

Developing The tools for UAM operations

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Urban Air Mobility Workshop – Deep dive into urban airspace

 **SPEAKER**

 **@POLISnetwork #POLIS22**



DRONE-
PILOT



Challenges ?

Urban Airspace organization / vertiports

Tactical and strategical flight planning

Drones Conflict detection / Resolution

Communication Loss

Meteo, wind turbulence

...





IS The Technology ready ?

Propulsion systems / eVTOL
Detect & Avoid Systems
Sensors technologies
Navigation systems
Communication, Cloud Computing,
Artificial Intelligence , decision making
systems

Ect...





USEPE Project

Operational: the number of drone operations can be increased regardless of drone performances under a U-space system.

Technical: beyond the state of the art concepts, including those not widely addressed in aviation world, such as the use of artificial intelligence for separation of drones and wind conditions.

Safety: drone flights as well as manned aircraft flights sharing airspace with drones will be safer in both ATC controlled and non-controlled airspace.





USEPE Project



ANNUAL
CONFERENCE
2022

Systems Engineering organization.

Big Data and AI experts

Artificial Intelligence and Systems Engineering experts

U-Space activities. Experts in simulation

Sustainable transport from cities point of view

Institute of Meteorology and Climatology:
Experts in urban turbulent wind field simulation

Large multinational industry in ATM and U-Space sectors



NOMMON

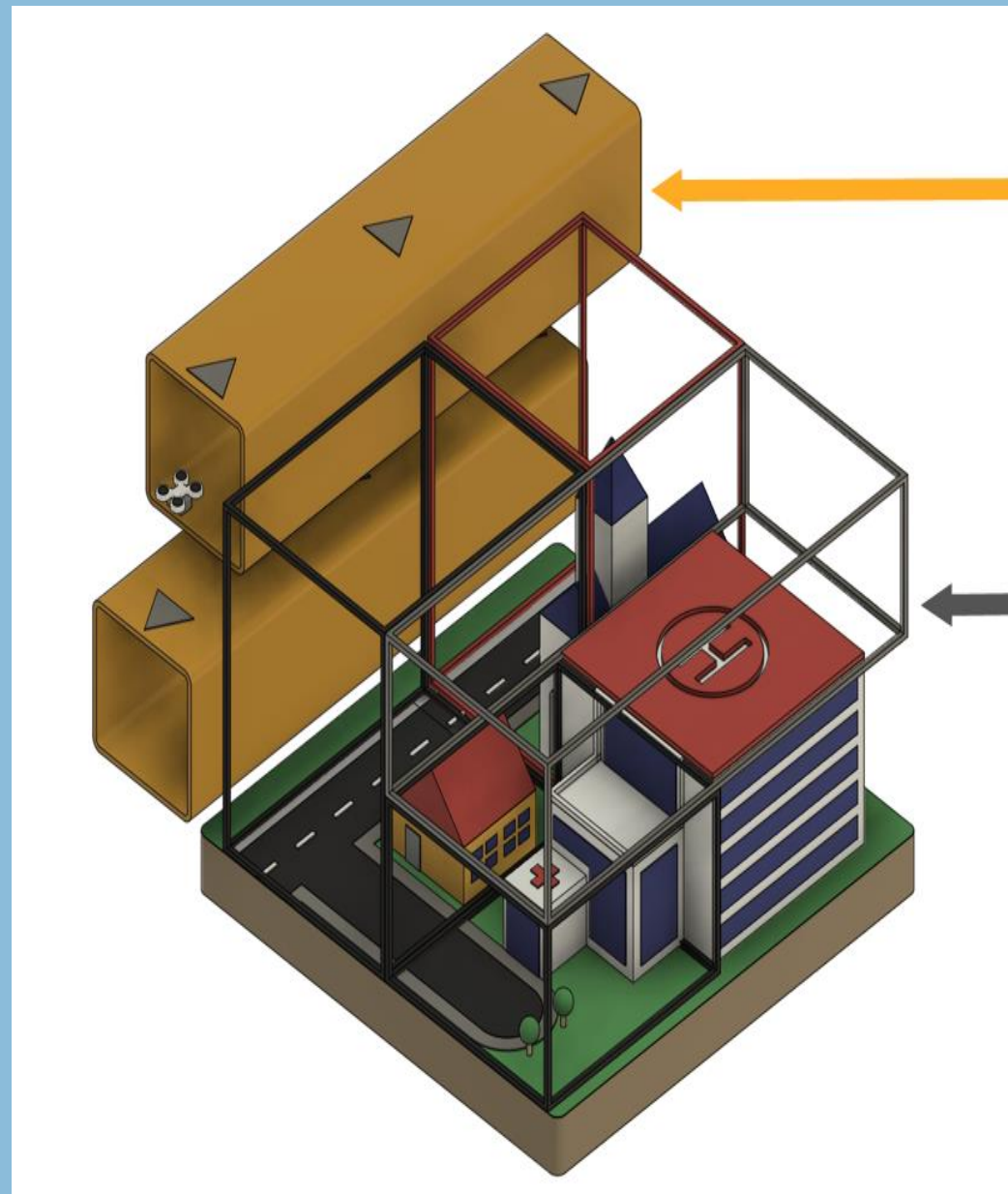


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D2C2 New Concept



High Speed Corridors

Density-Based Airspaces

Geovectoring

New Separation Method

Dynamic Density Corridor Concept (D2-C2)

