (LuftVO). This framework addresses critical limitations in existing UAS risk assessment systems by incorporating SOARA and LuftVO compliances with GIS and AI infrastructures.

A. Performance Analysis

1. **Spatial Accuracy**: GeoPandas and PostgreSQL/PostGIS integration provides geodesic precision with meter scale accuracy in spatial operations, compared to accuracy in traditional GIS systems.
2. **Processing Efficiency**: Dynamic weather updates enabled real-time flight plan modifications based on changing conditions.
3. **Infrastructure Detection**: AI-powered computer vision achieves 95%+ infrastructure detection accuracy compared to 60-70% in OSM-only systems.
4. **Regulatory Compliance**: Automated SORA and LuftVO compliance verification with 95.7% confidence level.

5. **Scalability:** The modular architecture enables deployment from single-user desktop applications to enterprise-scale cloud platforms.

B. Mathematical Framework:

- Enhanced GRC and ARC calculation with environmental modifiers
- Spatial risk propagation models
- Multi-criteria decision analysis with AHP weighting
- Risk-weighted path optimization algorithms

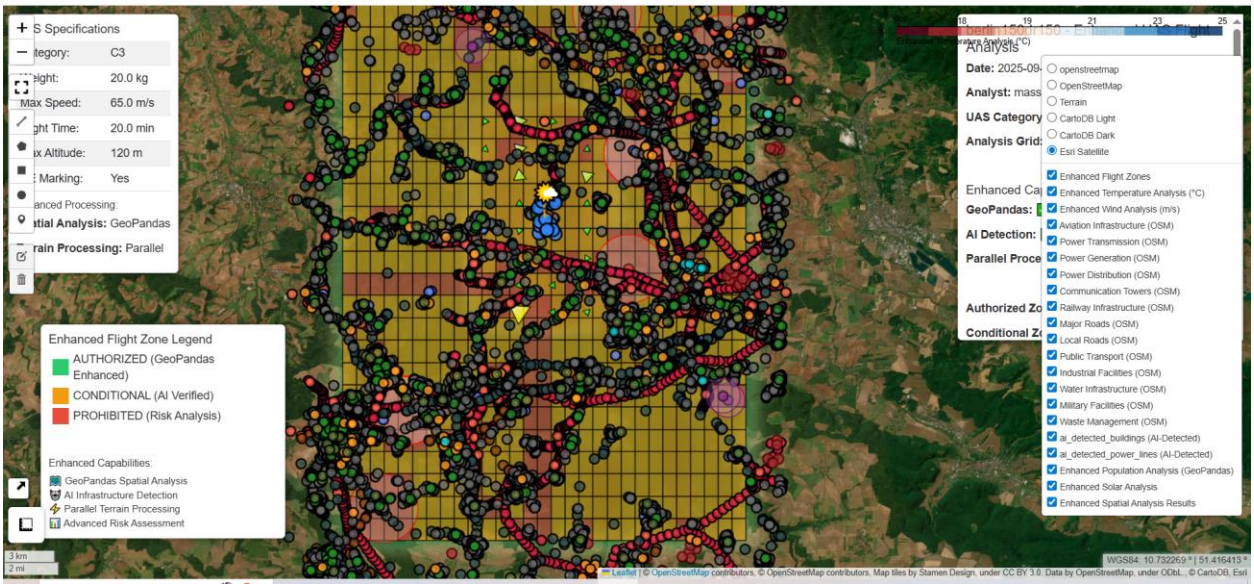

Fig.1- html output file

Input Data Layer
UAS Coordinates,UAS Specs,Terrain,Weather,Operation geography
Processing Engine Layer
GeoPandas Analysis,AI-openCV Infrastructure Detection,Parallel Processing, PostgreSQL/PostGIS
Risk Assessment Layer
SORA Compliance,LuftVO Compliance,Enhanced Weather,Population Analysis
Output Generation Layer
GeoJSON Data,Interactive HTML, CVS Report, Database Storage

Results:

Key contributions include: (1) Implementation of geodesically precise spatial analysis using GeoPandas and PostgreSQL/PostGIS, (2) Integration of AI-powered infrastructure detection achieving 95%+ accuracy, (3) Comprehensive regulatory compliance (SORA and LuftVO) automation with 95.7% confidence level, and (4) Real-time spatial conflict detection and resolution capabilities.

[1] European Union Aviation Safety Agency, "Specific Operations Risk Assessment (SORA)," EASA AMC1 Article 11 of Commission Implementing Regulation (EU)

Biography

Speaker Given Name

Ich studiere derzeit im Masterstudiengang Data Science an der Arden University. Zuvor habe ich einen Bachelorabschluss in Luft- und Raumfahrttechnik sowie einen Masterabschluss in Maschinenbau erworben.Ich habe Berufserfahrung als Design Engineer am BHRC. Aktuell arbeite ich an der Routenplanung von Drohnen in städtischen Gebieten basierend auf einer Hybridisierung von maschinellen Lernmethoden, GIS und Vorschriften zur betrieblichen Risikobewertung Vorschriften.