

Origin of HYPERSTREAM project

- **HYPERSTREAM is a continuation of Engage project FC2A**
- **HYPERSTREAM builds on Hypersolver SESAR project developments**

HYPERSTREAM explores flight centric bundling strategies with Hypersolver simulation platform.

- The FC2A project objective was to evaluate the performance of flight centric approach compared with current ATFM/ATC management.
- With the Hyperstream research we **explore the potential of Hypersolver to solve pending questions** related to the concept of Airstreams.

Our project supports the **thematic challenge 3: Disruptive ATM system modernization**.

FC2A project analysed the feasibility of defining Airstreams (corridors made of a collection of parallel lanes)

Within FC2A, it was decided not to solve the following questions:

- How to insert flights in the airstream traffic
- How to pass over slower traffic within the airstream
- How to arrange Airstreams crossings

These questions were supposed to be solved later by some anti-collision equipment on board

Application Domain

An alternative to the use of an advanced anti-collision system is to tackle the problem with a centralized approach. Such an approach cannot be even tested with the commercial aviation because the ATM is insufficiently automated.

On the other hand, it is possible for **drones /HAO** because we commonly send commands to the autopilot of the drones. Experiment can only be performed with drones.

In the drone domain, we can target TRL2-3

The goal of Hyperstream project is to explore if we can solve the 2 following questions by using a solver such as Hypersolver (i.e. in a centralized manner):

- How to insert flights in the airstream traffic
- How to pass over slower traffic within the airstream

In the framework of Hyperstream, we propose to adapt HYPERSOLVER to drones and simulate drone movements into / within an Airstream.

Objectives

Assumptions:

- We suppose the Airstream is pre-defined.
- The trajectory of aircraft are completely imposed remotely in a centralised manner.
- In the case of drones, the auto-pilot of the drone receives and apply the trajectory.

Research:

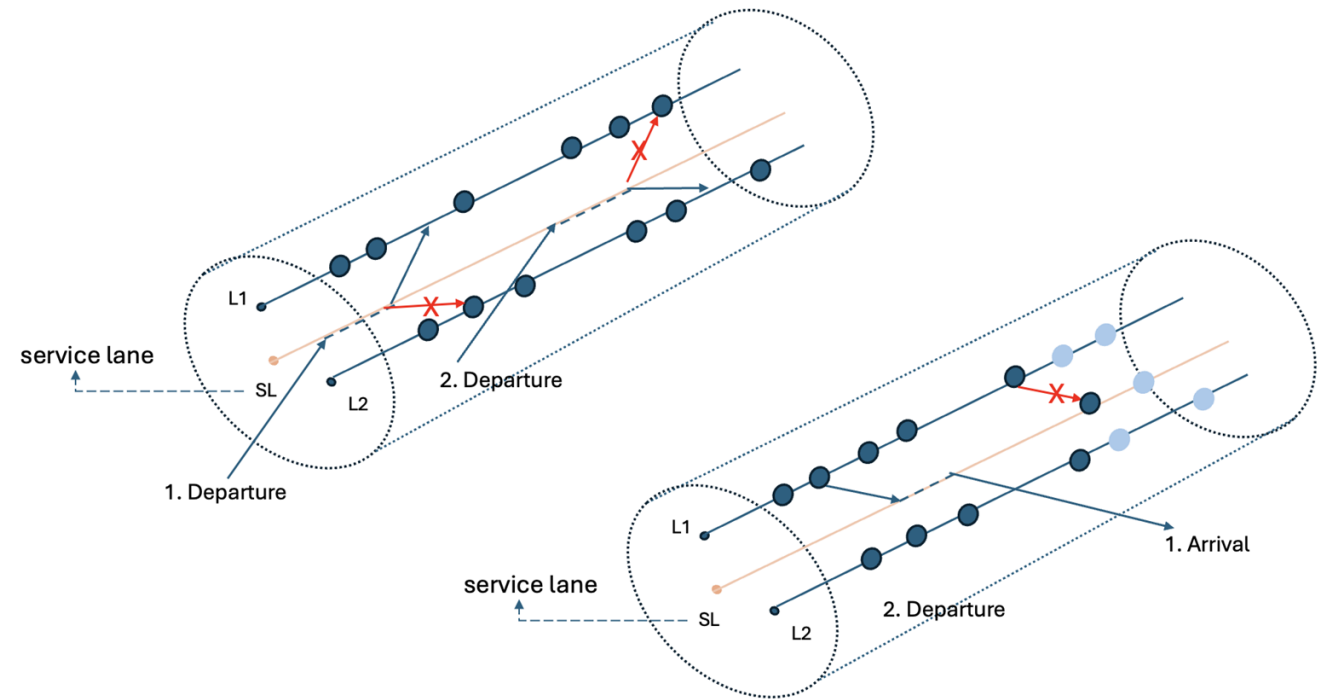
- Can we insert flights in the Airstream traffic?
- Can we pass over slower traffic within the Airstream?
- by using Hypersolver (simulator, solver, platform). The solver modifies the trajectories to prevent conflicts (i.e. loss of minimum separation between aircraft).

