# LABSIM Simulation Laboratory

Salon de Provence

Christian Schulte

ONERA

THE FRENCH AEROSPACE LAB

retour sur innovation

# Plan

1. LABSIM Presentation
2. Software Architecture
3. VESA – Image Generator
4. UAV & Hybrid Simulation

# 1 - LABSIM : Simulation Laboratory

The LABSIM is the aggregation of all the real time simulation tools of the ONERA Salon-De-Provence centre.

Composition :

- Bench for Prototyping and Conception of Systems for Helicopters (PycsHel)

- Bench for simulation and evaluation of innovative human system interaction concepts (SCHEME)

- Pilot-System Interaction Laboratory (LIPS)

# 1 - LABSIM : PycsHel - Hardware installation

Four faced cuboidal CAVE simulator

PYCSHEL

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# 1 - LABSIM : PycsHel - Hardware installation

Dashboard :

- ✓ 4 multipoint touchscreens
- ✓ Automatic configuration through XML files
- ✓ FMS / Instruments / Simulation control dashboard, …

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# 1 - LABSIM : PycsHel - Hardware installation

- ✓ Passive helicopter sticks :
  - * Cyclic (2 axes 8 buttons)
  - * Collective (2 axes)
  - * Rudder (1 axis)

- ✓ Active sidesticks:
  - * Cyclic (2 axes 7 buttons)
  - * Collective (2 axes 7 buttons)

- ✓ NVIS nVisor ST50 see-thru augmented reality head mounted display

- ✓ Headtracking OptiTrack V120:Trio

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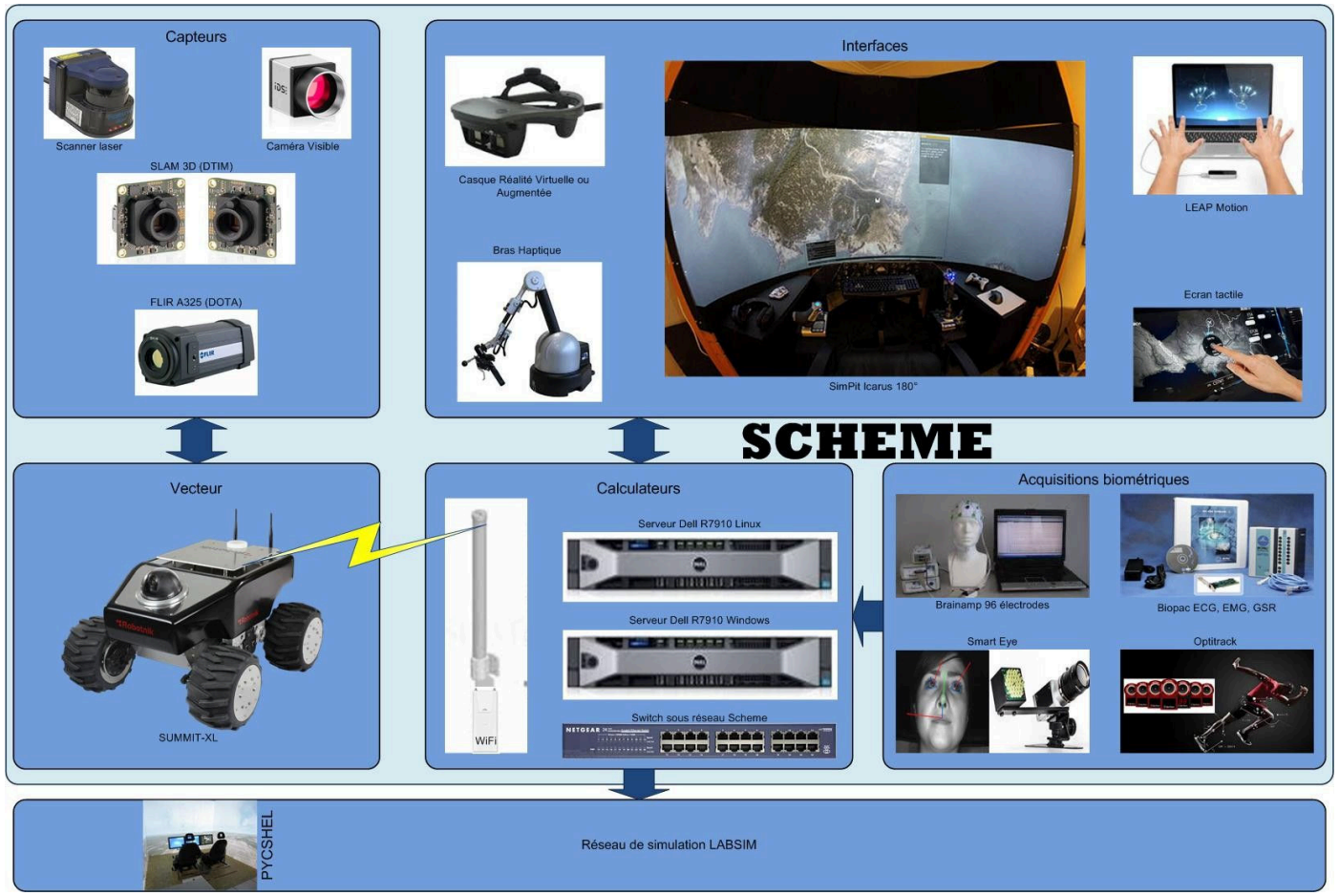
# 1 - LABSIM : PycsHel – Control Room