Airspace

- USSP defines the airspace structure
- Dynamic segments reconfigured based on traffic density.
- Considers drone performances for separation.
- Multi-layered segmentation in high density areas.

Corridors

- Higher-speed corridors with lower conflict risk.

Geovectoring

- General syntax for drone velocity and heading speed limitation.

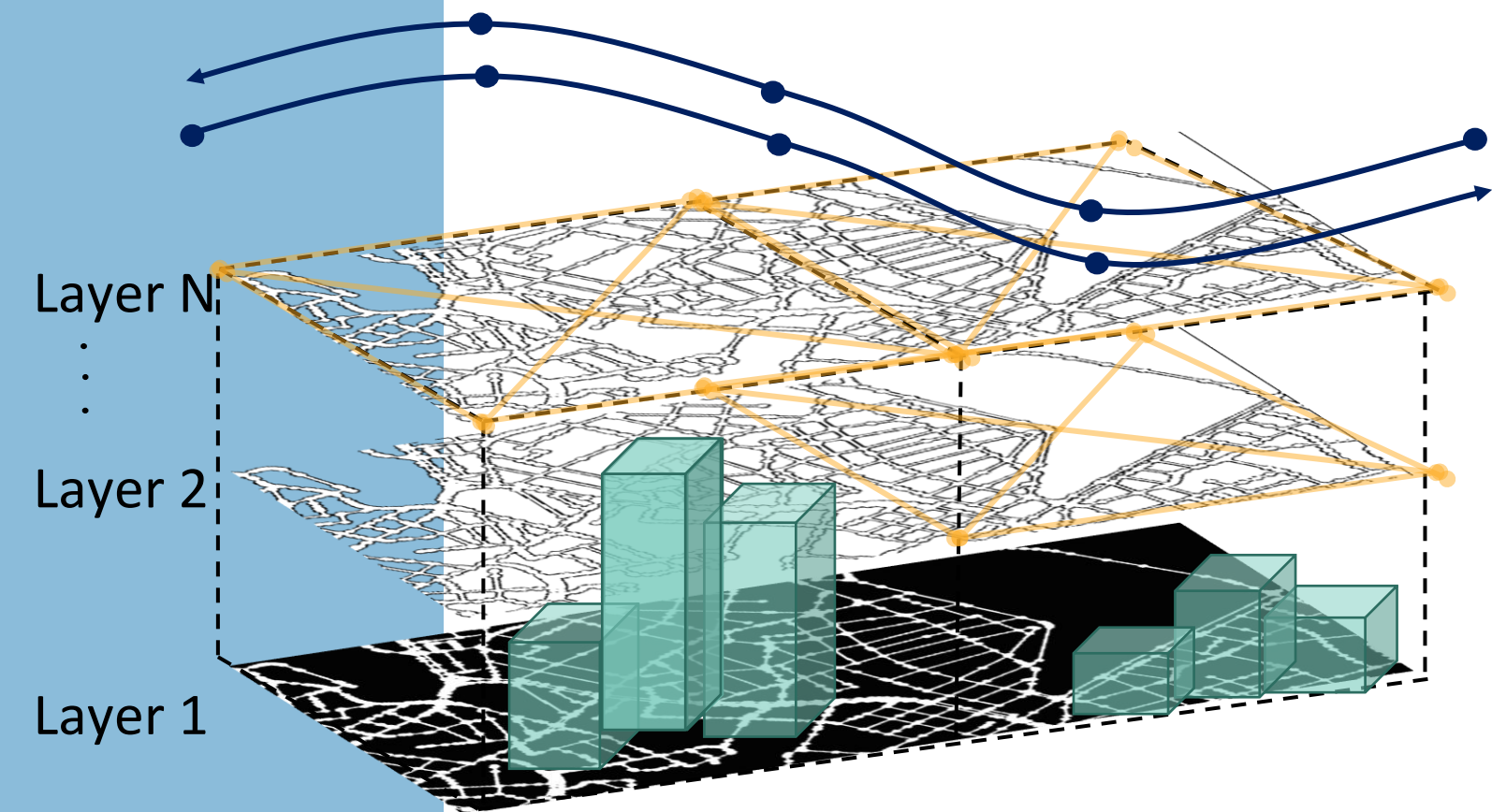


City Model



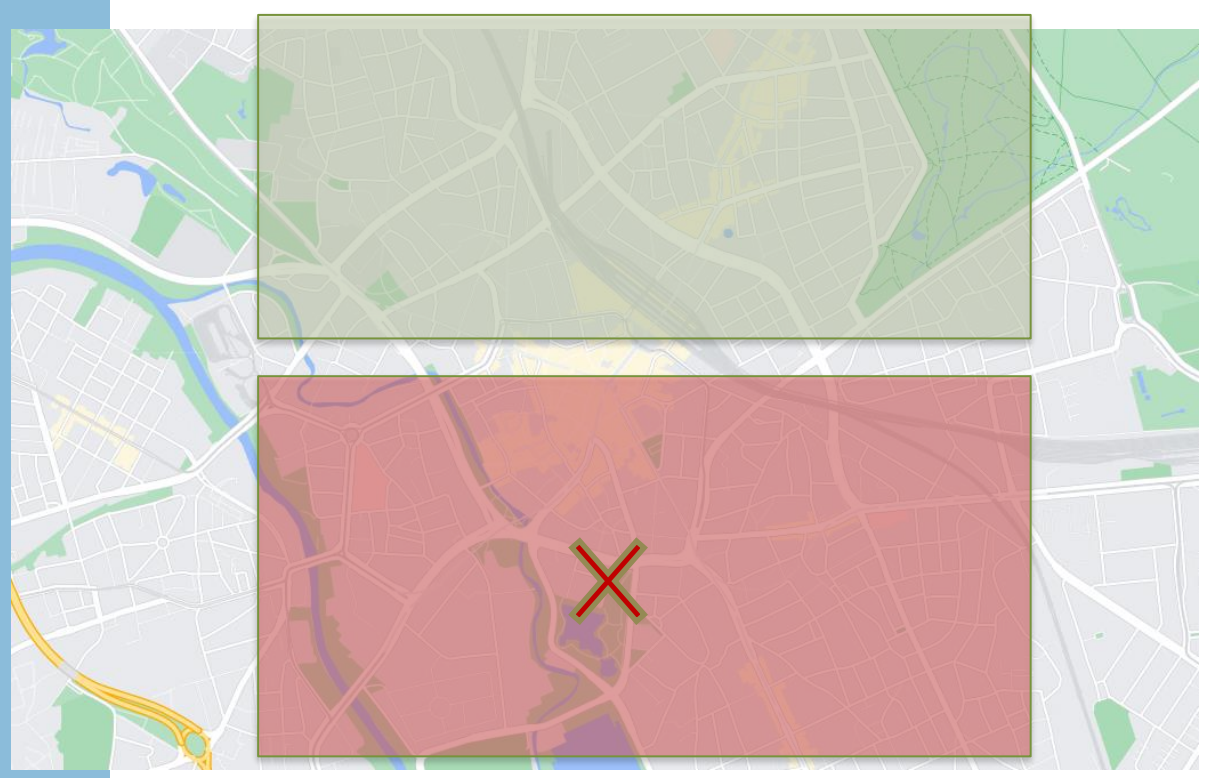
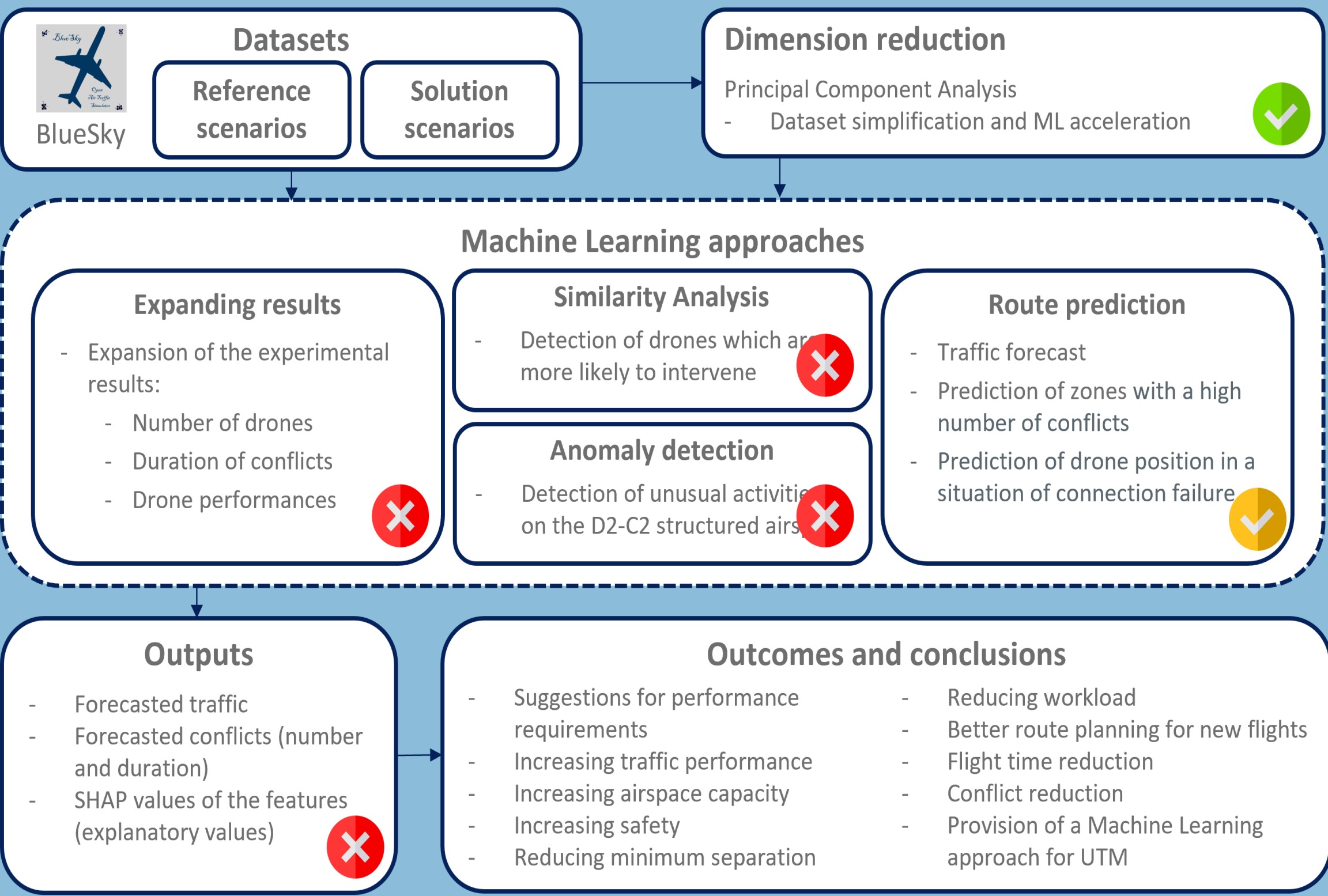
Corridors implementation

