USEPE : U-SPACE SEPARATION IN EUROPE

17 May 2022

UAM for all workshop

This project has received funding from the SESAR Joint Undertaking under grant agreement No 890738 under European Union's Horizon 2020 research and innovation programme

What is USEPE?

Isdefe your best ally

indra

Leibniz Universität Hannover

University of South-Eastern Norway

NOMMON

POLIS CITIES AND REGIONS FOR TRANSPORT INNOVATION

DLR

SESAR JOINT UNDERTAKING

This project has received funding from the SESAR Joint Undertaking under grant agreement No 890738 under European Union's Horizon 2020 research and innovation programme

24 months

January 2021 — December 2022

7 partners

4 countries

Isdefe your best ally

Project coordinator

H2020-SESAR-2019-2
H2020 Call

Why does USEPE exist?

SESAR 3 Joint Undertaking

⇒ institutionalized EU partnership

⇒ R&I for Digital European Sky.

Digital European Sky

⇒ latest digital technologies in aviation infrastructure

⇒ Enable growth & diversity handling + minimize environmental impact

What does USEPE do?

Develop a method to ensure the safe separation of drones over urban areas.

⇒ Concept of operations (documentation)

⇒ Enabling technologies (Machine-learning & AI)

Why is USEPE needed?

Increasing number of use cases for drones in urban areas.

⇒ Monitoring: Inspection of constructions, electrical lines, fishing, fires…

⇒ Saving: Medical deliveries, emergency situations

⇒ Accessing: Delivery or travel in remote areas

What can we do ?

➔ Monitoring ➔ image processing from image of the camera ➔ Inspection of electrical line, fishering, fire ect…

➔ Health Care ➔ Medical deliveries (for ex. During Covid Pandemia) Zipleine delivers more Than 70 000medical devices using drones

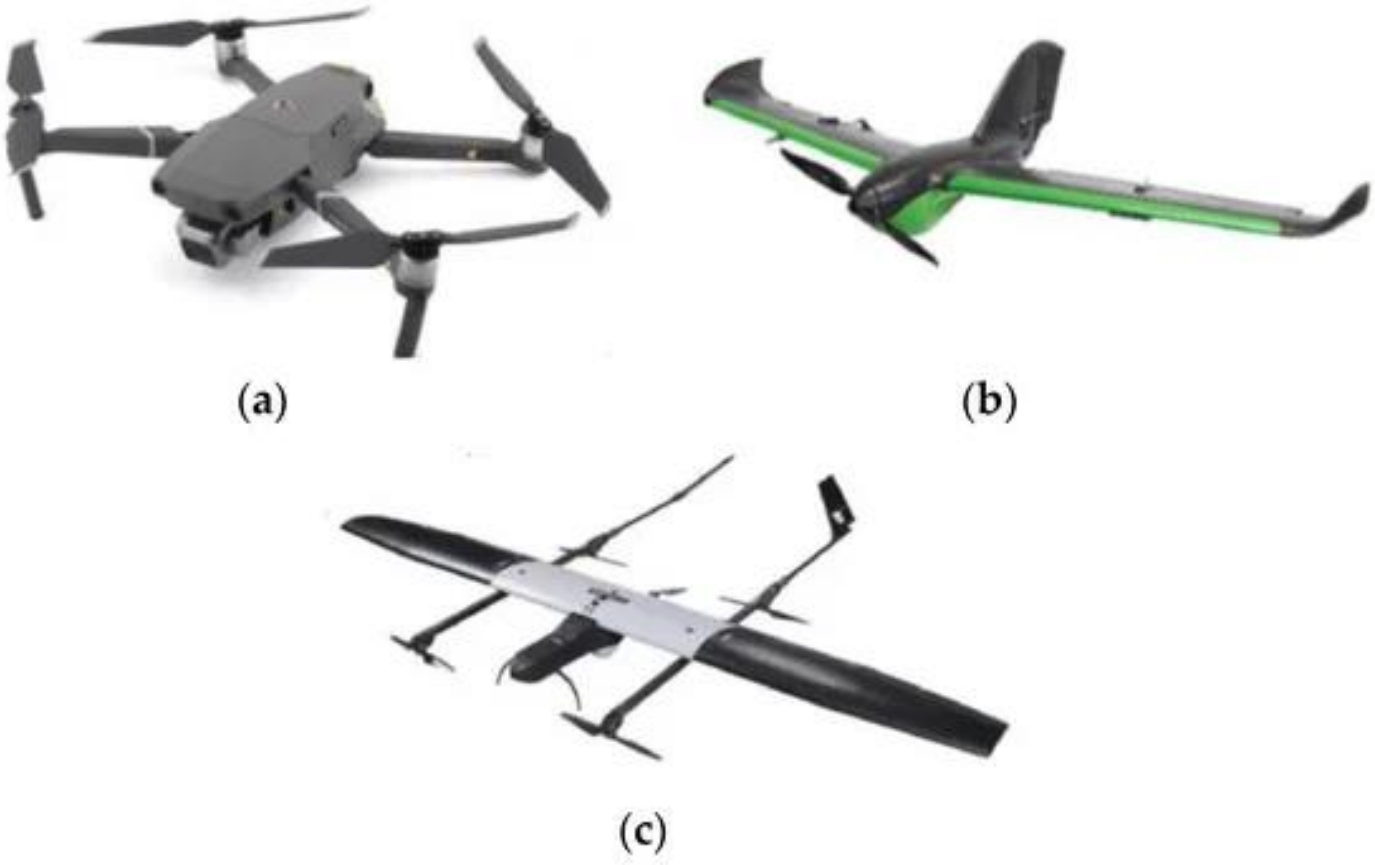
➔ Urban air mobility (transport people, goods, ect…)

➔ Military purpose

Why ?? NOW ? FUTURE? Techonology

Drones as the future for urban air mobility?