Development & Simulation supervision :

- ✓ Copy of whole dashboard & visual environment
- ✓ Real-time monitoring & recording of all variables
- ✓ Offline replay from recorded variables, with different view angles, trajectory visualization, video recording, etc.

# 1 - LABSIM : SCHEME - Goals

- Human systems interaction study and research platform for human centred conception of teleoperation ground stations.

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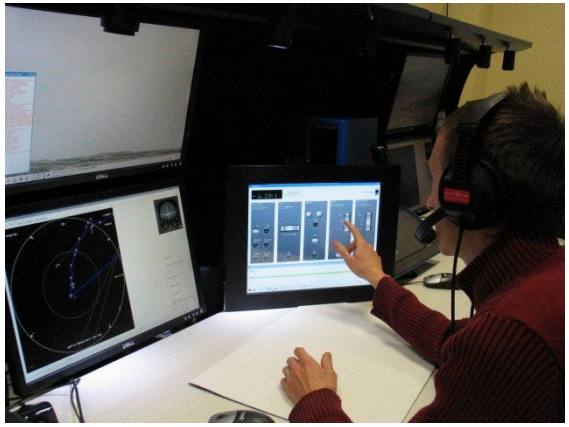
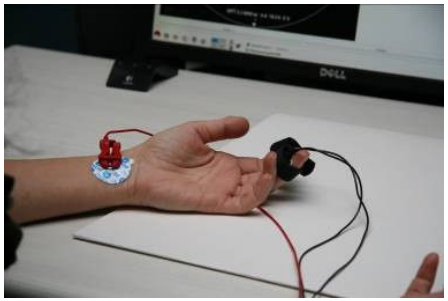
# 1 - LABSIM : SCHEME - Hardware installation

- SimPit Icarus 180  Avenger immersive cylindrical environment

# 1 – LABSIM : LIPS - presentation

- This laboratory is used for the human-system interaction studies
- It allows the interaction of up to 10 operators (ATC's, pilots, UAV payload operators, UAV pilots,…) in a complex scenario with up to 128 vehicles
- Allows to study the interactions between the operators and the systems or between the different operators