Apply the concept to a flow of drones

- Simulate a fleet of drones of the same type.
- Experiment with drones (e.g. DJI mini3 drones turning on a circuit).

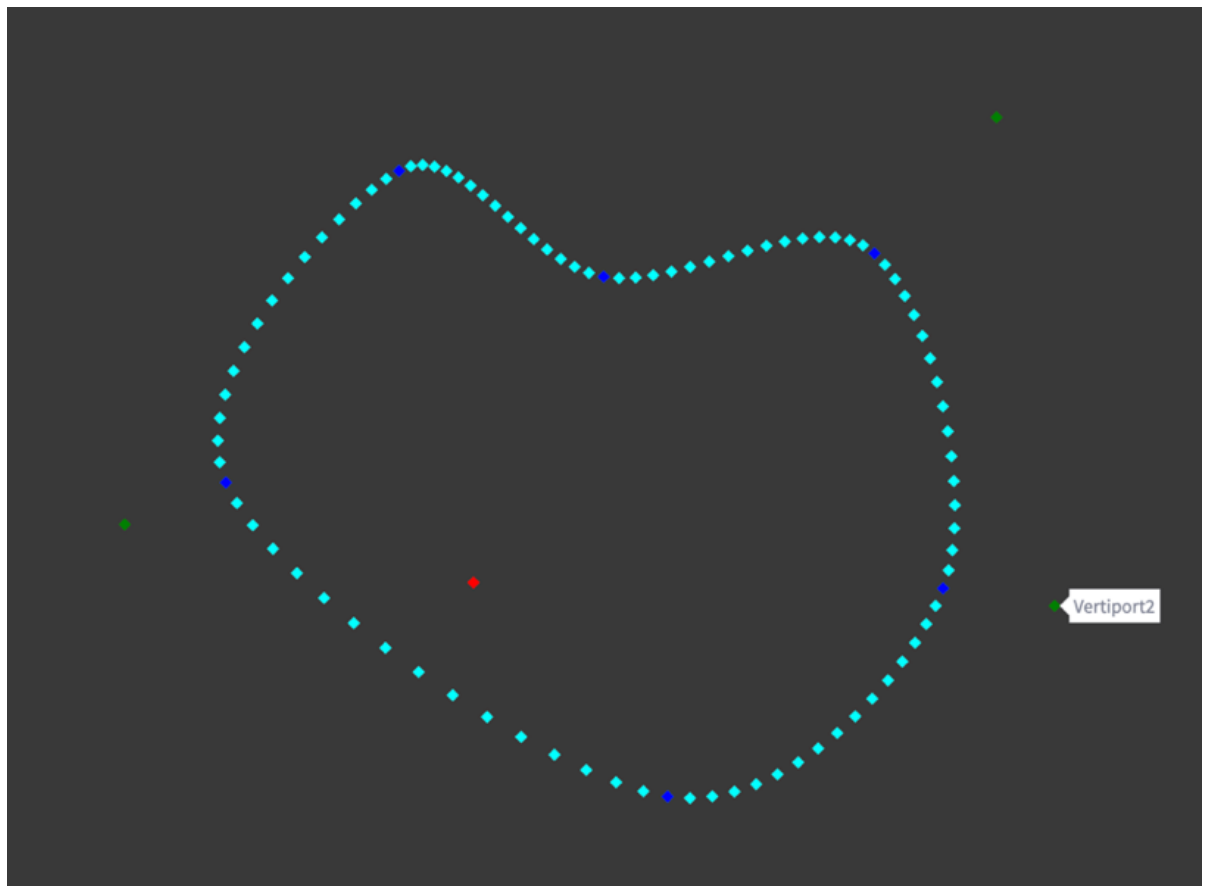
Concept

- The Airstream does not cross any restricted area thanks to an Adaptive Corridor Generation algorithm that also optimises vertiport access
- Every flight is on a lane of the Airstream. (Definition of the action space of the solver)
- The traffic enters and exit the Airstream via the (orange) service lane. (Definition of the action space of the solver)
- The traffic should minimise the occupancy of the service lane. (Definition of the reward of the solver)
- The Airstream does not cross any restricted area
- When enroute, the drone cannot exit the Airstream (geocaging). It can exit the Airstream only for landing.

