Collaborative Immersive Environment for Forest Fire Fighting Training

Foreword :

This tool has been designed as a pedagogic support for training forest fighters crews. It has been designed to provide a shared forest fire environment.

The students are fire fighters at different commandment levels. Lower levels are ground group commanders (typically commanding a group of vehicles), higher levels are supervising several simultaneous fires at a large geographic scale.

Different simulation stands are usable, each providing a specific set of environment and functionalities, from ground attack vehicles groups, to airborne water bombers planes or helicopters, or ground inquiry vehicles, HQs, etc …

System architecture :

A typical session currently uses 20 machines (PC 1G / 512 Meg / GeForce class video card), dispatched in five different groups.

Pedagogic team   Students
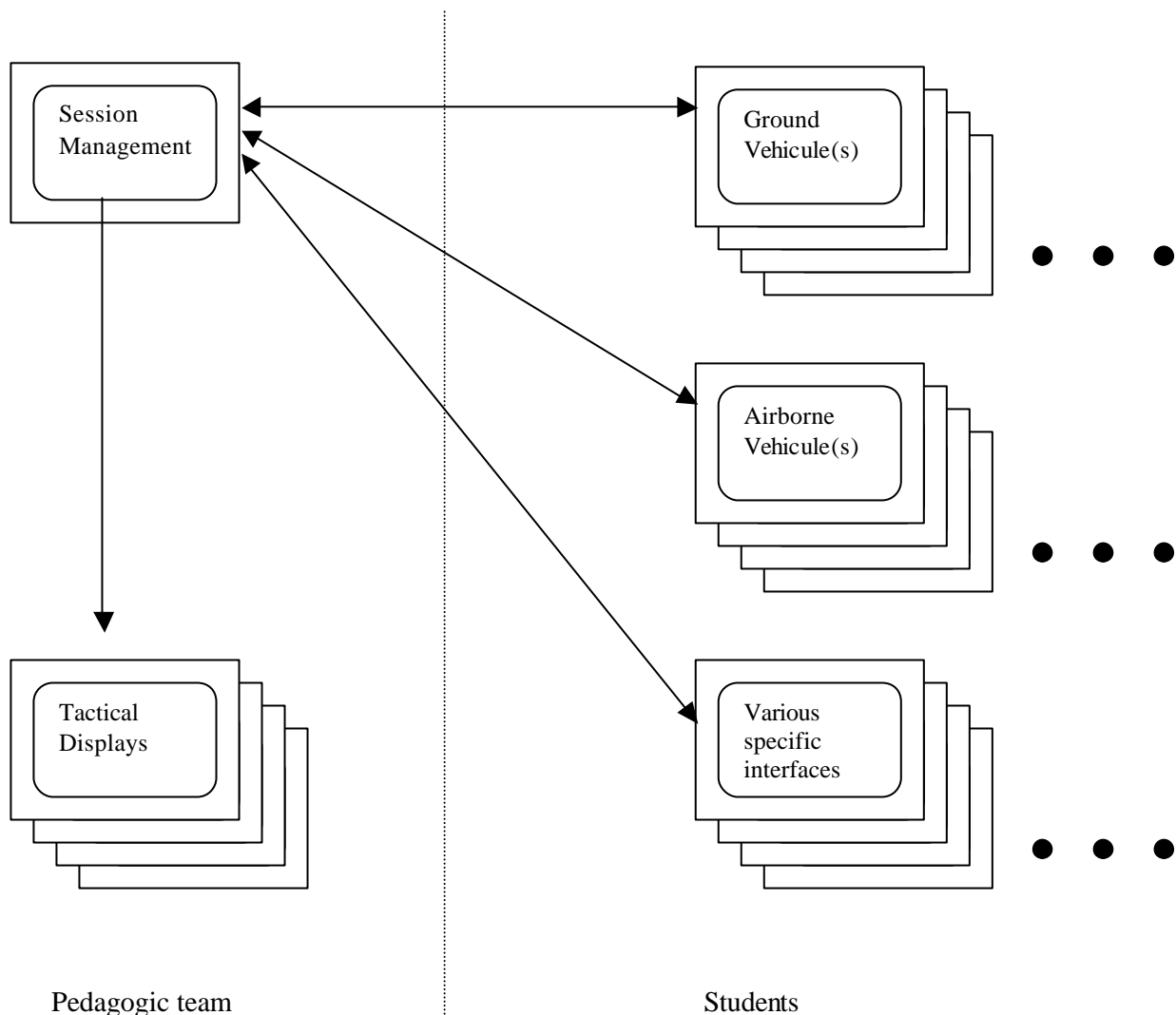
Of course each user can see and hear each other, the fire, the vehicules, the actions (ie a plane's water bombing … or crashing on a non signalled electric power line). Hearing is heavily used for plane guidance.