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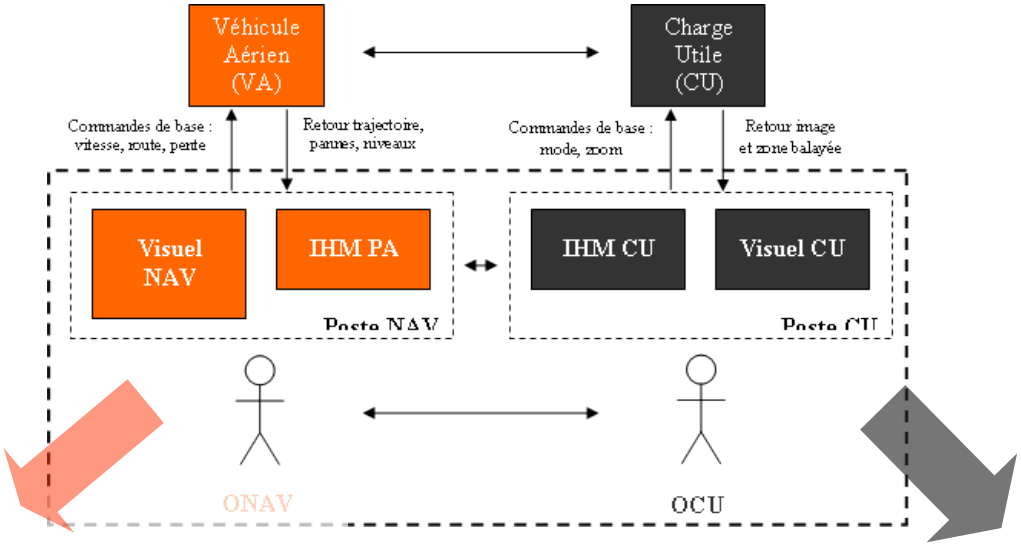
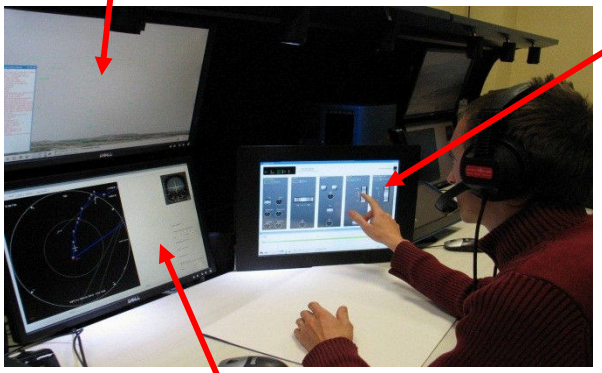
# 1 – LABSIM : LIPS - UAV Simulation




