OpenGAIN

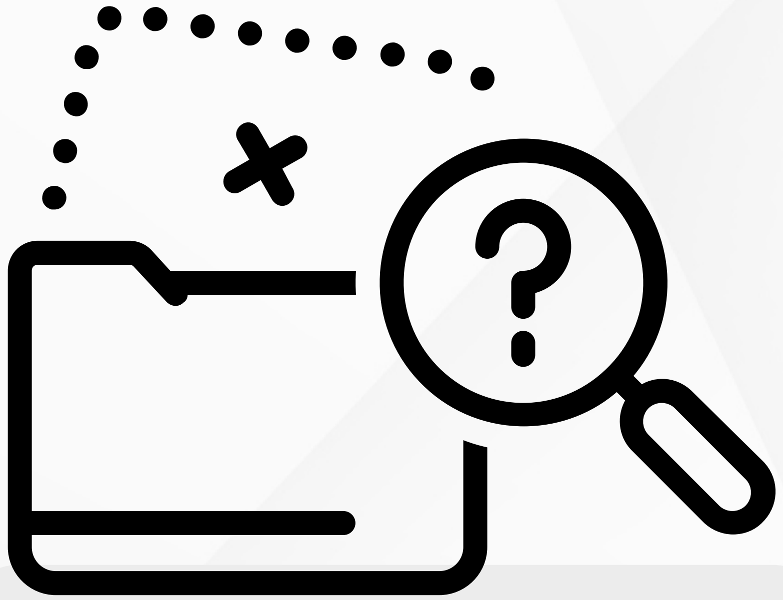
Co-creating the future of SAFE Low Altitude Economy (LAE) In the Northern Metropolis:

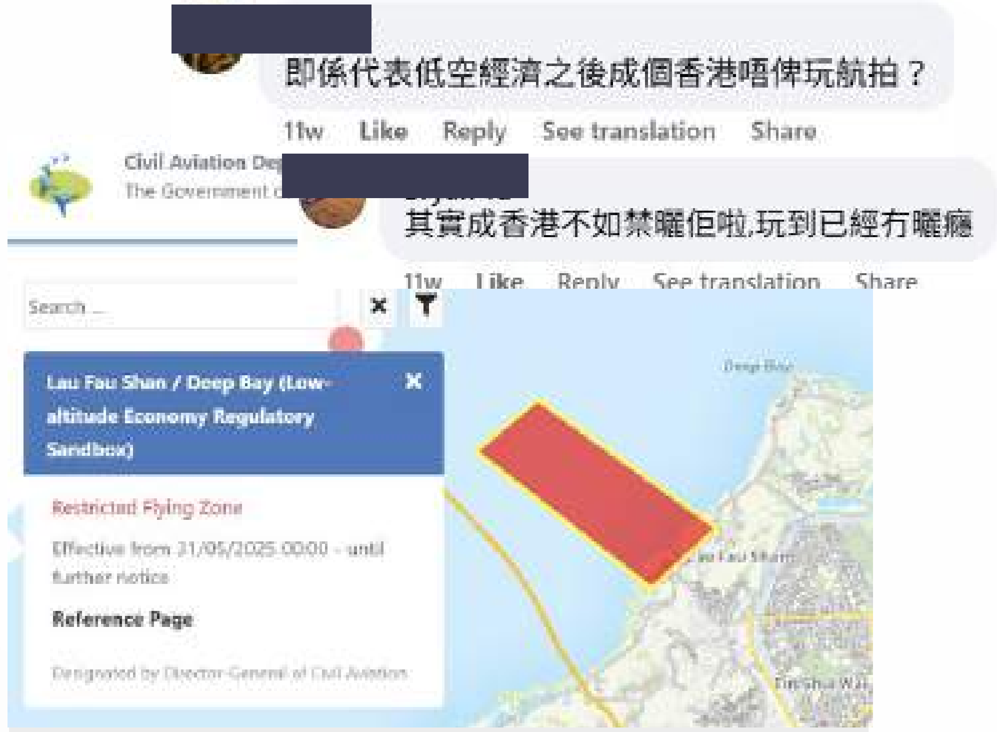
1 webapp 2 layout 3 innovations
4 key features for 5+1 stakeholders,
co-creating
the SAFE LAE with 30 Data Streams

CSDI 2025 - 0324F - Pathfinder

- NM - LFS become one of the most complex airspace :
  a. Delivery services
  b. Tourists recreational flying
  c. Emergency response operations (GFS helicopter, FSD or police drone)
  d. Patrol / duty drone (CEDD, Lands etc)
  e. Flyaway Birds

Why these happen ? The pain point we're Solving





數不通

Data silos / No data !

No SHARE / SILOS, no reference. struggle to coordinate flight plans

"You can't improve what you don't measure !"

查不全

Check multiple apps / website before fly

Manually check disconnected sources (Map, HKO, CAD eSUA 448G, CAD 448C RFZ, park rules, etc.) → 20+ minutes per flight prep.

飛不序

Fly by random / imagination / no plan

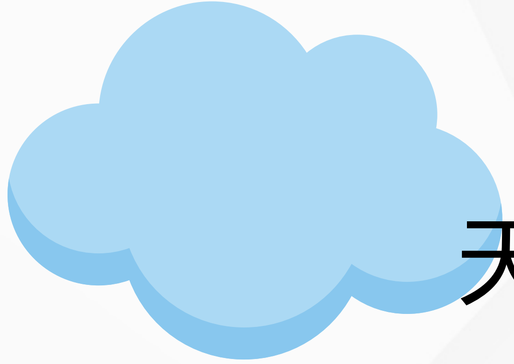
ad-hoc, imagination, randomly and poorly planned and no risk mitigation

用不盡

Resource Inefficiency / 2D Visualization

2D airspace occupy entire 0 to 300m, when only one altitude layer is needed → wasted >80% of airspace capacity

Open G eo - Air - Information Nexus - 4 key features



天

地

人

機

物

OpenGAIN

Powered by

esri

2 layout:
Desktop
+
Phone

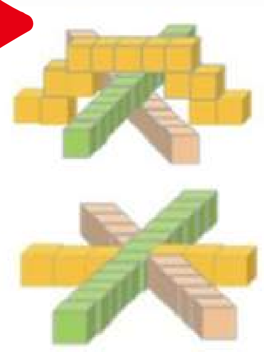
Community of practice
One stop to plan and share flight plan in 3D with privacy by design