- High speed corridors over the city graph defined before
- Corridors have only one direction (A -> B) and the opposite direction (B -> A) is placed at a different height
- Acceleration (and deceleration) lanes are defined in the same plane of the corridors



Machine Learning

Machine Learning Approach





Wind?

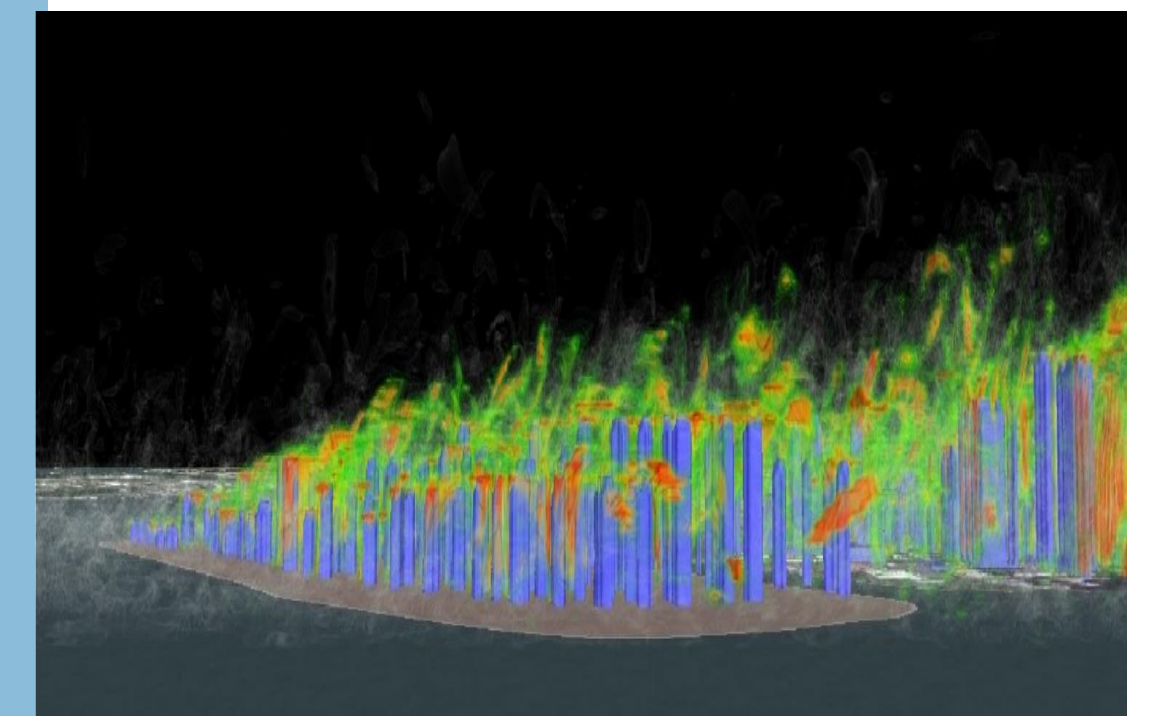
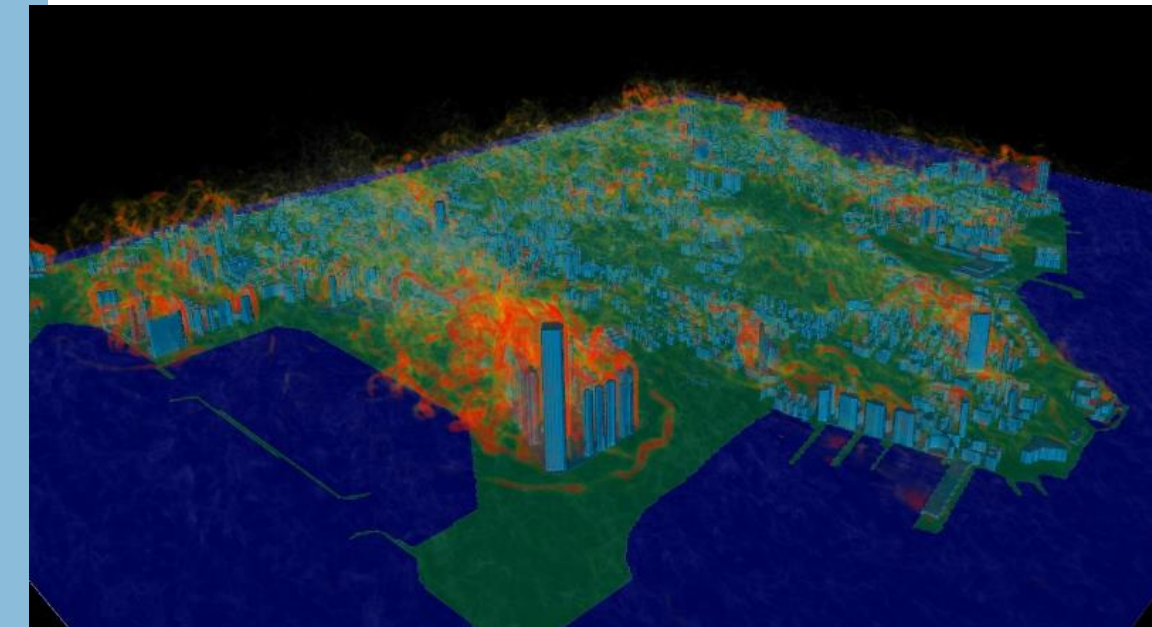
Turbulent wind can be a crucial factor for aircraft operations

