USEPE : U-SPACE SEPARATION IN EUROPE

1 December 2021

POLIS ANNUAL CONFERENCE

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

USEPE Consortium

Isdefe
your best ally

indra

Leibniz Universität Hannover

NOMMON

University of South-Eastern Norway

POLIS
CITIES AND REGIONS FOR TRANSPORT INNOVATION

DLR

24 months

January 2021 — December 2022

7 partners

4 countries

Isdefe
your best ally

Project coordinator

H2020-SESAR-2019-2
H2020 Call

2. What is the project about?

USEPE objectives

1. Propose, develop and evaluate a **Concept of Operations** and a set of **enabling technologies** aimed at ensuring the safe separation of drones in the **urban environment**.

USEPE objectives

2. Explore and develop **machine learning algorithms** to automate the safe separation and de-confliction.

Provide the U-space separation management system with **artificial intelligence**.

USEPE main topics to tackle

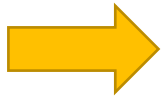
- Conflict detection - Conflict resolution
- Airspace capacity
- Traffic demand
- Meteorology (micro weather)
- Airspace optimisation
- Ground structure (buildings, streets, open spaces)
- Availability of communications (obstacles)
- Geofenced/forbidden areas (fixed or sudden ones)

3. What has been done so far?

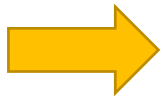
Analyse needs and requirements

- **Survey & Interviews**
- **Validation workshop** with 53 participants

Local authorities
Aviation authorities
U-space service providers
Air navigation service providers
Drone operators
Drone manufacturers
Urban logistics, retail, emergency responses
Researchers