查得快

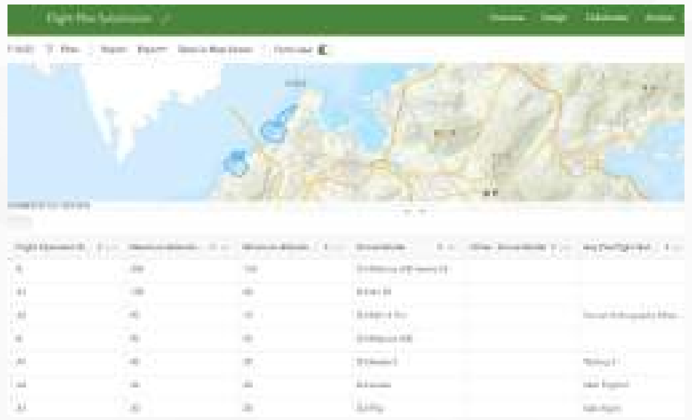
AI congestion detection

飛得穩

LIVE 2D/ 3D Anonymized Monitoring Map



用得盡



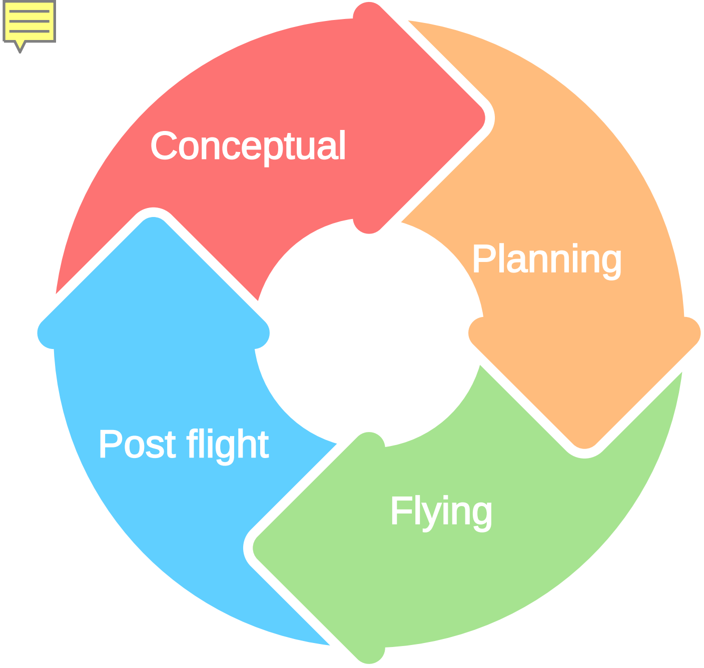
Data as a Service (DaaS)
Sharing Without Privacy Concerns with china standard MH/T 2011-2019, ISO 19115, 19139, 19119, 27040 for LAE / Data Econ. transformation, Smart cities development

數互通

MH

中华人民共和国民用航空行业标准

无人机云系统数据规范



OpenGAIN - ready to use platform to support drone flight lifecycle with User -Centricity and data privacy

1. Anonymous flight plan submission and drone location display Complies with HK PDPO (Privacy by Design)
2. Anonymization of usage / store data
3. ESRI ArcGIS have FedRAMP moderate authorization (handle sensitive data), complies with EU GDPR ,US DPF and 中国网络安全等级保护三级认证（GB/T 22239）及 ISO 27001). (system stability and data privacy.)

OpenGAIN

5 + 1 Target users - Every airspace stakeholder

飛得穩
10000+ Registered drone pilot / Traveler / Citizen

Accesses AI Alerted situational maps, improving flight safety and enjoyful

管得活
Governing body and city planner

Data driven dynamic airspace management (e.g. Restricted Flying Zone)and compliance monitoring, enhancing safety. design drone-friendly urban infrastructure and zoning

保得專
Insurance company

Operational air risks and factors data for more precise underwriting and dynamic policy pricing . Saving premium

救得快
Emergency Responder (700+ police & 6 Fire officers)

real-time flight coordination support to deploy drones quickly and safely in urban situations.

送得達
2+ Commercial delivery enterprise

Optimizes drone delivery routes schedules, reducing delays and incident

遷得安 (Eco-balance)
FLYAWAY BIRD 候鳥!

Sep - Jan every year is the busiest bird flyaway month.

Balance the LAE and Eco-Tour and Eco-environment !

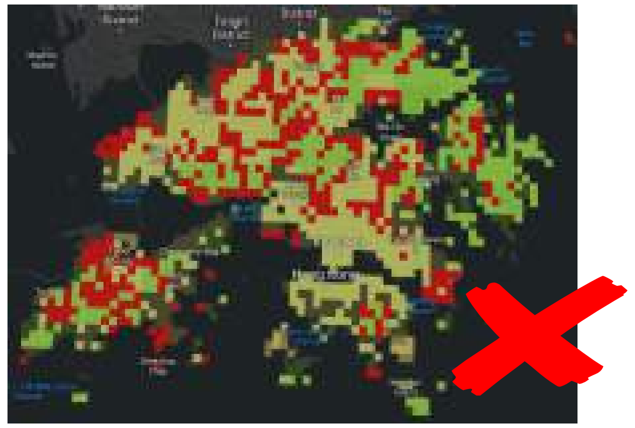
30 Data steam used in this webapp （ 22 from CSDI ）

CATEGORIES	DATASTEAM (MULTIPLE SET INSIDE)	HOW TO USE / GEOPROFESSING
Geography (5)	1.3D Visualization Map API 2.iB20000 Hong Kong Boundary 3.NM Boundary 4.iB1000 Hydrography 5.iB5000 Pavement Road and Rails	3D Map as Digital foundation Hong Kong and NM Boundary as analytic boundary (clip function) Find the potential take off site by Overlay (Erase)
Development (1)	1.Building	Find the potential take off site by Overlay 30m Buffer (Erase)+ Building -weighted SORA Map
Utilities (7)	1.iB1000 Utilities - Wireless / Microwave / Signal Station / Electrical pole / Electrical Pylon / electical cables 2.Multiple Pipes (Stormwater) 3.Pipe (Sewage) 4.Pipe (Stormwater) 5.Box Culvert / Tunnel Polygon (Stormwater) 6.Box Culvert / Tunnel Polygon (Sewage) 7.Catchwater - Engineered Drainage Systems	Find the potential take off site by Overlay 10m Buffer (Erase) for Interference
Land Information (2)	1.ic1000 – Lot, GLA, Resumption lands 2.Public Toilet / helipad	LOT, GLA and STLA for take off site by Overlay Feature introduction in Storymap
Health (1)	1.AED Location	Point XY to feature
Transportation (4)	1.Green MiniBus Route (33 and 35 in LFS) 2.448G CAD RFZ 3.448C Aircraft + Disney RFZ 4.NOTAM with parser	How to go to the recommended take-off points Flight planning webapp
population (1)	1.2021 Census (Large Subunit)	Building-weighted SORA Map
Recreation and Culture (3)	1.Park, Zoos, Gardens 2.Sturnia Sinensis (from movebank) 3.Aviary Boundary	Most Parks are Limited Flying Zone, from point to polygon Bird migration corridor modeling (Sturnia Sinensis data + temporal analysis) Bird location for reference on bird strike risk
Climate and Weather(4)	1.Sunset / Sunrise 2.Mean 10min wind ▶ LIVE 3.Kp Index (from NOAA) ▶ LIVE 4.Raining nowcast ▶ LIVE	Monitoring the weather and EMI interference live dashboard, Early mission abortion decision
ioT (2)	1.Drone RF Radar ▶ LIVE 2.Helicopter ADS-B ▶ LIVE	Monitoring Drone and Helicopter flight path for congestion and collision risk