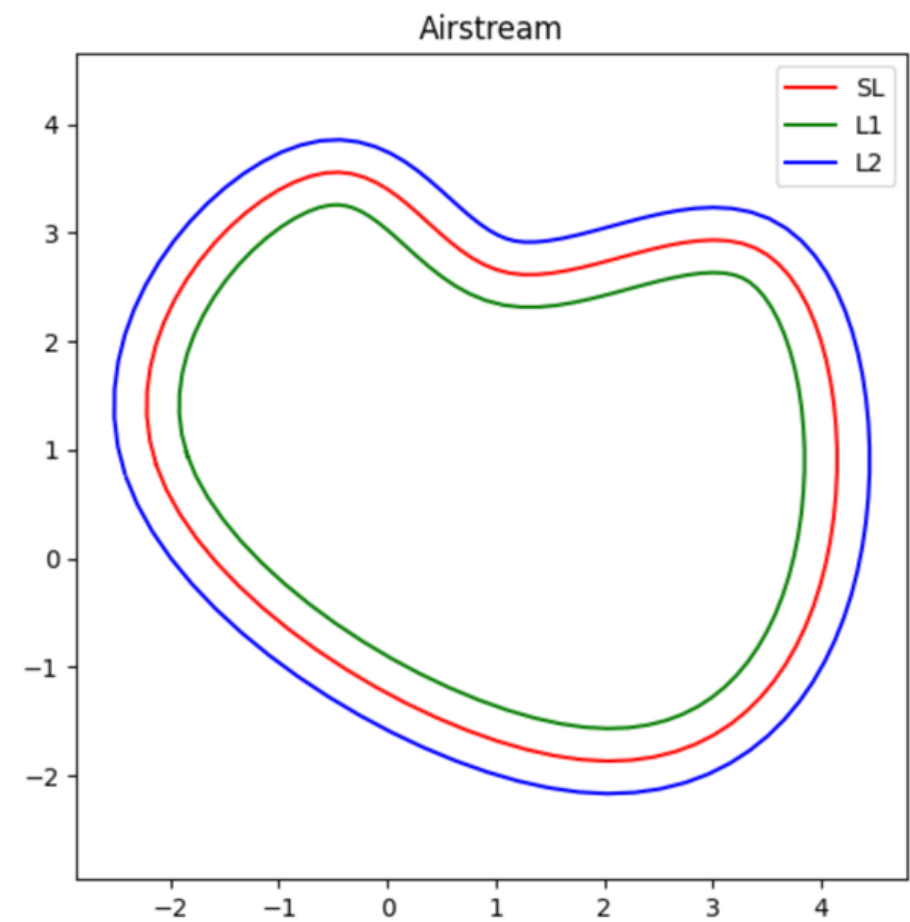


Airstream entry/exit and overtaking concept

Simulation



Spline importation in Hypersolver



Calculation of the Airstream lanes

Publications

- Presentations at the 44TH AIAA DATC/IEEE Digital Avionics Systems Conference (DASC 2025)
Abstracts of 2 papers accepted on 10/03/2025:
 - *Bio-Inspired Swarm-Based Adaptive Corridor Generation for Urban Air Mobility: A Safe and Efficient Routing Framework*
 - *A Deep Reinforcement Learning Approach to Cyclic Airspace Corridor Design and Optimization for UAS Traffic Management*

Full papers to be published on 05/05/2025.

- Presentation at IEEE/CoDIT2024 Conference, Malta, July 2024
and paper published:
 - *A Two Level Structure for Efficient Logistics in the Urban Airspace*
- Hyperstream LinkedIn account created

(see <https://www.linkedin.com/company/hyperstream-engage2-sesar-project/posts/?feedView=all&midToken=AQEPHQNBykTPzw>)

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