## UAV Control

UAV front camera with specific HUD

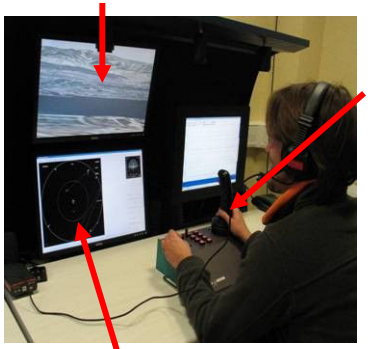


Automatic pilot control touch screen

Screen for tactical situation and navigation

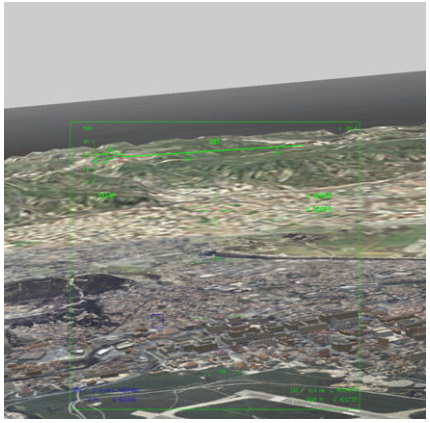
## UAV Payload

Payload camera



Flybox for payload controls

Screen for tactical situation and navigation



HUD dedicated for payload control

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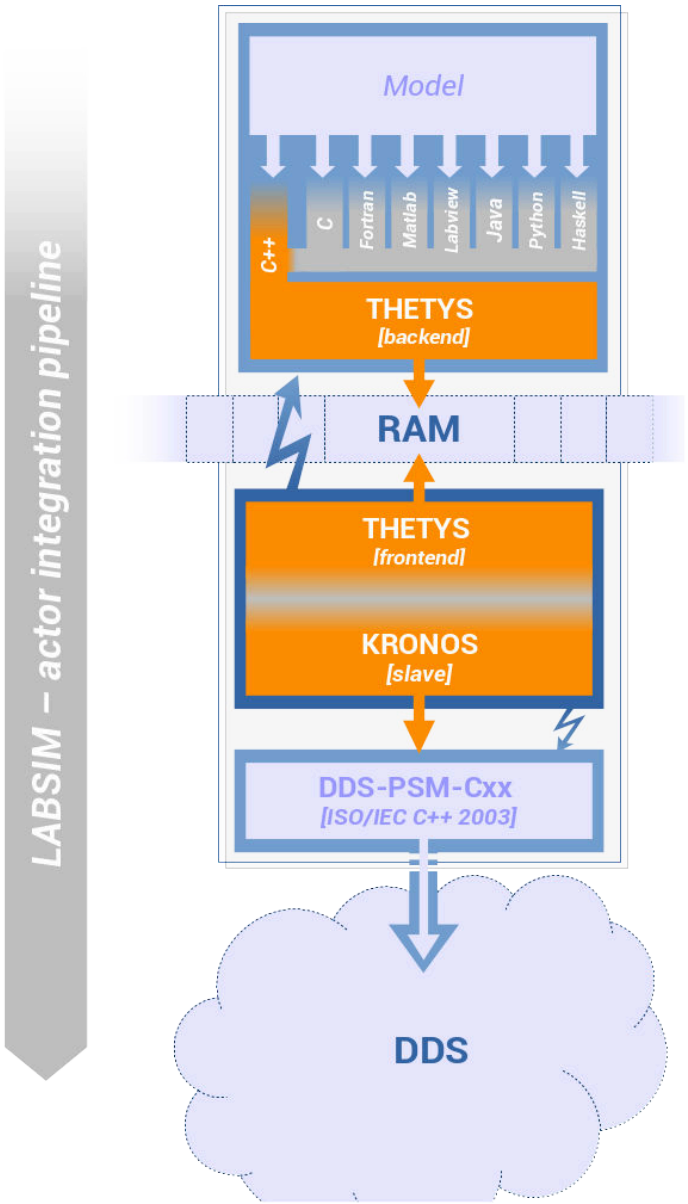
# 2 - Software architecture




- Seamless « Expert » model-based integration from various scientific domain
- Dynamic library encapsulation
- Multiple langage connector

- Data-centric architecture
- Process isolation
- Resiliency through RAM-hosted data-broker frontend

- KRONOS : soft real-time DDS-based simulation orchestrator with discrete-event mechanism
- Vortex OpenSplice Community-Edition v6.4 middleware
- Standard ISO C++ API

- Agent-Based Simulation
- Multiple OS supported (Linux,Win)
- Fully configured through XML

- Typical use case :
  - 12 model ;
  - Mean bandwidth : ~50Mb/s ;
  - Cycle frequency : 100Hz.

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# 3 - VESA : Image Generator

## VESA

**« Visual Environment for Simulations in Aeronautics »**

Developed by the ONERA in order to match the research requirements and exigencies

Based upon the Open Source graphic 3D toolkit OpenSceneGraph

Fully configured through XML

Screenshot and video recording capable

Distributed visualisation on different PCs

Multiview capable

OpenGL shader generated weather and ocean by Sundog™ Software

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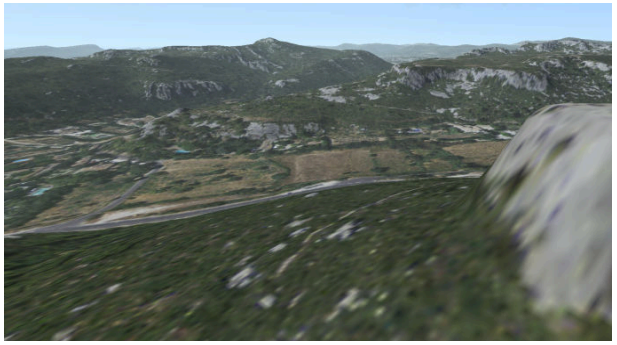
# 3 - VESA : Image Generator