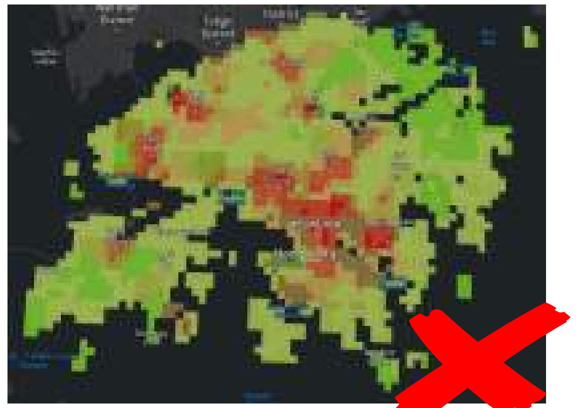
Our 3 innovations – GIS / Machine Learning integration

Find the SAFEtake - off site from 20 open dataset

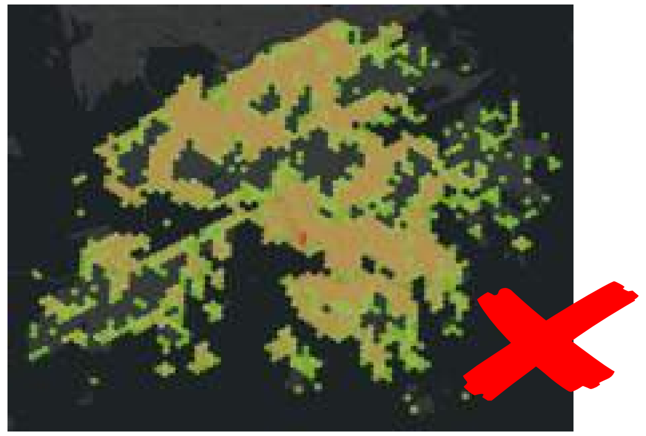
- Spatial analysis (Buffer, Overlay, Clip, Erase, Projection convention, XY point to feature, point to line)
- Walking accessible with Pavement and Road datasets
- Buffer 30 meters for uninvolved road, rails, building(448G ordinance)
- Buffer 10m inference from electrical pole, pylon, underground water pipe,
- Highlight 1580m from radio station



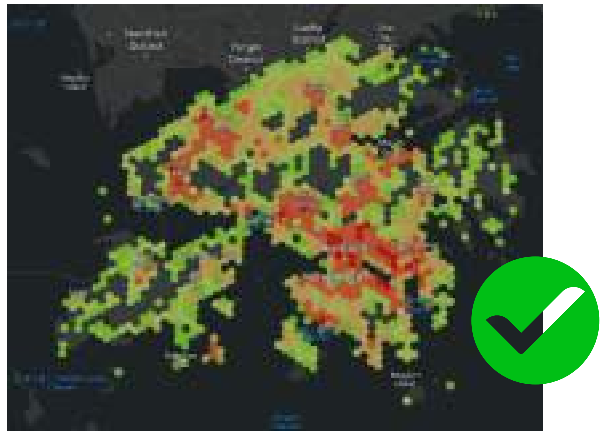
Landscan (R=0.876)



WorldPop (R=0.794)
(random forest regression)



by mean (R=0.463)



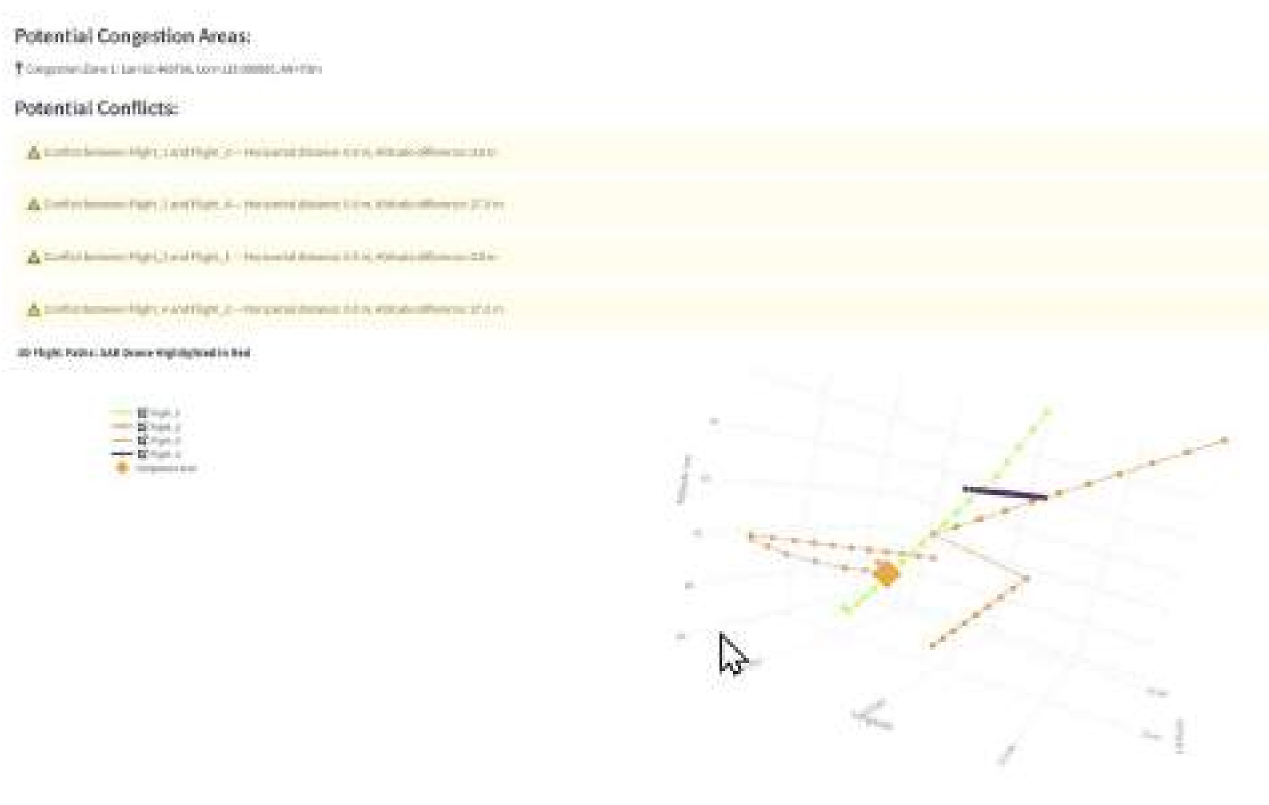
Our algorithm (if R=1)