Expected drones characteristics & flight conditions



Expected separation needs & conditions

4 criteria to evaluate separation methods

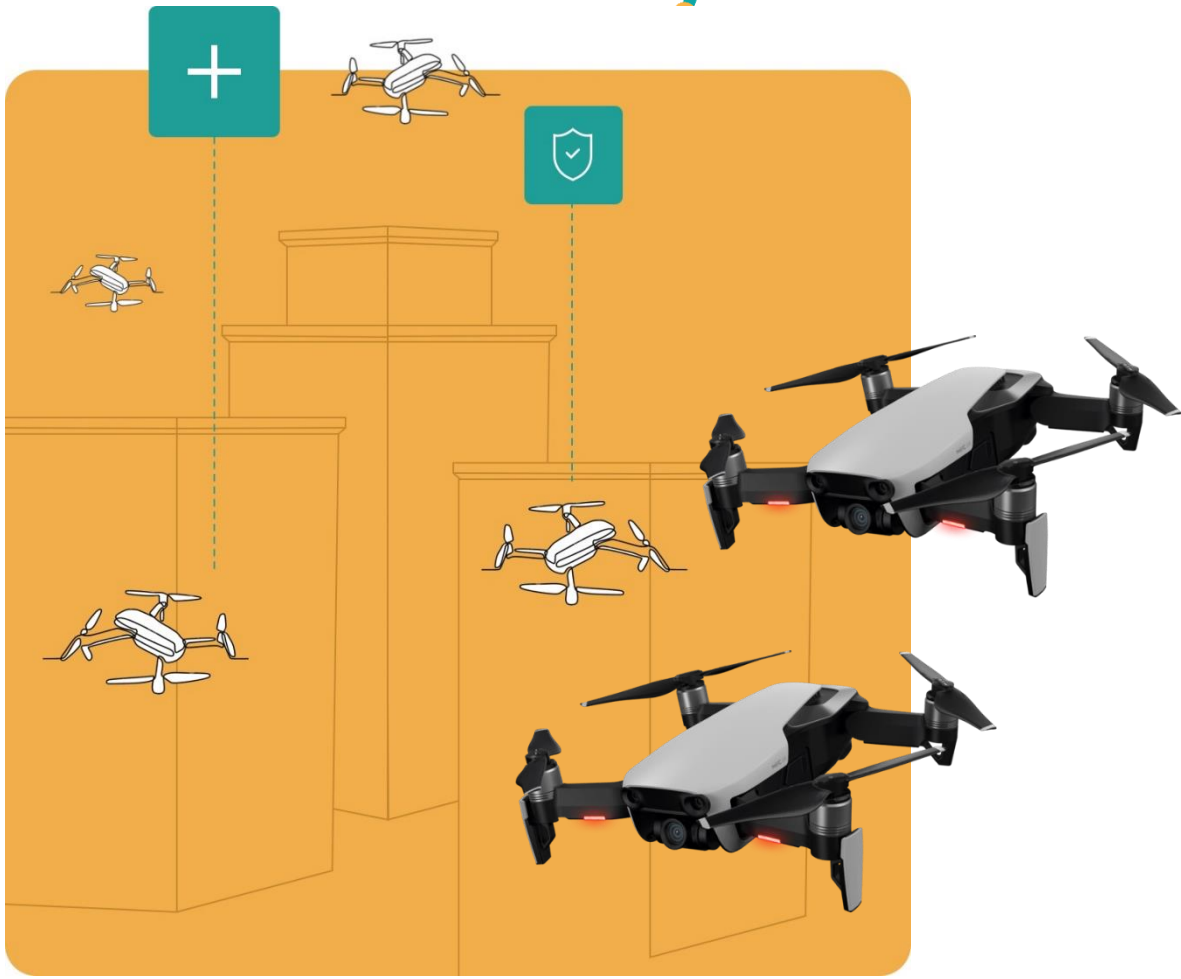
Identify & select Separation Methods

13 potential methods were identified & ranked to manage the safe separation of drones

- Flying at VLL
- In densely populated urban & suburban environments.

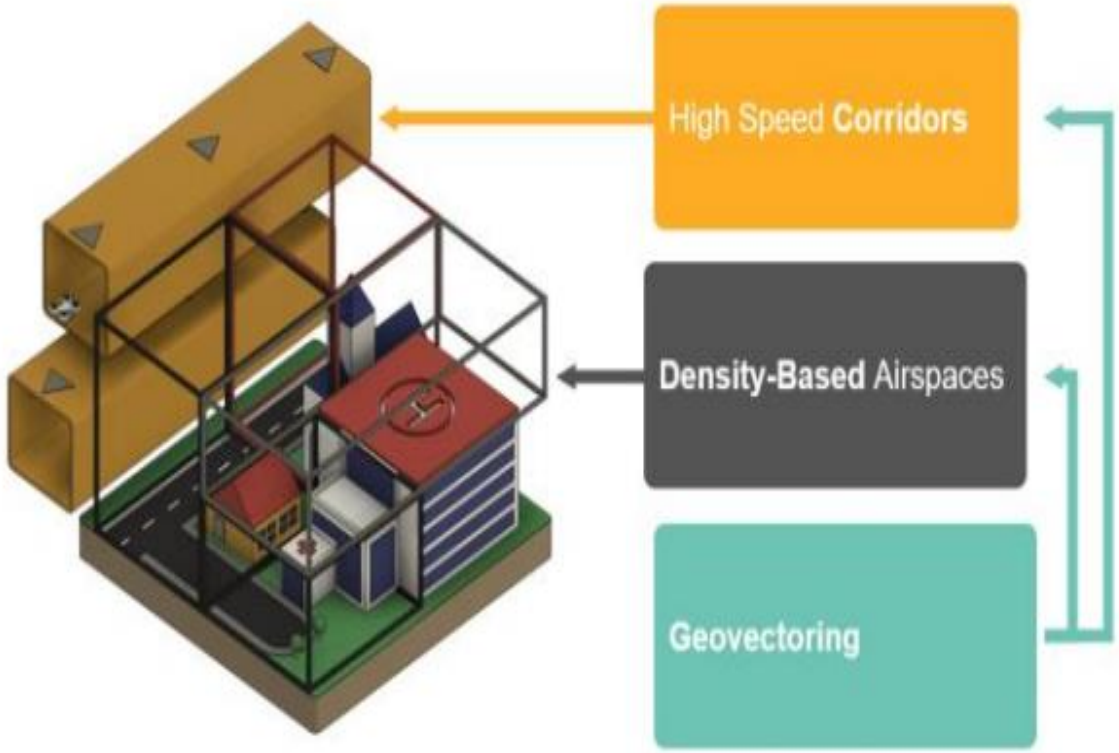
Hierarchy order	Separation method	Score
1	Density Based Airspace Management (Method 8)	0,47
2	Drone Corridors (Method 7)	0,23
3 = 2 (same score)	Geovectoring (Method 9)	0,23
4	Relating Airspace Structure and Capacity (Method 11)	0,07
	Total	1,00