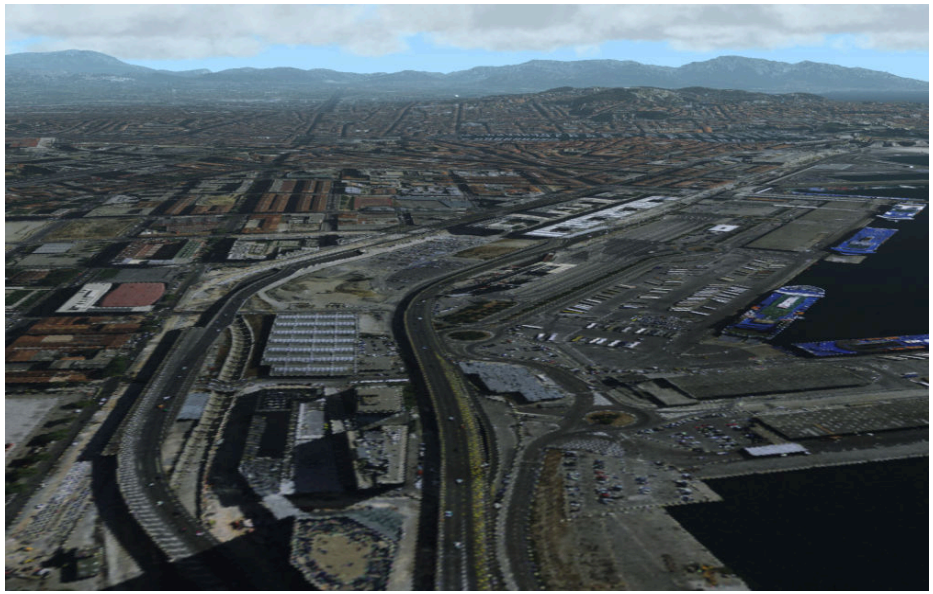


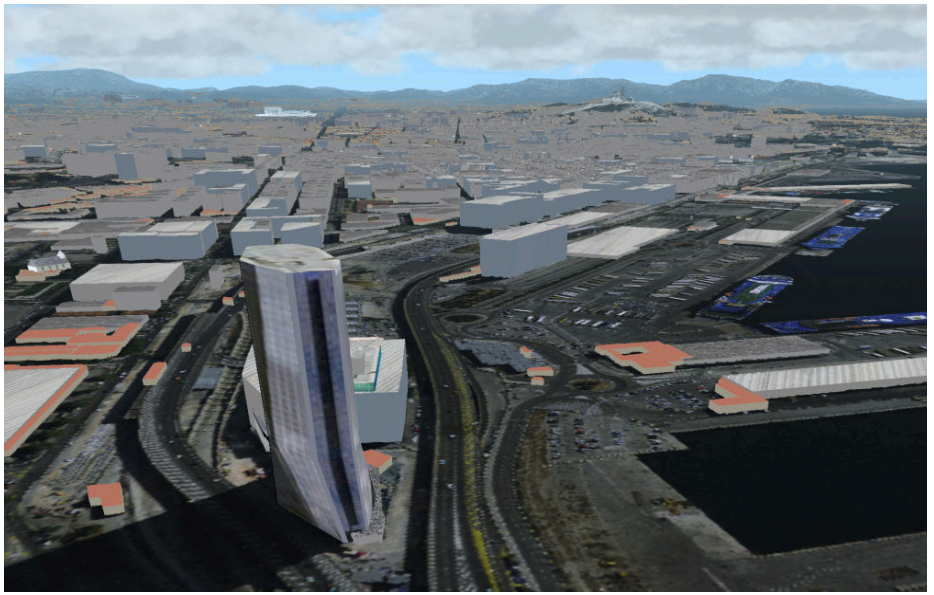
Terrains generated by ONERA directly from the DEM data and Orthophotos

Formats : OSG, OSGEarth, Flt, Presagis CDB,…

Integrated geospatial systems : WGS84, Lambert 93, Lambert II, Transverse Mercator, Universal Transverse Mercator, Flat Earth, …