HK drone ground risk map ©
香港無人機地面人口密度風險地圖©
a NEW SAFETYdata map

Spatial analysis with Census 2021data + 330,000 building weighted, into ground risk level map , display as international standard SORA (ISO 21384-3:2019 and China AC-92-2019-01)

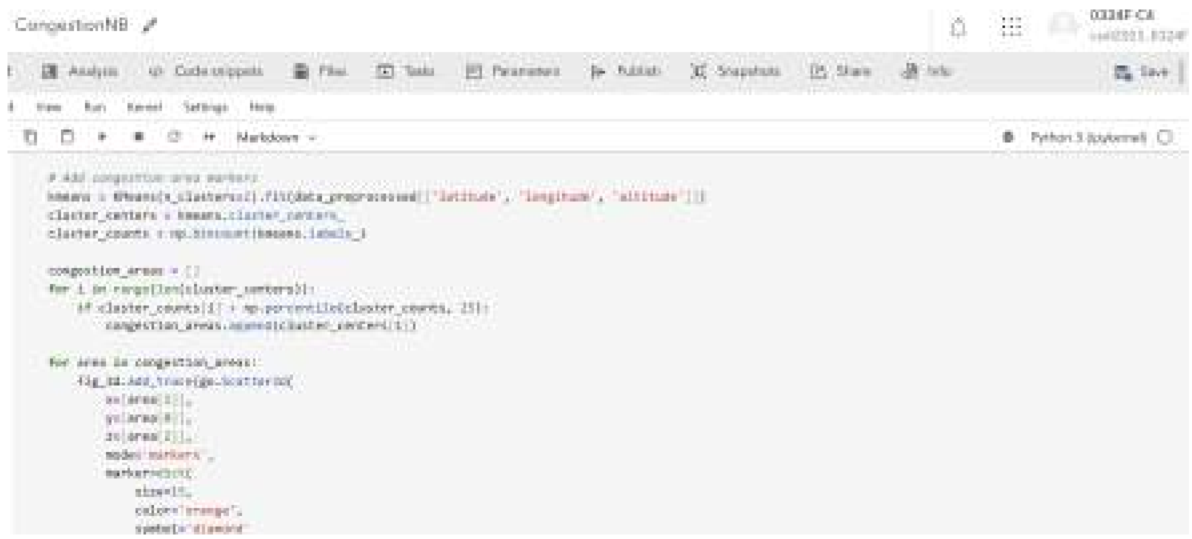
JARUS Joint Authorities for Rulemaking on Unmanned Systems

JARUS guidelines on Specific Operations Risk Assessment (SORA)



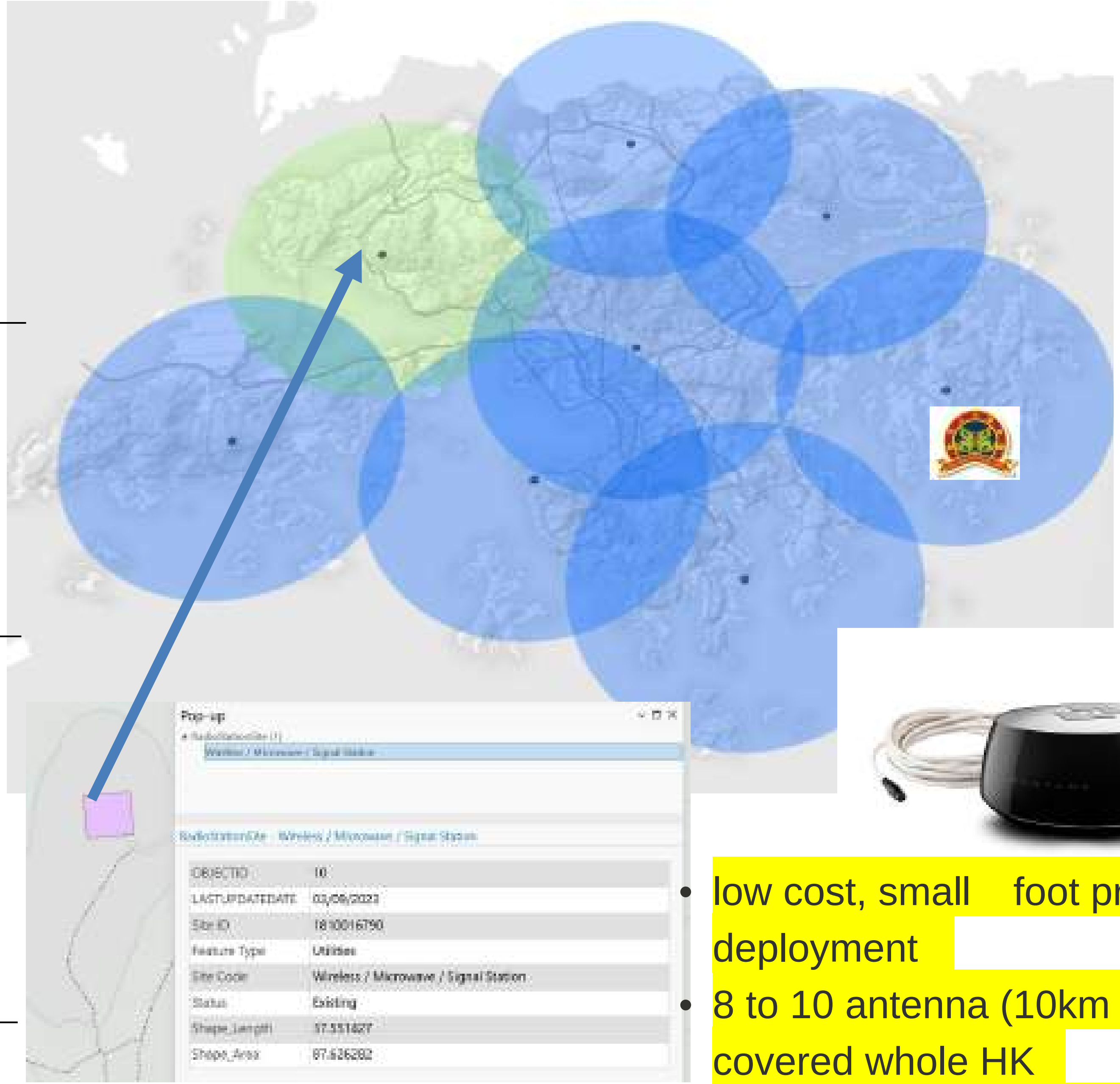
crash prevention via Airspace congestion alert