Drones ?? An unmanned aerial vehicle (UAV) or Drones

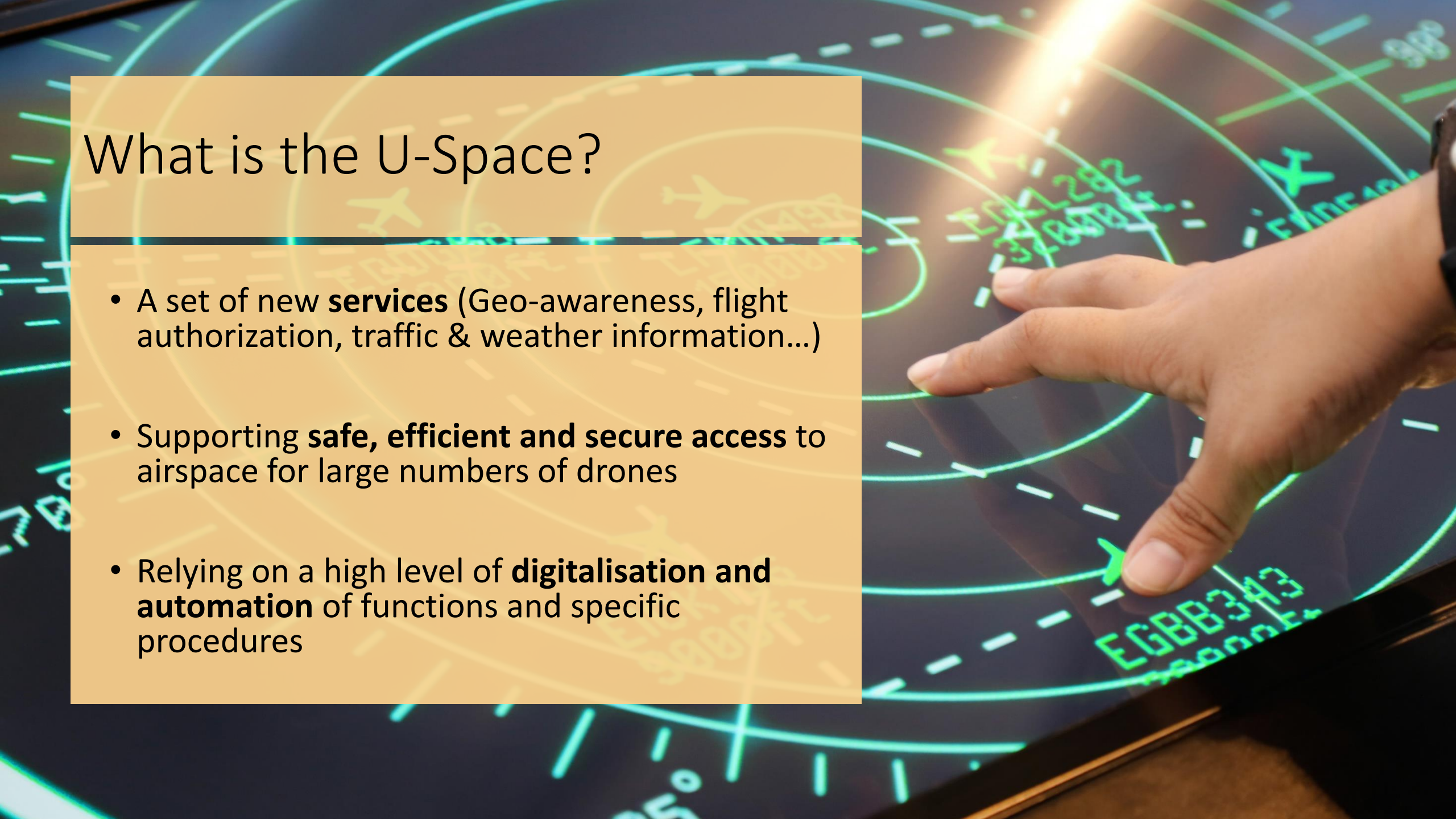


https://www.mdpi.com/2504-446X/5/4/148/htm

1. Few elements of context

What is the U-Space?