Table 14: Hierarchy of design concepts for separation methods



Conclusion: Combination needed

Develop a new separation method: D2-C2



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.

Define scenarios for validation

LAST MILE DELIVERY

- 3 simultaneous parcels delivery => punctuality requirement
- Wind adverse situation => loss of separation
- Assign cells with different altitudes or decrease velocity

EMERGENCY FLIGHT

- Riot surveillance and emergency blood transfer => several simultaneous drone flights
- Unexpected emergency drone flight => exceed segments capacity, but priority
- Transfer of surveillance drones to other segments when required or creation of a new geo-fence segment

URBAN SURVEILLANCE

- Simultaneous surveillance of traffic jam & construction works => Drones, background traffic, manned city security surveillance forces
- Air convection => wind turbulence in the vicinity of buildings
- Order landing or altitude increase

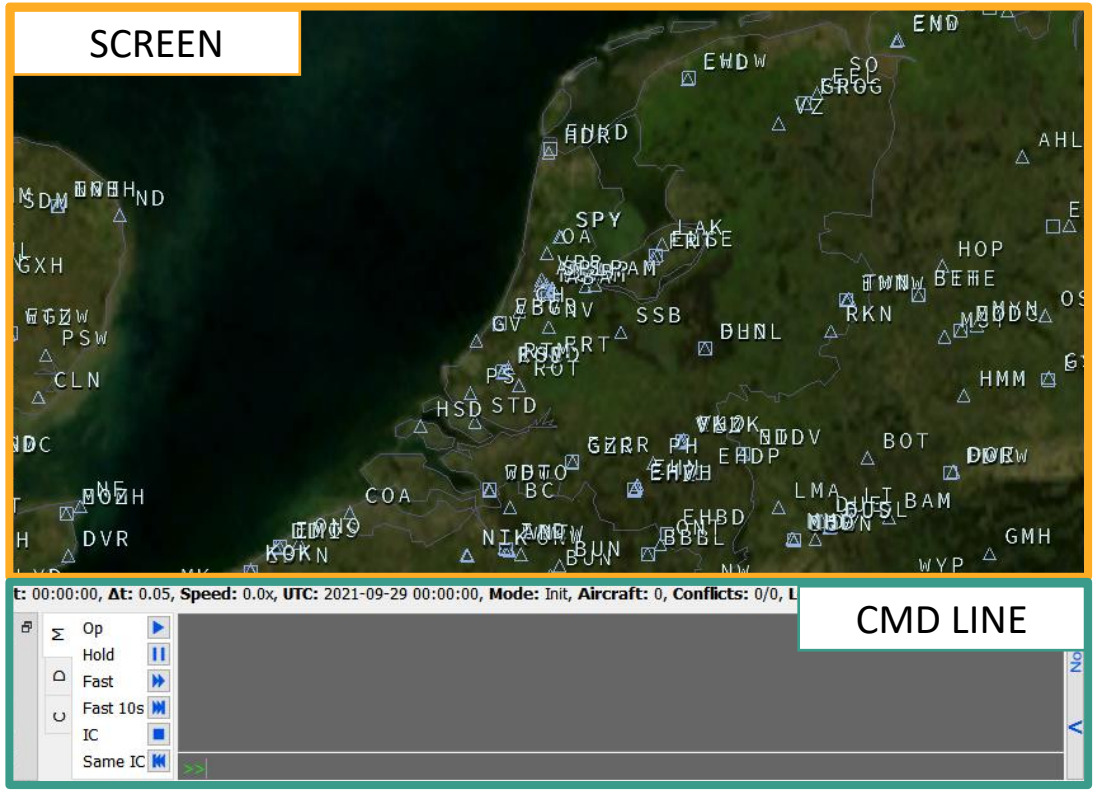