The smaller the aircraft

→ the stronger the sensitivity to fluctuations of the wind field

Turbulence is generated by wind shear due to surface friction

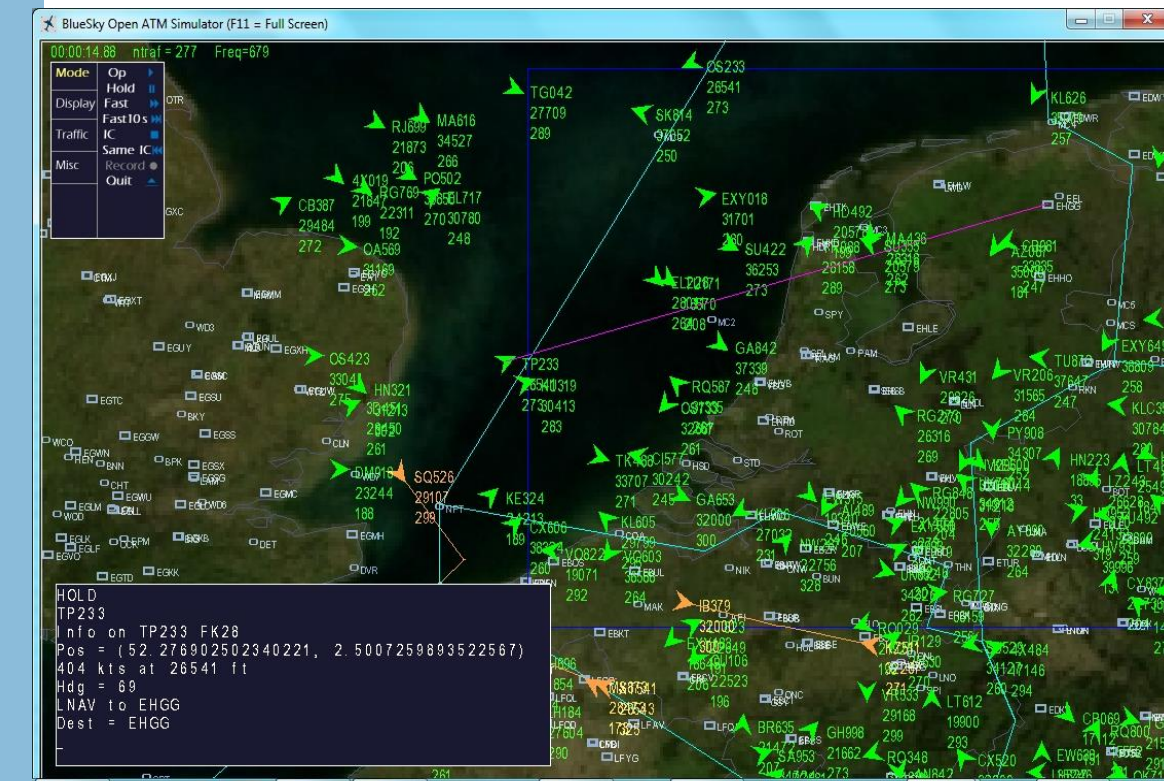
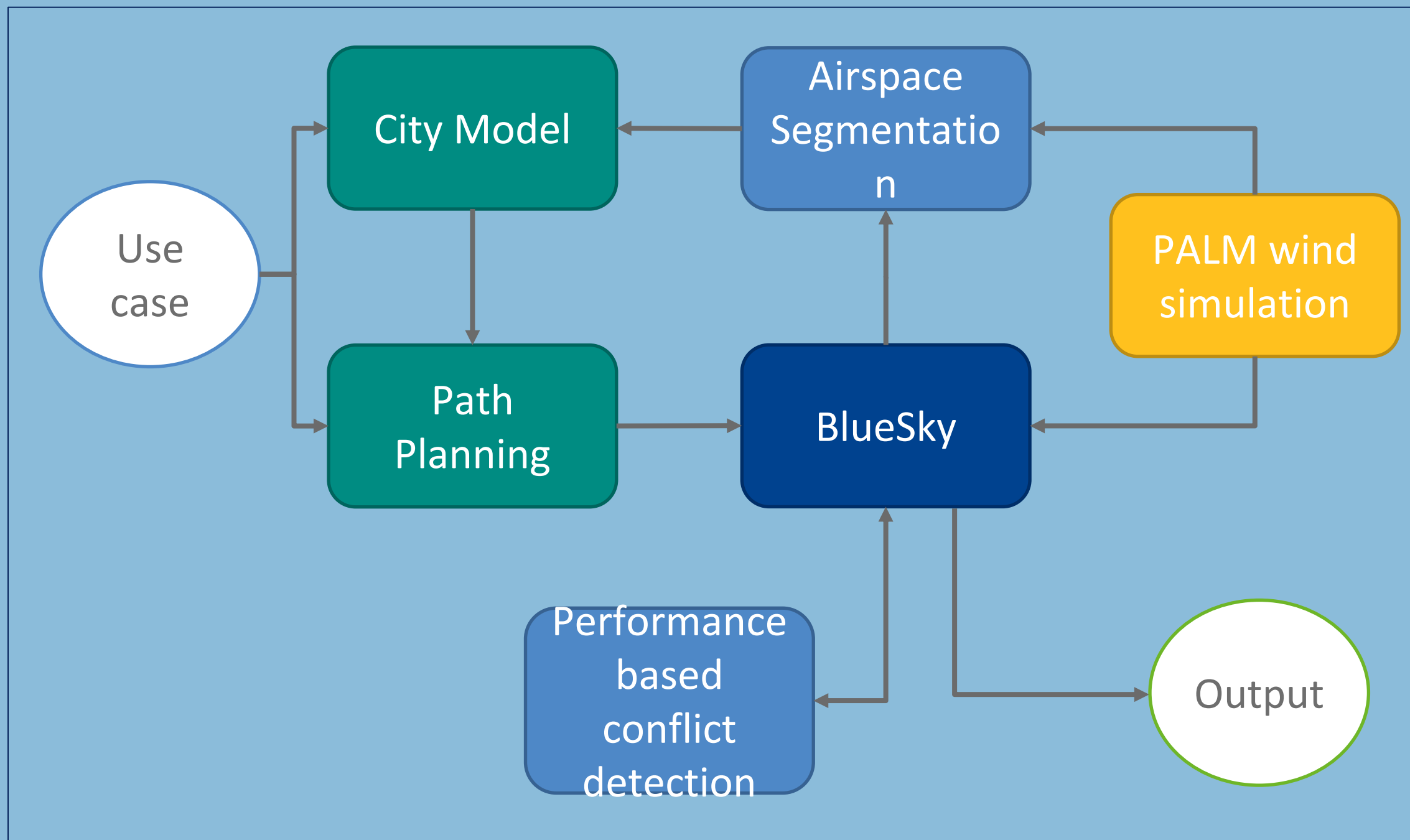
Building surfaces generate turbulence with strong spatial and temporal variations