- A set of new **services** (Geo-awareness, flight authorization, traffic & weather information…)
- Supporting **safe, efficient and secure access** to airspace for large numbers of drones
- Relying on a high level of **digitalisation and automation** of functions and specific procedures



Increasing drones use cases

USEPE main topics to tackle

- Conflict detection - Conflict resolution
- Airspace capacity
- Traffic demand
- Meteorology (micro weather)
- Airspace optimisation
- Ground structure (buildings, streets, open spaces)
- Availability of communications (obstacles)
- Geofenced/forbidden areas (fixed or sudden ones)

Table of content

1. USEPE project: U-space separation for Europe

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USEPE

USEPE partners

DLR Deutsches Zentrum für Luft- und Raumfahrt German Aerospace Center

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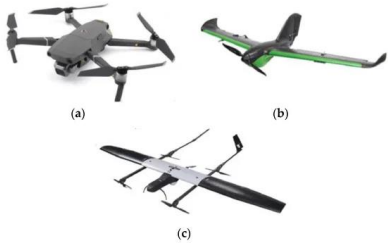
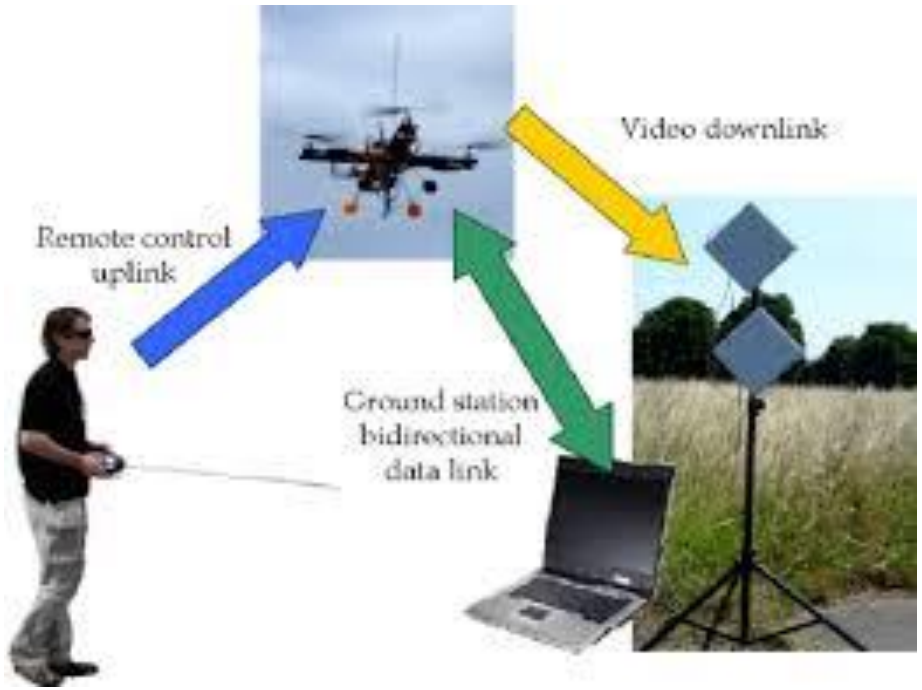
USN University of South-Eastern Norway

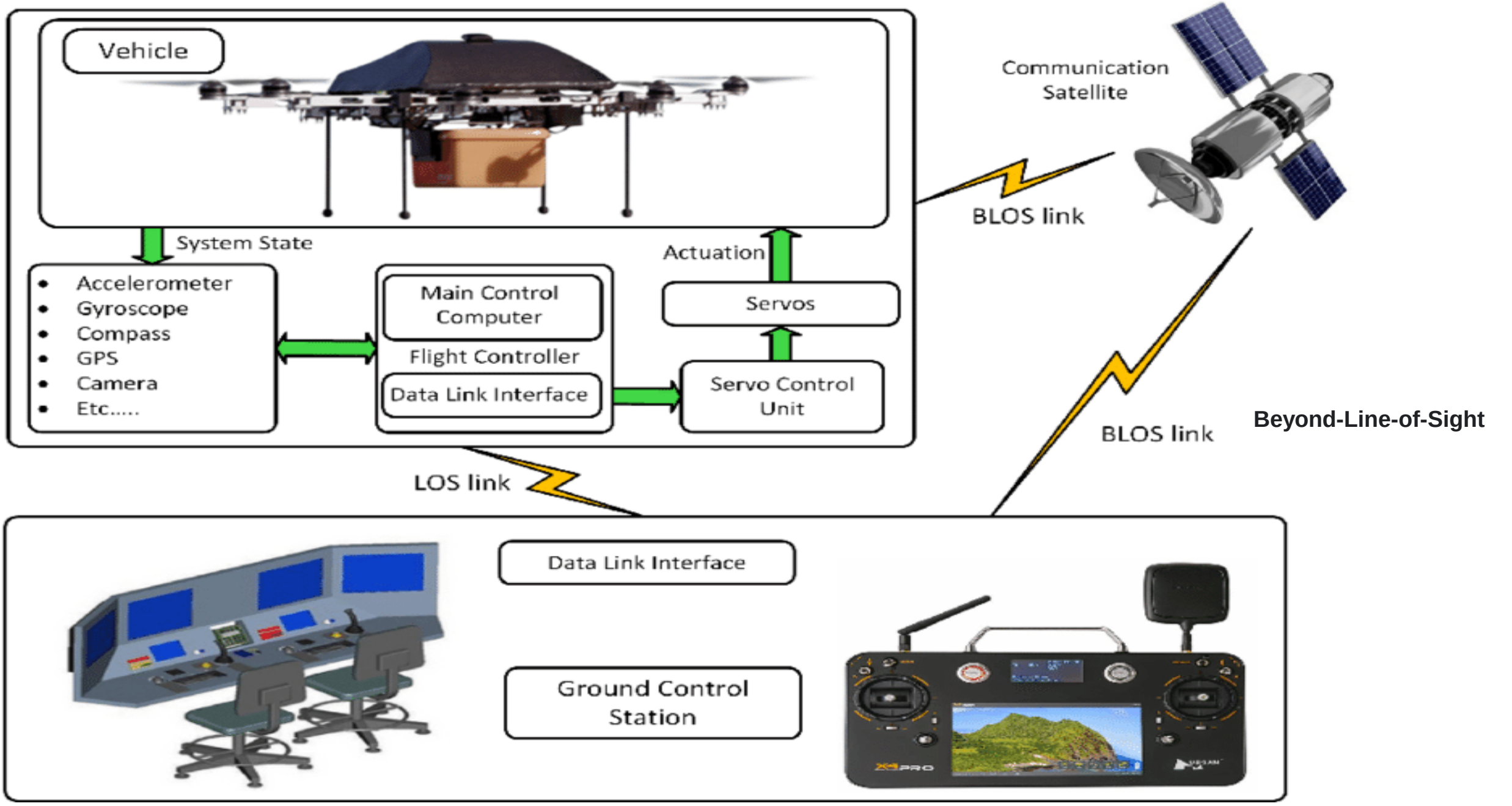
Drones as the future for urban air mobility?