AI Unsupervised machine learning model (K-means clustering) abnormal detection from recent 30 sec (30 datapoint per drone) radar data



Tangible Benefits - ESG, Scalability, Sustainability

	Estimated Business Value	Social Benefit	Data Support Reference
Environment (E)	37% Carbon reduction	**eco-balance (flyaway Bird)**	**中國 2021农业无人机环境责任报告**
Social (S)	11% decrease in accident	Enhance aviation knowledge and drone awareness **看得見、摸得到**	Hong Kong Adventure Corps drone study group data
Governance (G)	Compliance check time: 22min → 45 seconds	>90% drone user satisfaction Decrease non-compliance	US LAANC (Low Altitude Authorization and Notification Capability) user satisfaction survey



- low cost, small foot print deployment
- 8 to 10 antenna (10km radius) covered whole HK
- Feasible installation site via spatial analysis (tessellation + buffer)
- **OpenGAIN** – A **non - profit NGO** will be established to operate openly regardless of this competition result (ref business model:
  - UK Altitude Angel,
  - FlightRadar24,
  - OpenWeatherMap.org)

OpenGAIN

Our Team

SMALL UNMANNED AIRCRAFT
ADVANCED OPERATIONS PERMISSION

香港特別行政區政府
THE GOVERNMENT OF
THE HONG KONG
SPECIAL ADMINISTRATIVE REGION

民航處
CIVIL AVIATION DEPARTMENT

AOP/NT/24

Issue : 1

Point of Contact: CHAN Chun Kit Jacky

Contact No.:

Email:

Location :

OpenGAIN

"We are Pathfinder — uniting data, GIS, IoT & AI to chart SAFE, enjoyable flight paths in NM from user perspective"

齊齊數據互聯! 智飛北都共贏!!

With deepest gratitude to:

- Dr. Elton CHAN - Sr Land Surveyor, LandsD
- Dr. ZHANG Haotung - Land Surveyor, LandsD

Without Whom None of This Would Exist

- our GIS teacher –Mr. Steve LAU - Geolab staff !!

Jacky CHAN

Assistant Professor (Nursing)

Hong Kong Metropolitan University

- Civil Aviation Department SUA Advanced Operation Permit holder and Adv rating pilot
- Fellow and instructor in Search and Technical Rescue (drone)(UK)
- Lead, HK Adventure Corps Drone Study Group
- Certificate in Python programming
- Certificate CCBC BIM Coordinator course

Responsible for Project Management, ArcGIS Pro spatial analysis, literature review, Live Map

Vincent MA

Biomedical Engineer (Greater China)

Laerdal Medical

- CAD Advanced Rating Remote pilot
- Certified Laerdal Engineer
- Completion of Cisco Certified Network Associate (CCNA) Training
- Instructor, HK Adventure Corps Drone Study Group

Responsible for survey123 flight plan submission and 3D visualization on ArcGIS Online

Ken CHUNG

Director

Neo production company Limited

- CAD Advanced Rating Remote pilot and instructor
- Registered Social Worker and Experienced social entrepreneur
- Drone search and Rescue Instructor (HK & UK)
- Instructor, HK Adventure Corps Drone Study Group

Responsible for storyboard, and showcase, citizen user experience design, business development.

KAN Wing Chung

Simulation Officer

Hong Kong Sanatorium & Hospital

- Experience funding application, managing simulation centers and organizing training programs in both the Hospital Authority and private hospitals.

Responsible for user experience design (management and governance workflow), Data privacy, ESG impact, sustainability

Marcy CHOI

Scientific Manager

Hong Kong Metropolitan University

- Experience in planning and managing IT system setup and development
- Oracle Database Administration Certified Professional

Responsible for technical system architecture and integration, including the data security, setup and operation of IoT data to spatial data processing and API

TANG Tin

Software Engineer

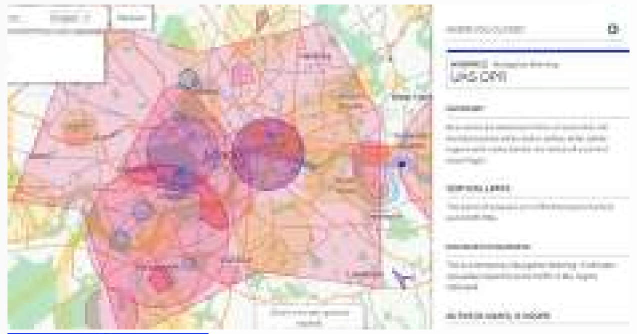
- CAD Advanced Rating Remote pilot
- Drone search and Rescue Instructor (HK & UK)
- Superintendent of St John Ambulance Brigade

Responsible for technical system architecture and integration, and emergency responder workflow user experience design

Reference: Oversea cases and our Competitive edge

airspacelink

US FAA
LAANC



ALTITUDE ANGEL

UK Altitude
Angel (NGO)