Implementation / simulation Tools

Overview



Simulation Results . 3 levels of background traffic density



LAST MILE DELIVERY

- 3 simultaneous parcel deliveries
- Punctuality requirement
- It is a cloudy day

Good results for the highest traffic density.

90% of delivery flights arrive at their destination with delays lower than 10 minutes (compared to reference case)



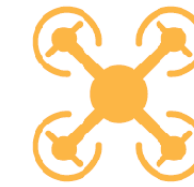
EMERGENCY SITUATIONS

- Riot surveillance and emergency blood transfer
- Sunny day
- Several simultaneous drone flights
- Unexpected emergency drone flight. Prioritised

- D2-C2 can prioritize a specific flight

The number of loss-of-separation events is significantly lower in the solution scenario than the reference scenario with rising traffic density .

The emergency drone has no conflicts at all no matter the traffic density, but the airspace capacity is severely restricted with D2-C2.



URBAN SURVEILLANCE

- Simultaneous surveillance of traffic jam & building inspection
- Some air convection present
- police helicopter (manned departing from Za)

Method can handle manned aircraft

Good results for low and medium traffic density (conflicts decrease)

However flight time increases a great deal.

The method reached its capacity limit for high traffic density, showing a sharp decrease in completed flights

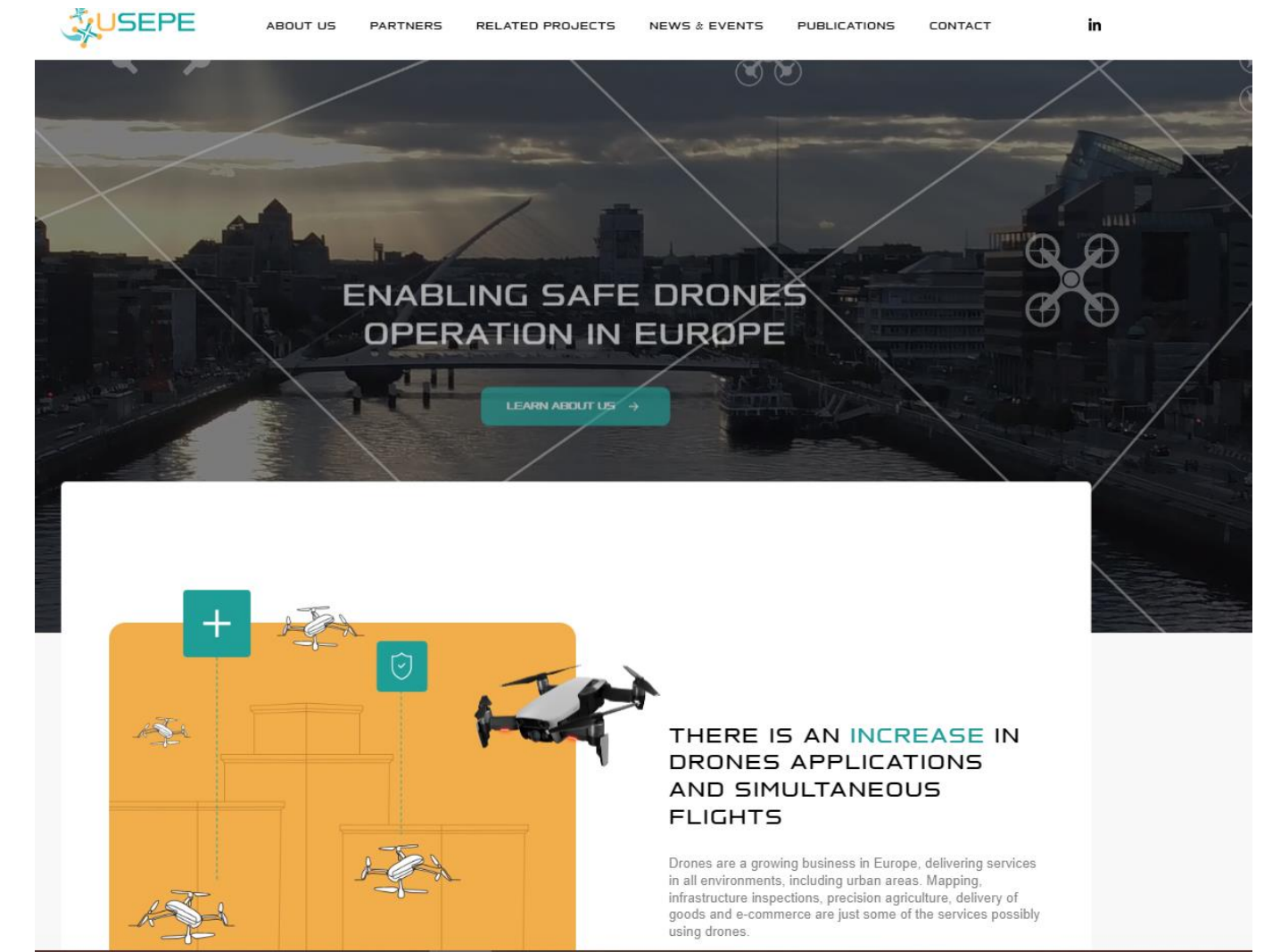
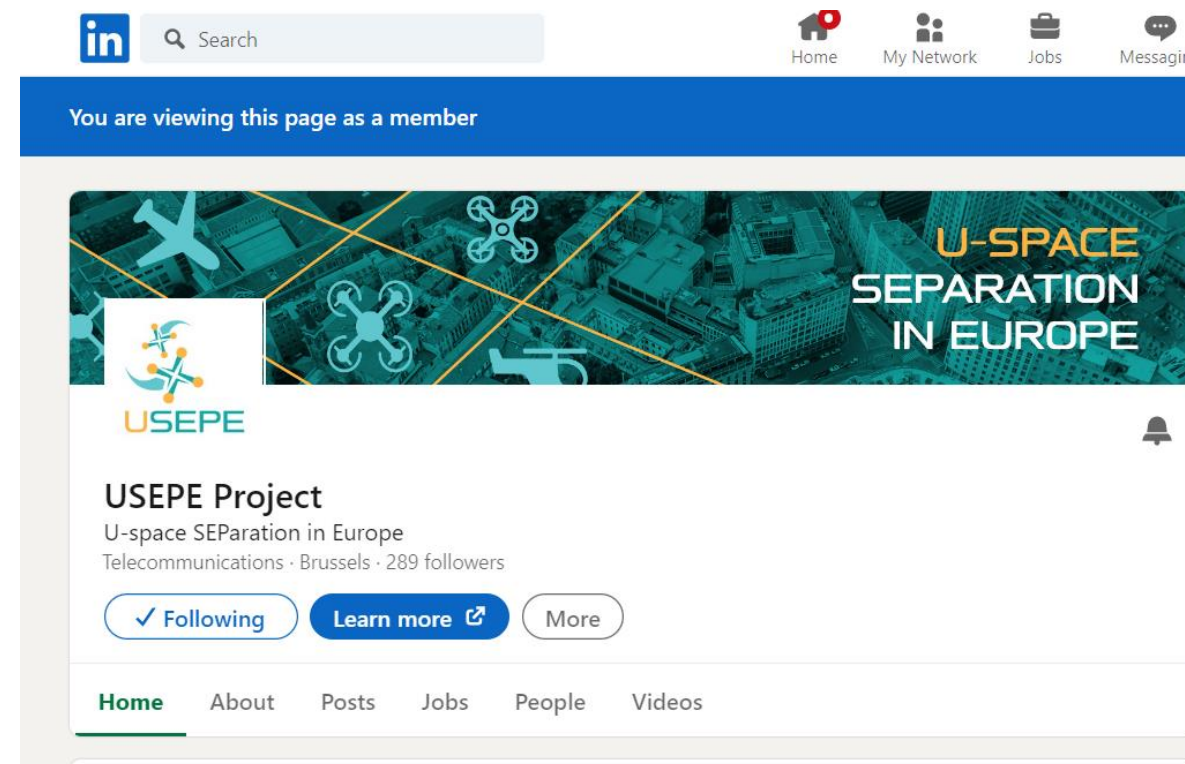


- Drones applications and emerging technology is opening up a new way to look into Urban air Mobility that could reduce for i.e the print carbone, or increase job market opportunities but TECHNOLOGY alone is not suffiecient
- * Ethics in Using AI for drone Operations
- Regulations, Laws, Legislation, social acceptance
- Security, sf safety , certification
- → Include local authorities in the process of UAM take off !!



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[\(655\) USEPE ML, Bluesky plugin for machine learning in drone systems such as U-Space. - YouTube](#)