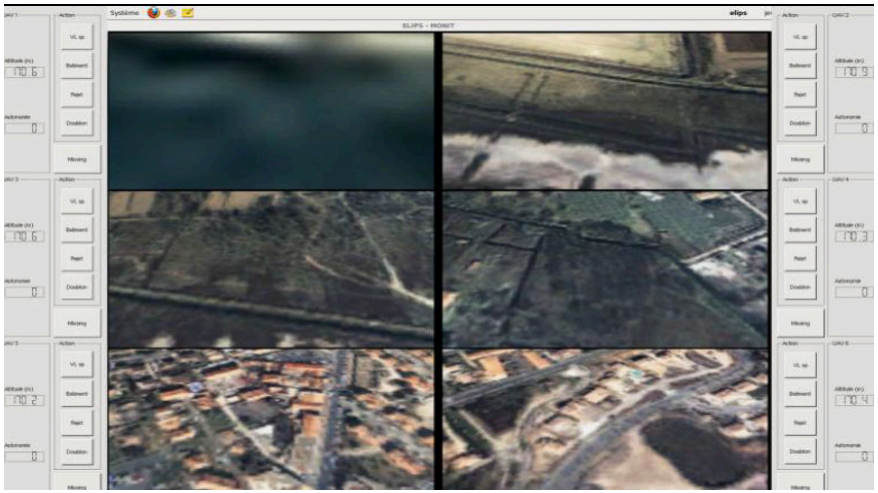
# 3 - VESA : I.G. + Hephaistos building generation

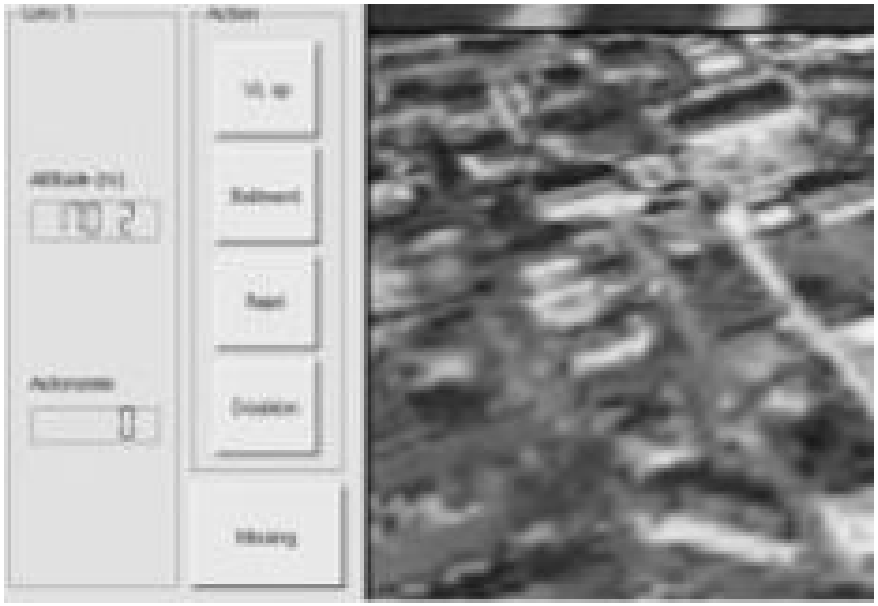




- Procedural GPU based building generation directly from cadastral survey data
- Possibility of inclusion of geospecific or remarkable buildings

# 4 – UAV simulation example





Supervision of multiple UAV's :

Study the influence of number of UAV's on the supervisor's workload.