民用无人驾驶航空器综合管理平台

China
CAAC
UOM

HK Geoinfo Map

HK CAD
eSUA apps

Open share API / User input ecosystem

Open
Co-creation

OpenGAIN

2D
Map

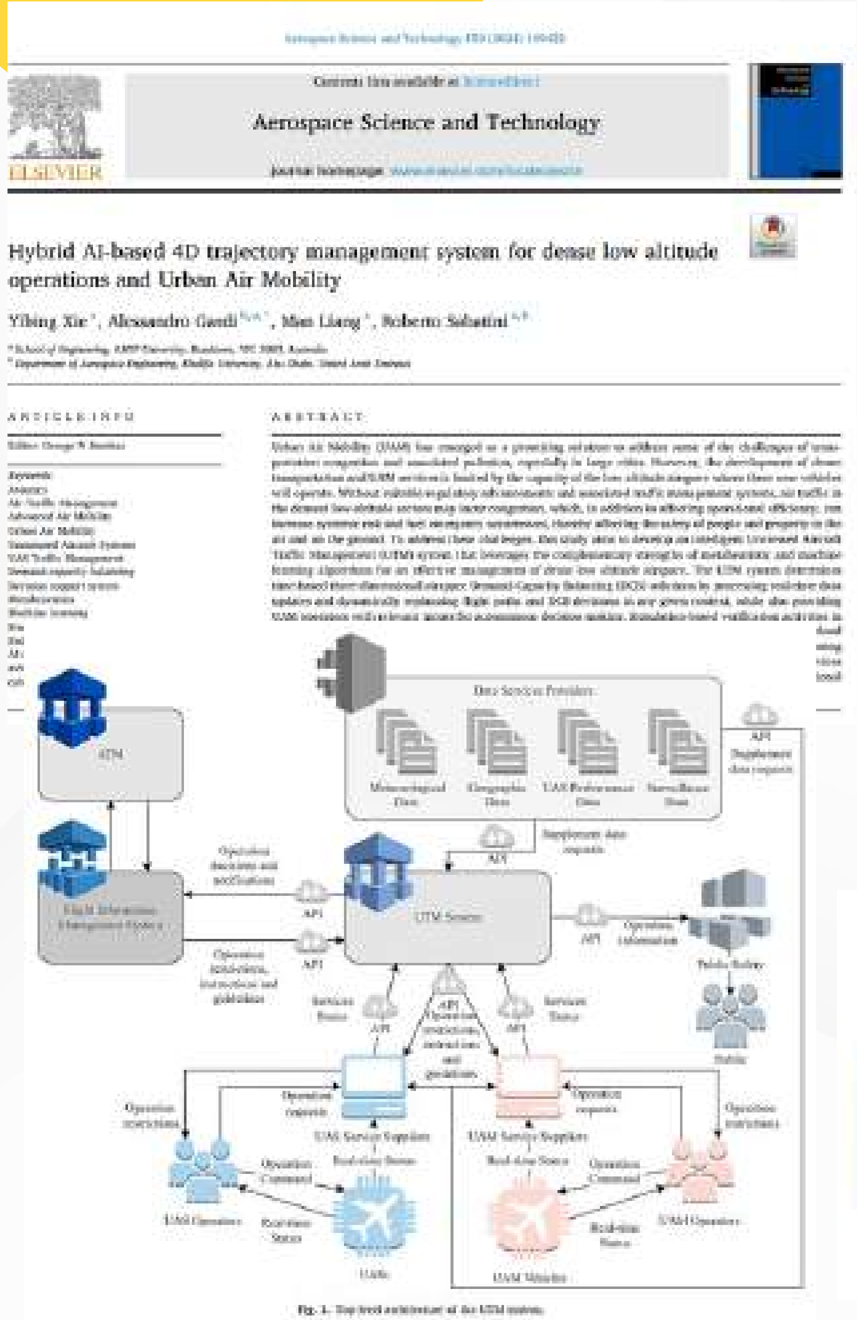
2.5D
Map

3D
Model

Siloed / Not share

Key Reference:

4D LAE UTM Geofence GIS 2D vs 3D U



Aerospace Science and Technology 153 (2024) 109422

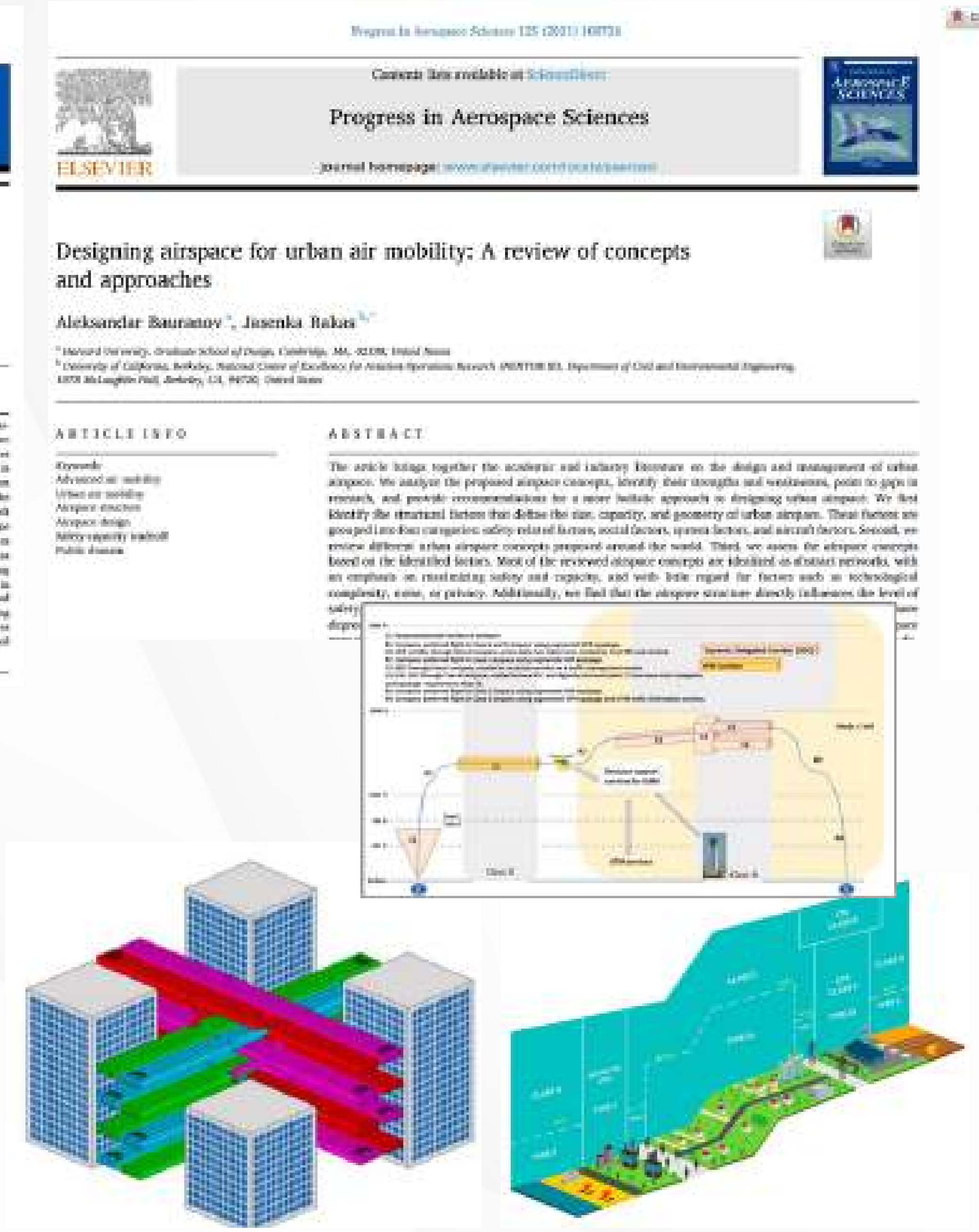
Aerospace Science and Technology

Hybrid AI-based 4D trajectory management system for dense low altitude operations and Urban Air Mobility

Yibing Xie, Alessandro Gardi, Man Liang, Roberto Sabatini

Fig. 1. Top level architecture of the UTM system.