Remote or Autonomous





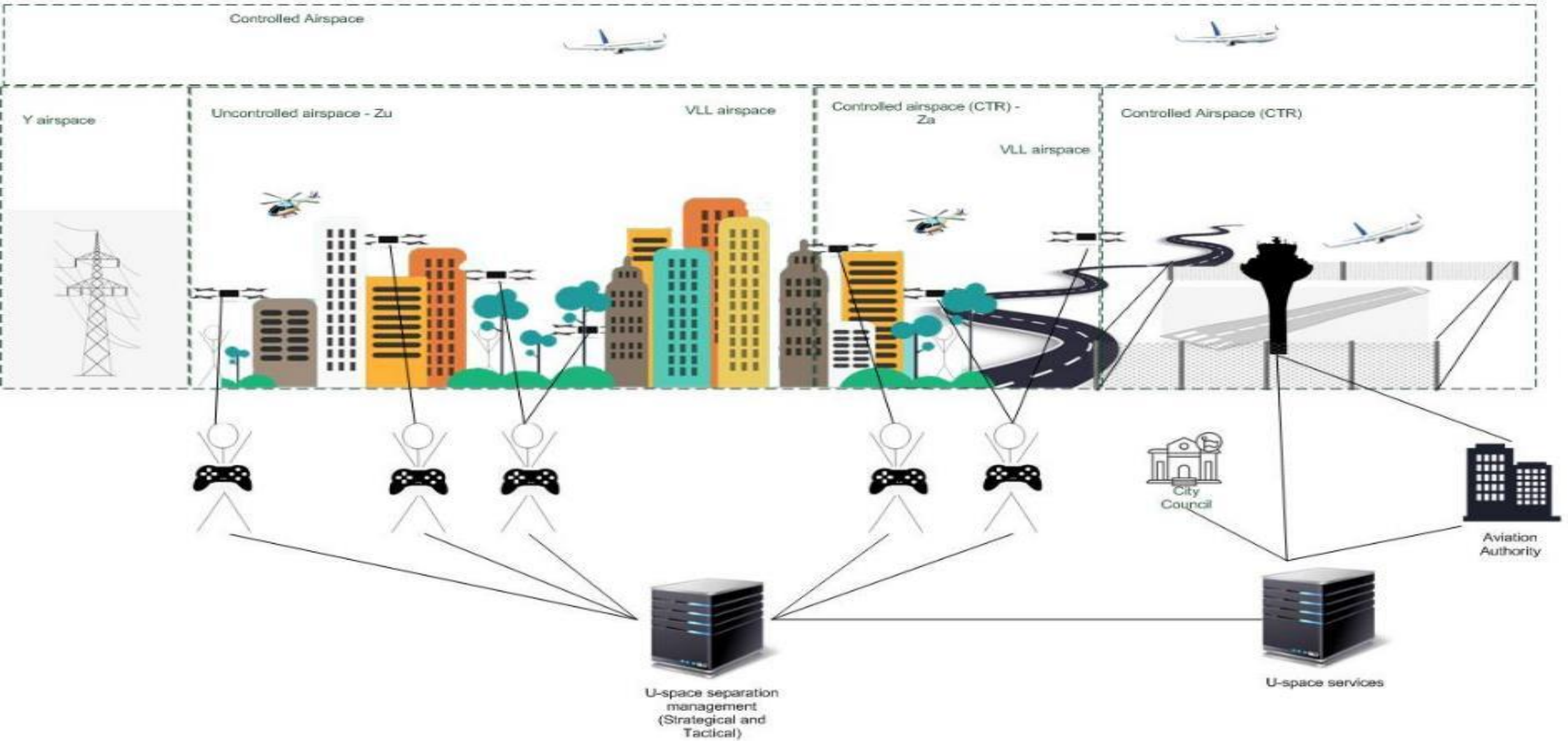
https://www.researchgate.net/figure/The-UAV-a-multiple-data-link-to-the-ground-station_fig3_241524070



