USEPE CONSORTIUM

Isdefe — Systems Engineering organization. Experience in ATM-UTM related projects

NOMMON — Big Data and AI experts

University of South-Eastern Norway — AI and Systems Engineering experts

Deutsches Zentrum für Luft- und Raumfahrt (DLR) — U-Space activities. Experts in simulation

POLIS CITIES AND REGIONS FOR TRANSPORT INNOVATION — Sustainable transport from cities point of view

Leibniz Universität Hannover — Institute of Meteorology and Climatology: Experts in urban turbulent wind field simulation

indra — Large multinational industry in ATM and U-Space sectors

Objectives

Main goal

Propose, develop and evaluate a Concept of Operations and a set of enabling technologies aimed at ensuring the safe separation of drones (from each other and from manned aviation) in the U-space environment, with particular focus on densely populated areas.

Apply the Systems Engineering approach: From problem to final solution taking stakeholders' needs into full consideration.

We asked them who should provided the separation: the USSP

Other objectives

- Study the implication of hyper local wind data (WIND TURBULENCE)

- Explore the use of ML

Achievements

The separation method: D2-C2

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**
- Manages **traffic complexity**
- Applicable in **corridors** and **segments**

More Achievements

- *Safety Volumes: how* to calculate the maximum capacity of a segment
- **Two-staged approach for conflict detection**:
    - Stage one: use of Bluesky performance based-detection
    - Stage two: pre-computed look-up tables.
        - *Look-up tables* for pairs of drones (ownship and the intruder). We have pre-computed individual simulations for all possible parameter combinations, considering the "best" avoid maneuver each time (i.e. largest possible distance at CPA).
- *ML algorithm* for Strategic deconfliction. To save computational time to calculate paths free of conflict. Other uses of ML have explored, but finally not implemented.
- *Accurate wind data simulations*: PALM simulations, considering turbulent wind field caused by building surfaces and Street layout. location, height, and the roof shape of the buildings have been input data.
    - *The wind data have used in the BlueSky simulator not only to modify drones flight paths but also to influence the actions of the segmentation service rules defined in the scope of the D2-C2 separation method.*
- *Bluesky developments: shared with the simulation community and available at Github (path planning, dynamic airspace segmentation and ML modules, all together are called "USEPE plugin").* *Outcome not expected at the beginning of the project*

Simulation Results : 3 levels of background traffic density

USEPE

LAST MILE DELIVERY

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

Good results for the highest traffic density.

Only 5% reduction in simultaneous flights managed

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
- Several simultaneous drone flights
- Unexpected emergency drone flight
- Segment capacity is exceeded, but the flight must be 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

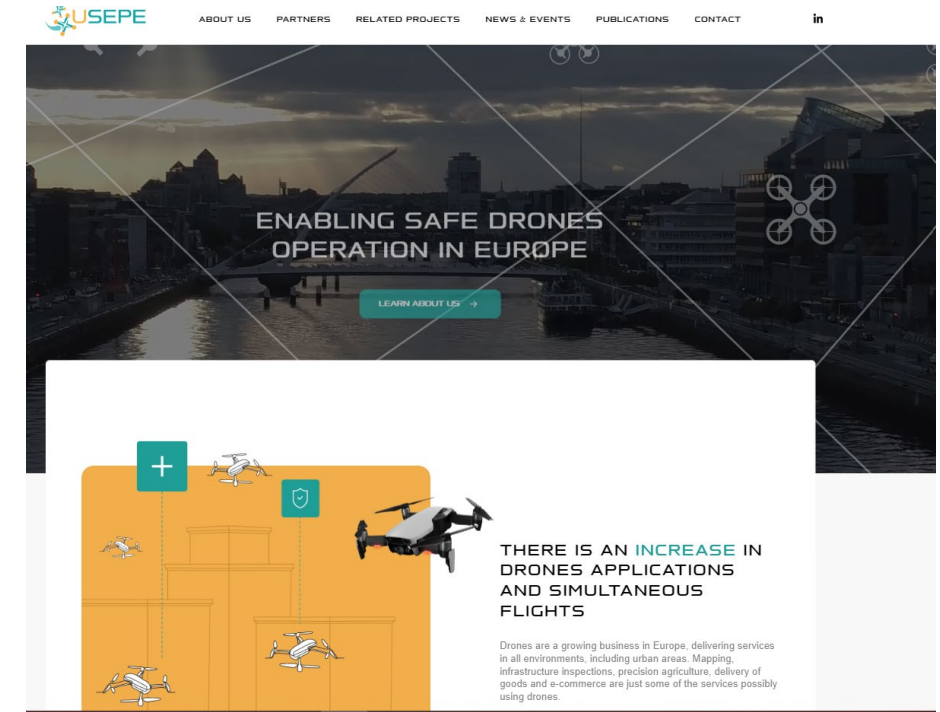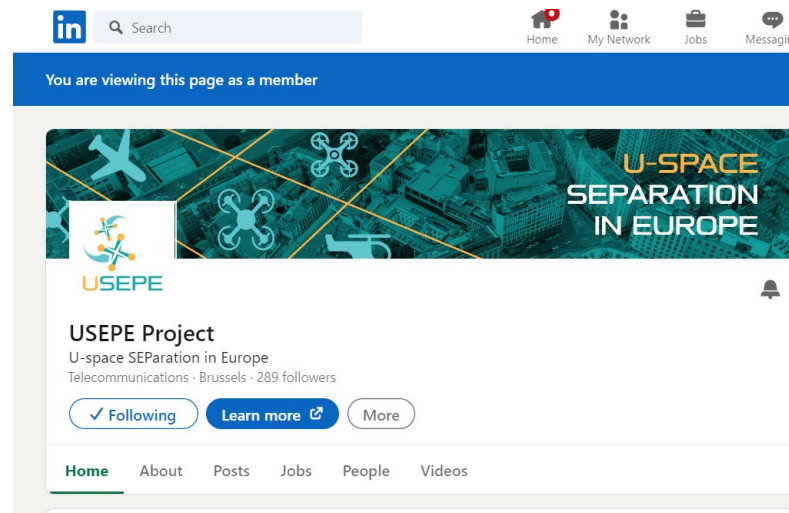Good results for low and medium traffic density (conflicts decrease)

However flight time increases a great deal.

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

sesar JOINT UNDERTAKING

EU Drone Days
Brussels, 29-30 November 2022

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