Develop a simulation tool: BlueSky

BlueSky source

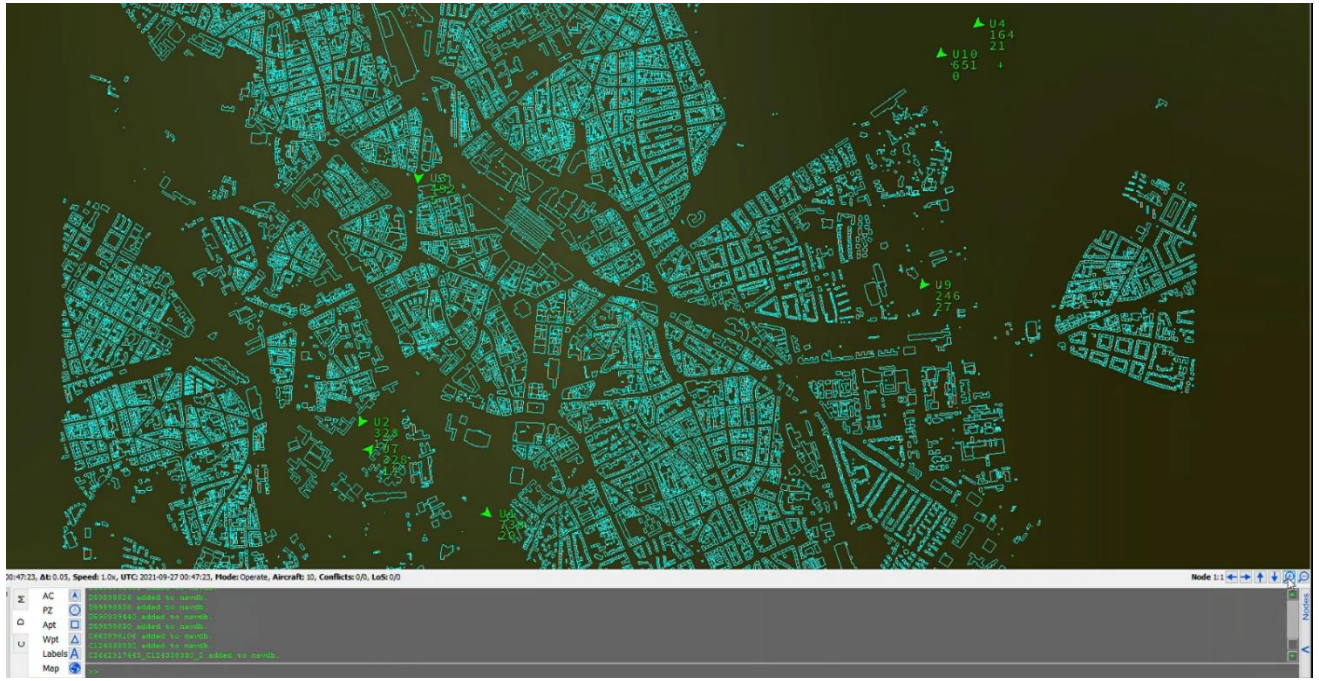
Simulation Engine

Language	- Coded in Python3
Traffic simulation	- Dynamical model - Aircraft performances - Conflict detection - Conflict resolution - Autopilot
Control	- Commands (built-in) - Scenario files - Plug-ins (add new functionalities)

Graphic User Interface



Create a simulated city: Hannover



3D city graph: between buildings → 3D city graph: above buildings → Corridor creation → Segment assignment

USEPE main challenges

1. Inclusion of **real turbulent wind fields** as part of the separation management processes.
2. Feasibility of using **machine learning algorithms** to optimize the separation methods.

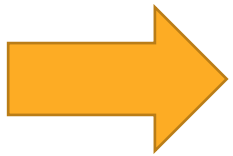
4. What comes next?

- **Complete simulations**

- **Develop algorithms**

- **Analyse results**

- **Provide an Exploratory Research Validation Report**



TRL2

Thank you!

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