Xie, Y.,Gardi, A., Liang, M., & Sabatini, R. (2024). Hybrid AI-based 4D trajectory management system for dense low altitude operations and Urban Air Mobility. Aerospace Science and Technology, 153, 109422. https://doi.org/10.1016/j.ast.2024.109422



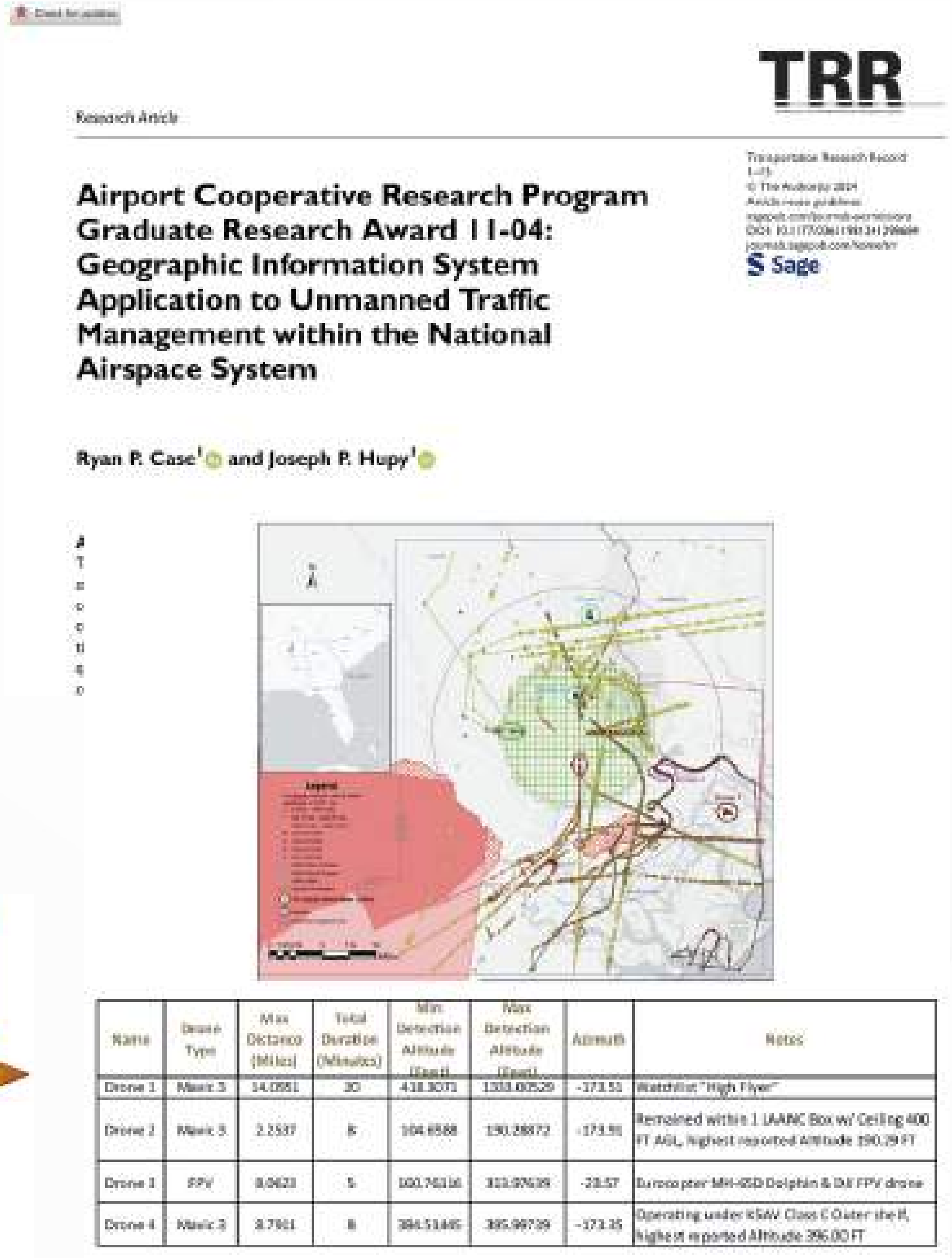
Progress in Aerospace Sciences 125 (2021) 100726

Progress in Aerospace Sciences

Designing airspace for urban air mobility: A review of concepts and approaches

Aleksandar Bauranov, Jasenka Rakas

Bauranov, A., & Rakas, J. (2021). Designing airspace for urban air mobility: A review of concepts and approaches. Progress in Aerospace Sciences, 125, 100726. https://doi.org/10.1016/j.paerosci.2021.100726