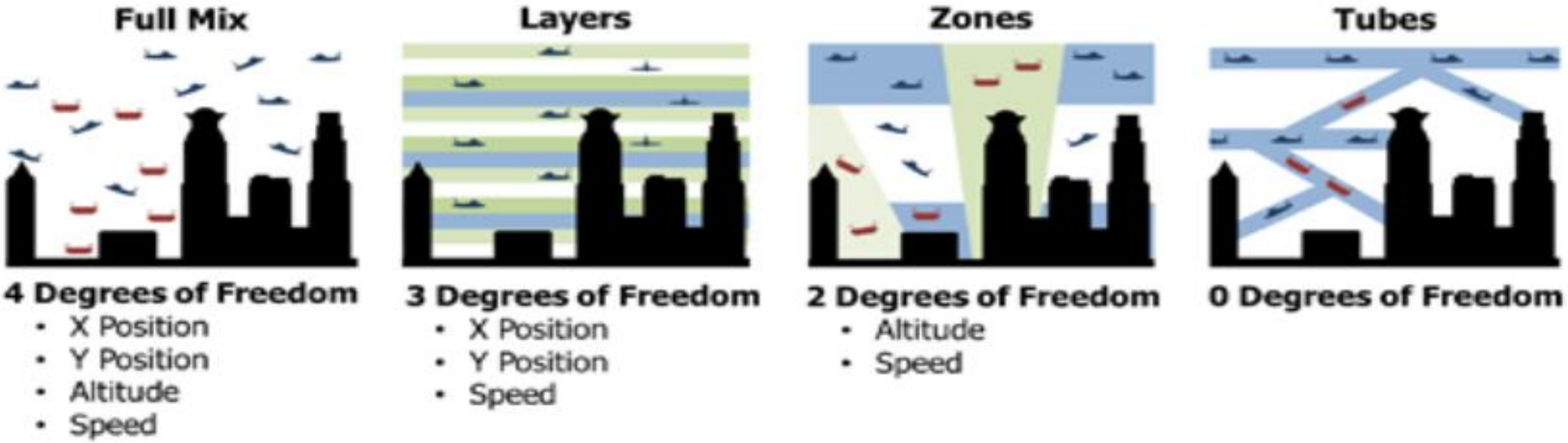
https://www.researchgate.net/figure/High-level-architecture-of-a-UAV-system_fig1_313329204


DRONE-
PILOT

Sharing the airspace ?



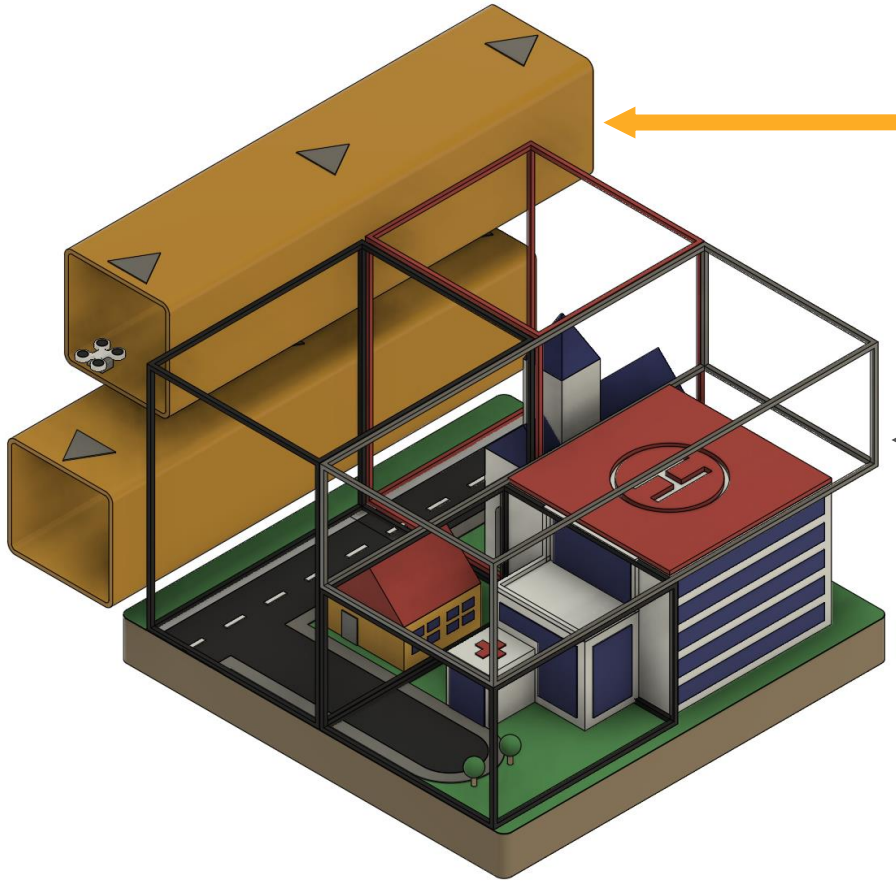
Airspace Structuring



Source: "Geovectoring: Reducing Traffic Complexity to Increase the Capacity of UAV airspace", Hoekstra et al. 2018