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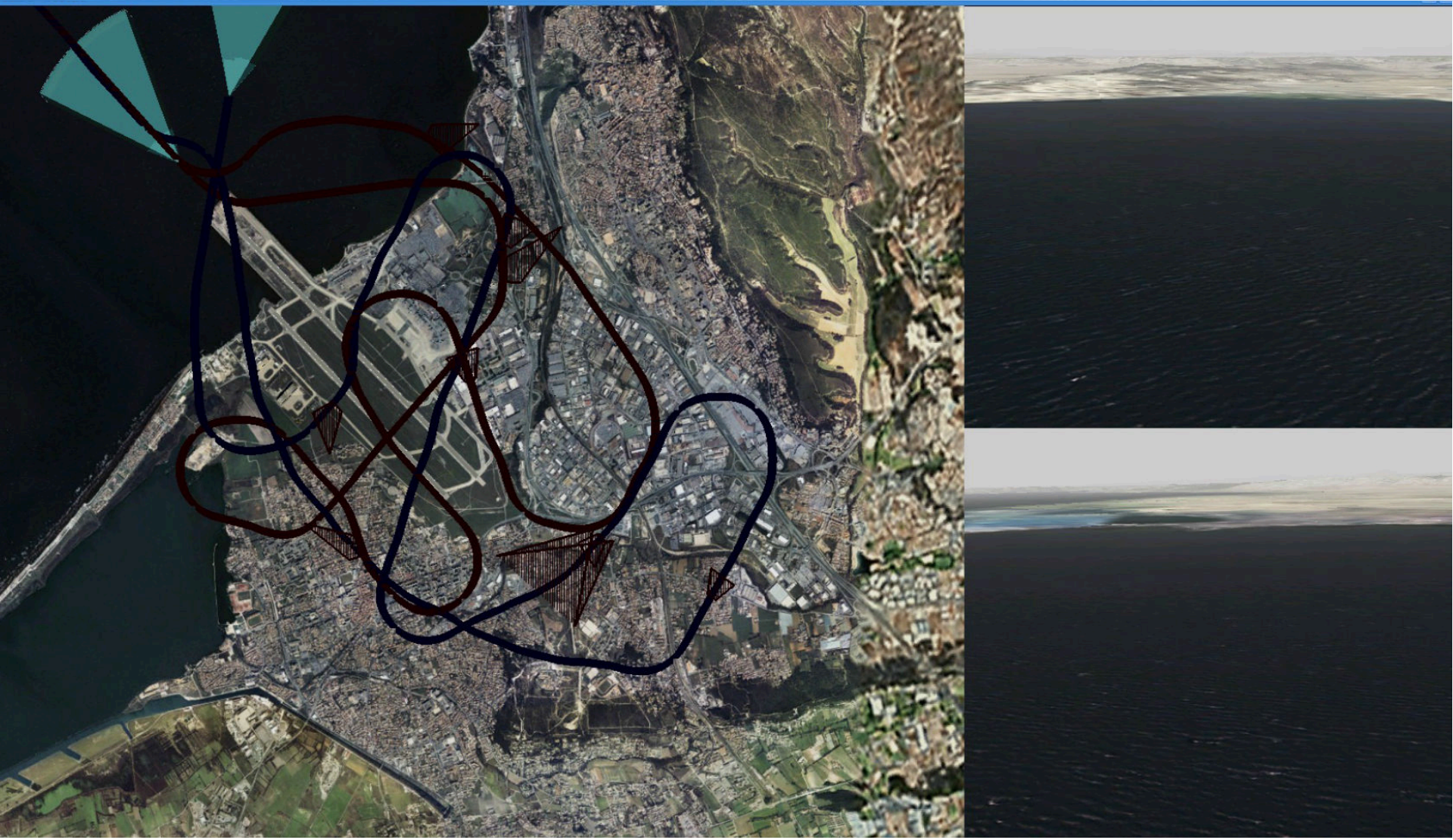
# 4 – UAV simulation example



Piloted UAV supervision interface with ground coverage of photography

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# 4 - Hybrid simulation architecture

*Vidéo & Data wireless transmission*

Datalink Protocol: MAVLINK (MICRO AIR VEHICLE COMMUNICATION PROTOCOL)

Middleware: MAUVE

Operating System: ROS.org, ubuntu

Unmanned Vehicle:

Cartography Payload:

Cameras Payload:

Datalink Protocol: MAVLINK (MICRO AIR VEHICLE COMMUNICATION PROTOCOL)

Middleware: DDS

Operating System: Linux, Windows

Ground Station:

Commandes:

Immersive Solutions:

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# Any questions ?

**https://labsim.github.io**

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