TRR

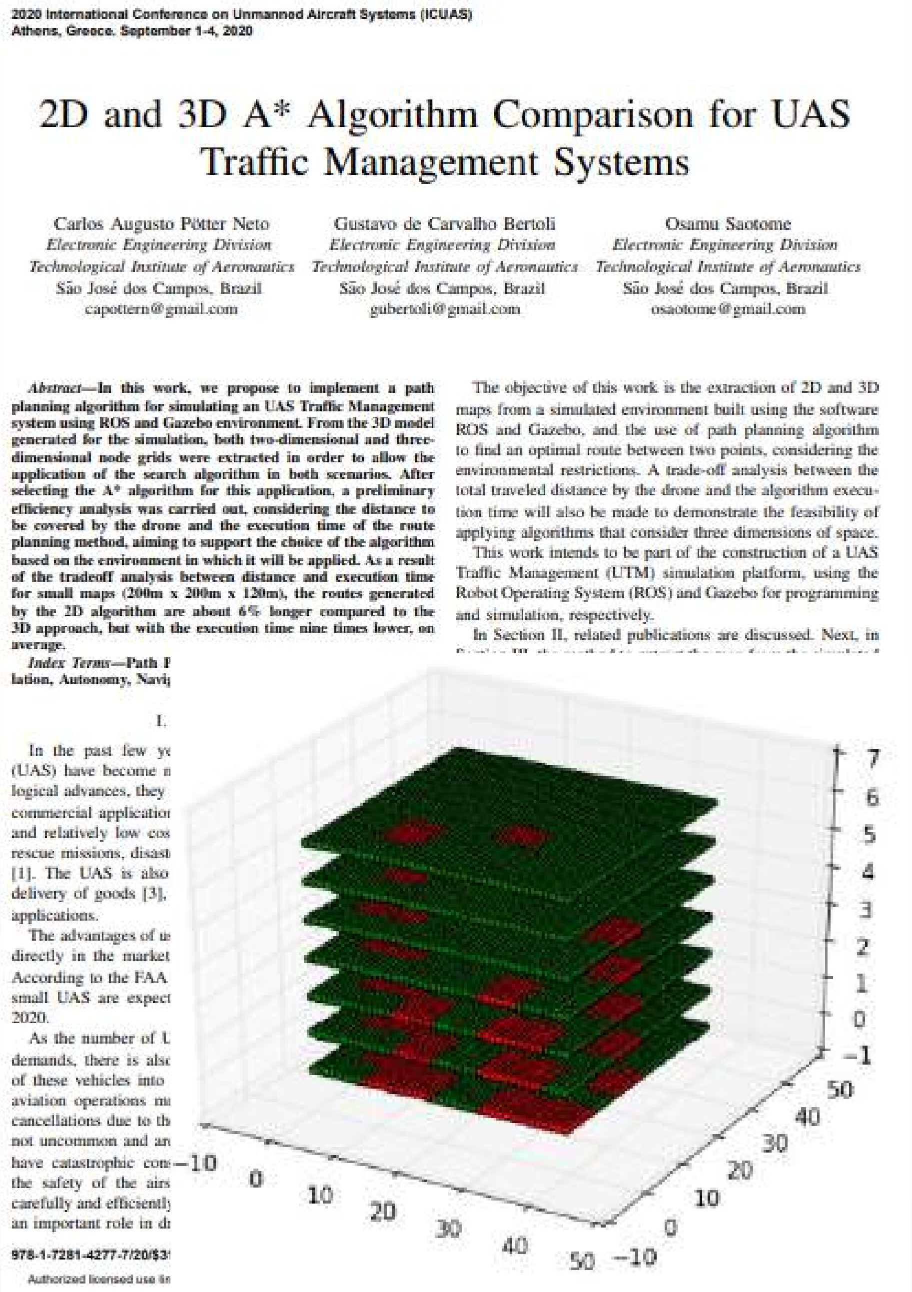
Research Article

Airport Cooperative Research Program Graduate Research Award 11-04: Geographic Information System Application to Unmanned Traffic Management within the National Airspace System

Ryan P. Case and Joseph P. Hupy

Name	Drone Type	Max Distance (Miles)	Total Duration (Minutes)	Min Detection Altitude (Feet)	Max Detection Altitude (Feet)	Azimuth	Notes
Drone 1	Mavic 3	14.0551	30	418.3071	1333.00529	-173.51	Watchlist "High Flyer"
Drone 2	Mavic 3	2.2537	8	104.6588	190.28872	-173.91	Remained within 1 LAANC Box w/ Ceiling 400 FT AGL, highest reported Altitude 190.29 FT
Drone 3	FPV	0.0623	5	100.76116	313.97638	-23.57	Eurocopter MH-65D Dolphin & DJI FPV drone
Drone 4	Mavic 3	3.7901	8	384.51445	395.99729	-173.35	Operating under KSAV Class C Outer shelf, highest reported Altitude 396.00 FT

Case, R. P., & Hupy, J. P. (2024). Airport Cooperative Research Program Graduate Research Award 11-04: Geographic Information System Application to Unmanned Traffic Management within the National Airspace System. Transportation Research Record: Journal of the Transportation Research Board. https://doi.org/10.1177/03611981241298684



2020 International Conference on Unmanned Aircraft Systems (ICUAS)
Athens, Greece. September 1-4, 2020

2D and 3D A* Algorithm Comparison for UAS Traffic Management Systems

Carlos Augusto Pötter Neto, Electronic Engineering Division, Technological Institute of Aeronautics, São José dos Campos, Brazil, capottern@gmail.com
Gustavo de Carvalho Bertoli, Electronic Engineering Division, Technological Institute of Aeronautics, São José dos Campos, Brazil, gubertoli@gmail.com
Osamu Saotome, Electronic Engineering Division, Technological Institute of Aeronautics, São José dos Campos, Brazil, osaotome@gmail.com

Abstract—In this work, we propose to implement a path planning algorithm for simulating an UAS Traffic Management system using ROS and Gazebo environment. From the 3D model generated for the simulation, both two-dimensional and three-dimensional node grids were extracted in order to allow the application of the search algorithm in both scenarios. After selecting the A* algorithm for this application, a preliminary efficiency analysis was carried out, considering the distance to be covered by the drone and the execution time of the route planning method, aiming to support the choice of the algorithm based on the environment in which it will be applied. As a result for small maps (200m x 200m x 120m), the routes generated by the 2D algorithm are about 6% longer compared to the 3D approach, but with the execution time nine times lower, on average.

The objective of this work is the extraction of 2D and 3D maps from a simulated environment built using the software ROS and Gazebo, and the use of path planning algorithm to find an optimal route between two points, considering the environmental restrictions. A trade-off analysis between the total traveled distance by the drone and the algorithm execution time will also be made to demonstrate the feasibility of applying algorithms that consider three dimensions of space.

This work intends to be part of the construction of a UAS Traffic Management (UTM) simulation platform, using the Robot Operating System (ROS) and Gazebo for programming and simulation, respectively.

In Section II, related publications are discussed. Next, in

Potter Neto, C. A., de Carvalho Bertoli, G., & Saotome, O. (2020). 2D and 3D A* Algorithm Comparison for UAS Traffic Management Systems. 2020 International Conference on Unmanned Aircraft Systems (ICUAS), 72–76. https://doi.org/10.1109/icuas48674.2020.9214028

Path, UTM and Geofencing Reference (18):

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Ditta , C. C., &Postorino , M. N. (2023). Three-Dimensional Urban Air Networks for Future Urban Air Transport Systems. Sustainability, 15(18), 13551. http s://doi.org/10.3390/su151813551

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Jakub Sláma, Petr Váňa, & Faigl, J. (2022). Generating Safe Corridors Roadmap for Urban Air Mobility. 2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 11866–11871. https://doi.org/10.1109/iros47612.2022.9981326

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Besada, J., Bergesio, L., Campaña, I., Vaquero-Melchor, D., López-Araquistain, J., Bernardos, A., & Casar, J. (2018b). Drone Mission Definition and Implementation for Automated Infrastructure Inspection Using Airborne Sensors. Sensors, 18(4), 1170. https://doi.org/10.3390/s18041170

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