Four Airspace Concepts of Increasing Structure

Basic Concepts of Usepe



High Speed **Corridors**

- **Static corridors** with strict limitations (**velocity/direction**)
- **Reduction of relative velocity** between UAS
- Considers **ground risks** and **environment** (e.g. noise)

Density-Based Airspaces

- **Dynamic segments** sized on various characteristics
- **Deconfliction** capability drives **capacity**
- Limitations for entering **may** apply based on demand

Geovectoring

- Set of requirements for **speed, heading, rate of climb**
- Manage **traffic complexity**, instead of **density**
- Applicable only in **corridors** and **specific segments**

2. socio-Techical consideration of drone's operation in Urban enviroment

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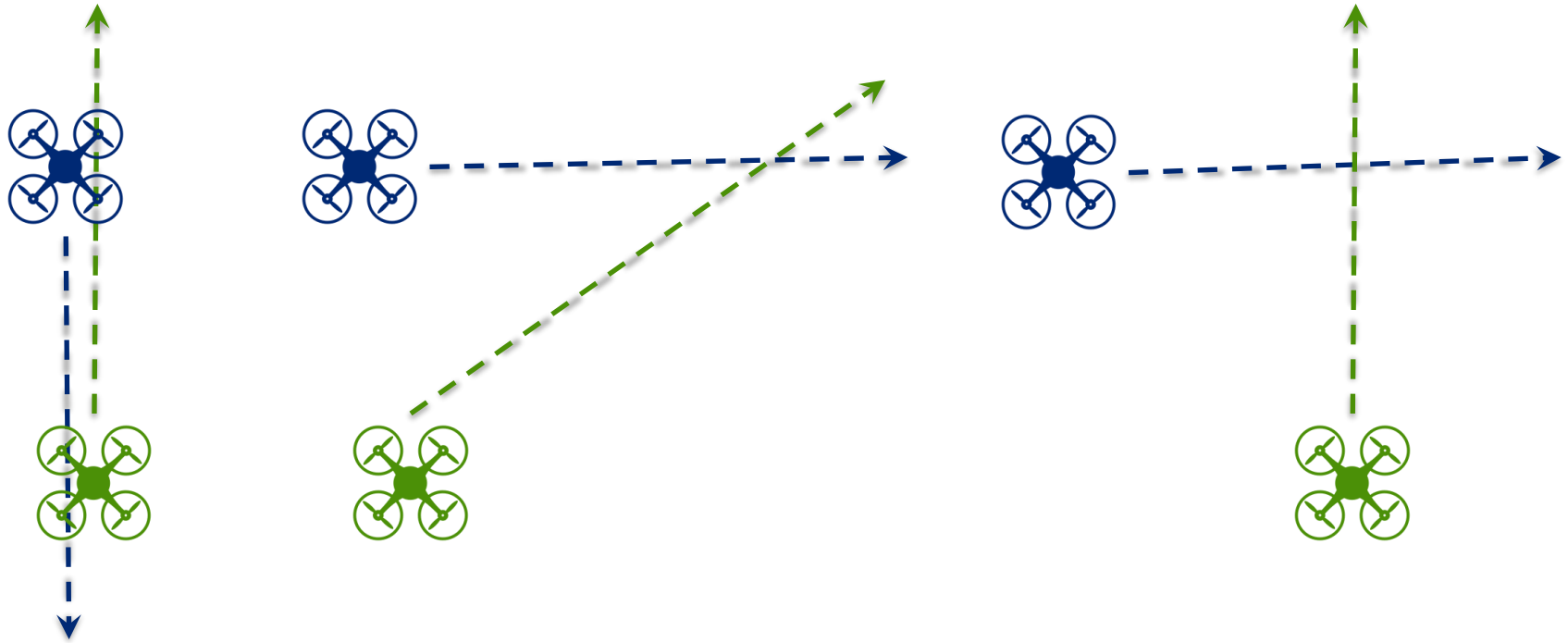
Challenges to overcome:

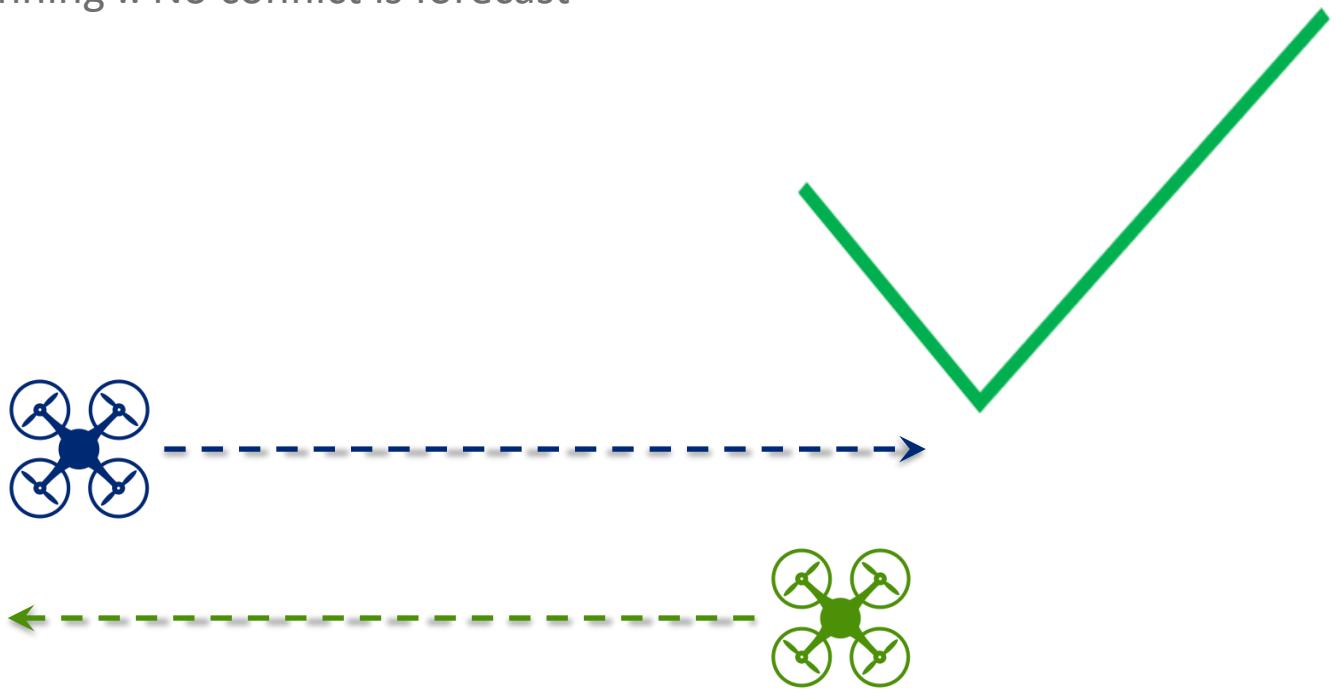
- A safe separation
- Conflict detection
- Autonomous flights
- Communication
- Conops delineation
- Urban airspace specification

Machine Learning Approach

Possible flight route conflicting ➔ Intersecting routes are easily identifiable.

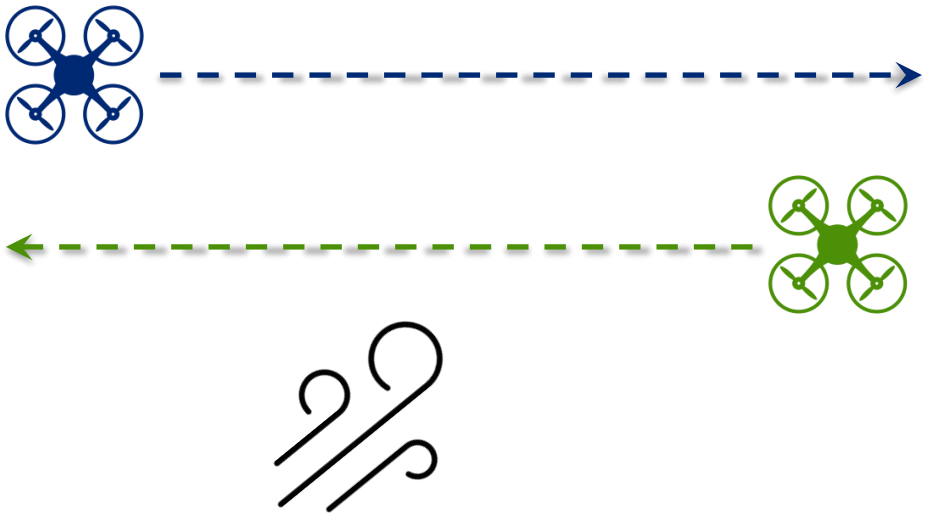


Drone’s Flight planning .. No conflict is forecast



Real Time flight ?

Several unexpected events could occur! Such for instance WIND?



- **Failure of drones**
- **Loss of communication**
- **Weather conditions**
- **Human errors**
- **Mission priorities**
- **Realtime closure of airspace ➔ Rerouting**
- **Real time control ??**
- **Autonomous?**

AI and Machine learning as an enabler for drones ?

We explore the use of In the Machine Learning approach and we identify the drones which are most likely to intervene with other drones.

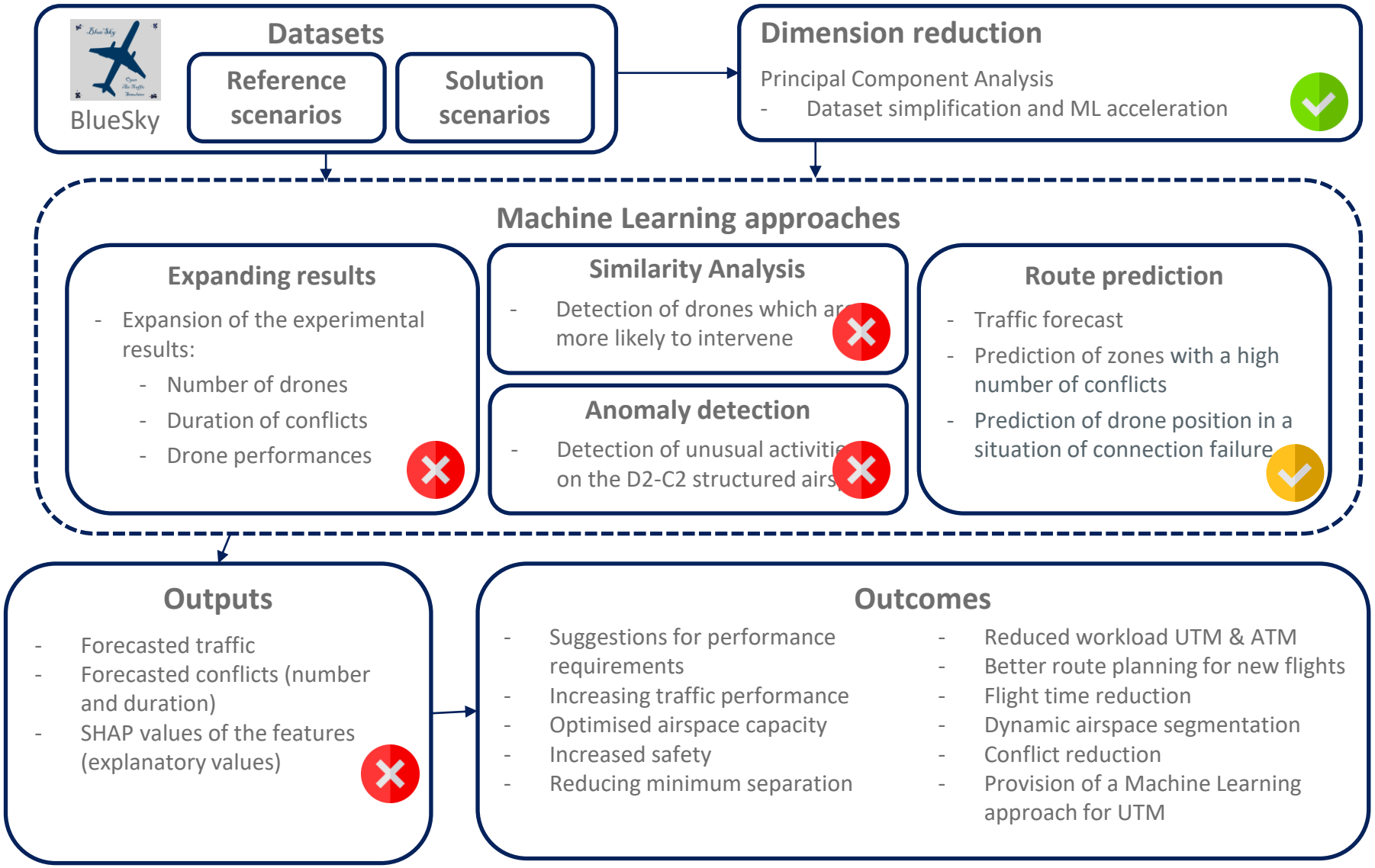
For that purpose, the ML algorithm considers measures such as route, timing, speed, wind, etc. from past experiences (training data) to predict the probability of conflict in future situations.

For example,

Less distances, less safety

More distance, more safety

Machine Learning Approach



Drones ➔ Hardware (sensors, Actuators, Camera, ect..) and Software

➔USE of ML at the Drones operation Level

➔ Huge number of drones, Flights plans➔ Automatic flight scheduling and approval (detect if any possible conflicts)

➔ DAA (Detect And Avoid) system on board? ML to analyze in Real Time data from different sensors that are attached to drones

➔ Automatic Rerouting in case of Drones failure

➔ Decision making during flight drones if unpredictable event occurs

➔ Automatic distance separation to insure a separation minina between drones and Manned traffic

➔ Ect…

several questions need to be tackled

- Can citizen trust AI-based Systems such as autonomous drones??
- Is It possible to integrate the ethical dimension of AI (transparency, non-discrimination, fairness, non- discrimantion etc.) in safety processes?
- How AI could be taken into account in standards or so that the level of safety of drones operation in Urban environment is Improved?
- Accountability, Liability in case of Accident?
- Security, Privacy,

4. Conclusion

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In summary

ML for better Safety of drones operation in Urban enviroment

ML for airspace use optimisation (noise, level of acceptance of citizens, type of mission, geofenced areas, ect..)

Dynamic airspace reconfiguration

➔ Ethics dimensions of not only using drones but as well on AI foundation

USEPE

Drones applications and emerging technology is opening up a new way to look into Urban air Mobility that could reduce for i.e the print carbone, or increase job market opportunities but in same time they are socio-technical challenges of drone operations in densiely populated areas.

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Online, June 16, 10:00 AM

How can the concept be validated by BlueSky simulations?

How can machine learning contribute to a safer U-space?

How do we assess the wind impact on separation using simulations?

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Thanks You

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Can we stop the advancement ?