The exercise ground is typically a 1000 sq kilometres reconstituted real ground, mapped with aerial photography. Depending on the user need (different for flying or ground users), the quality can be adjusted, both for geometry and raster cover. Maximum raster quality is 50 cm per pixel projected on the ground


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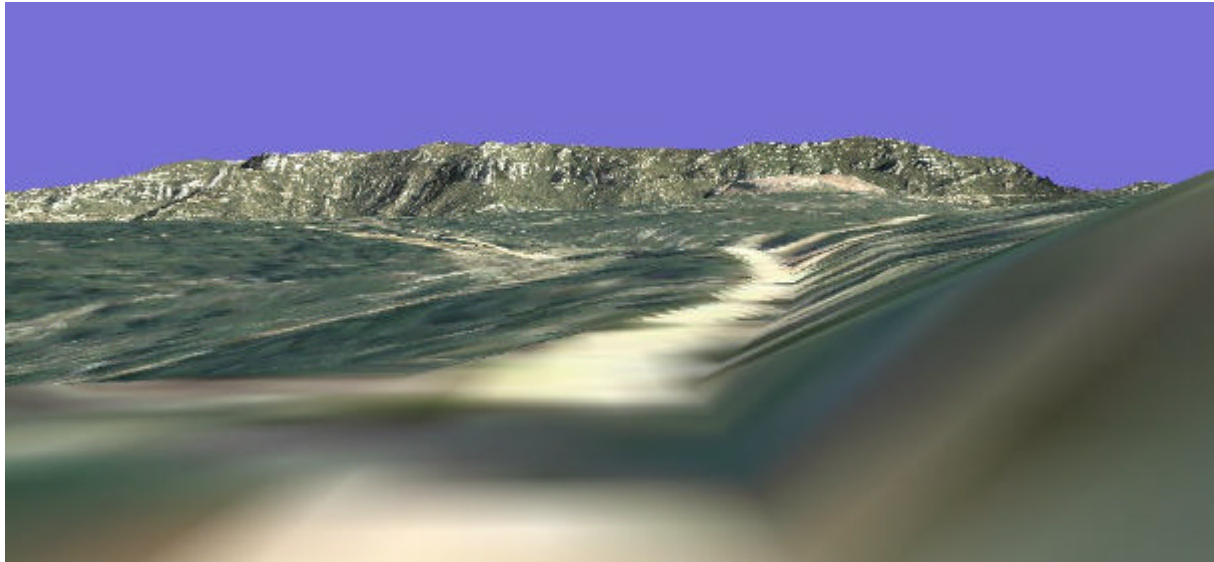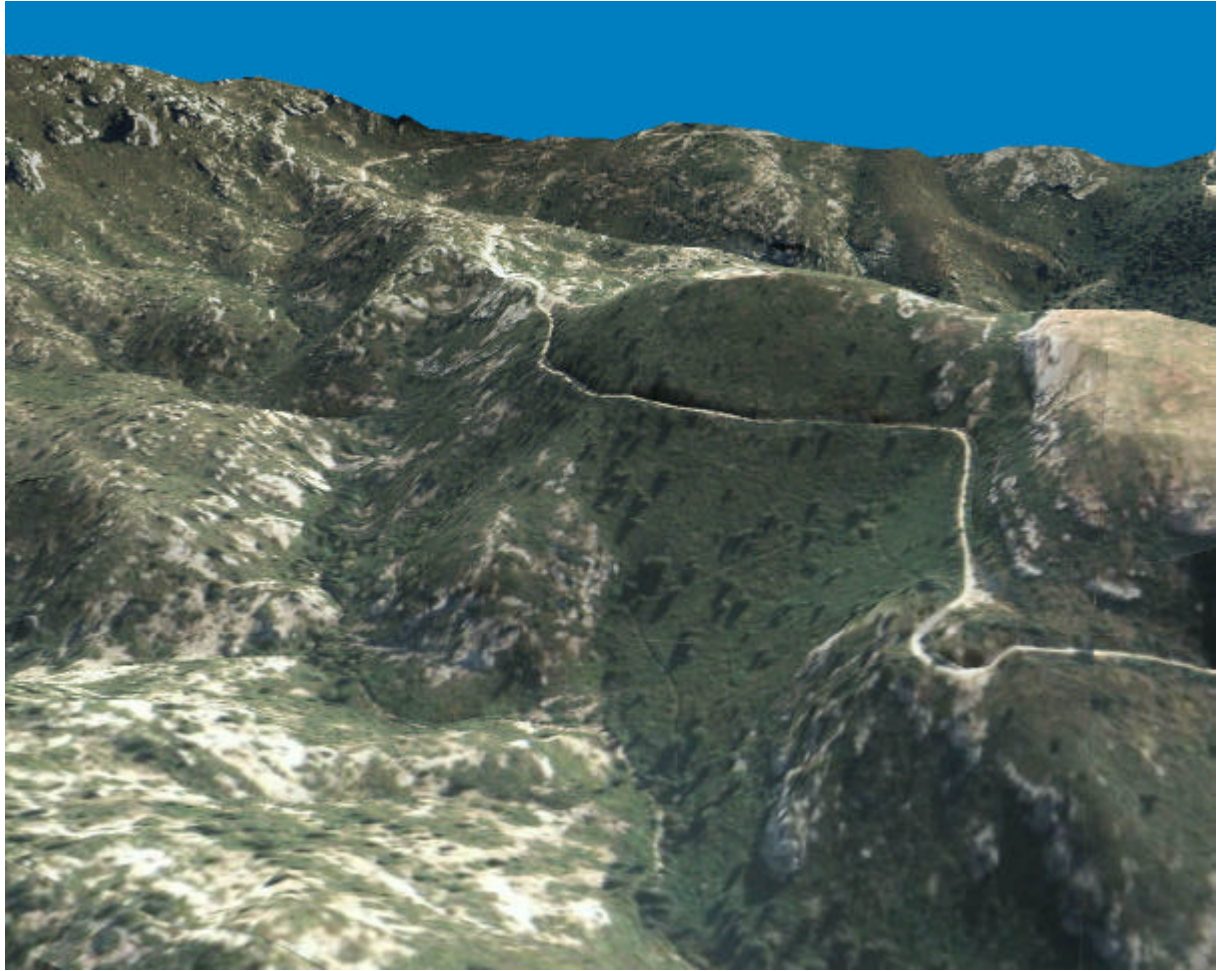
Session Management :

Also called DIREX. This display performs all training direction:
- defines time of day, wind conditions
- defines fire(s) start(s) and evolution(s)
- listen to radio traffic
- defines scenario and triggers events (mechanical breakdown, humans lost in smoke, accidents, train caught in fire, etc …, even animals escaped from zoo …)
- decides of the availability of vehicles (that may be shared on several fields of operations, or called from nearby fire stations)
- Monitors all traffic , vehicle positions/ heading/ user current line of sight, travel speed, etc …
- Monitors fire evolution
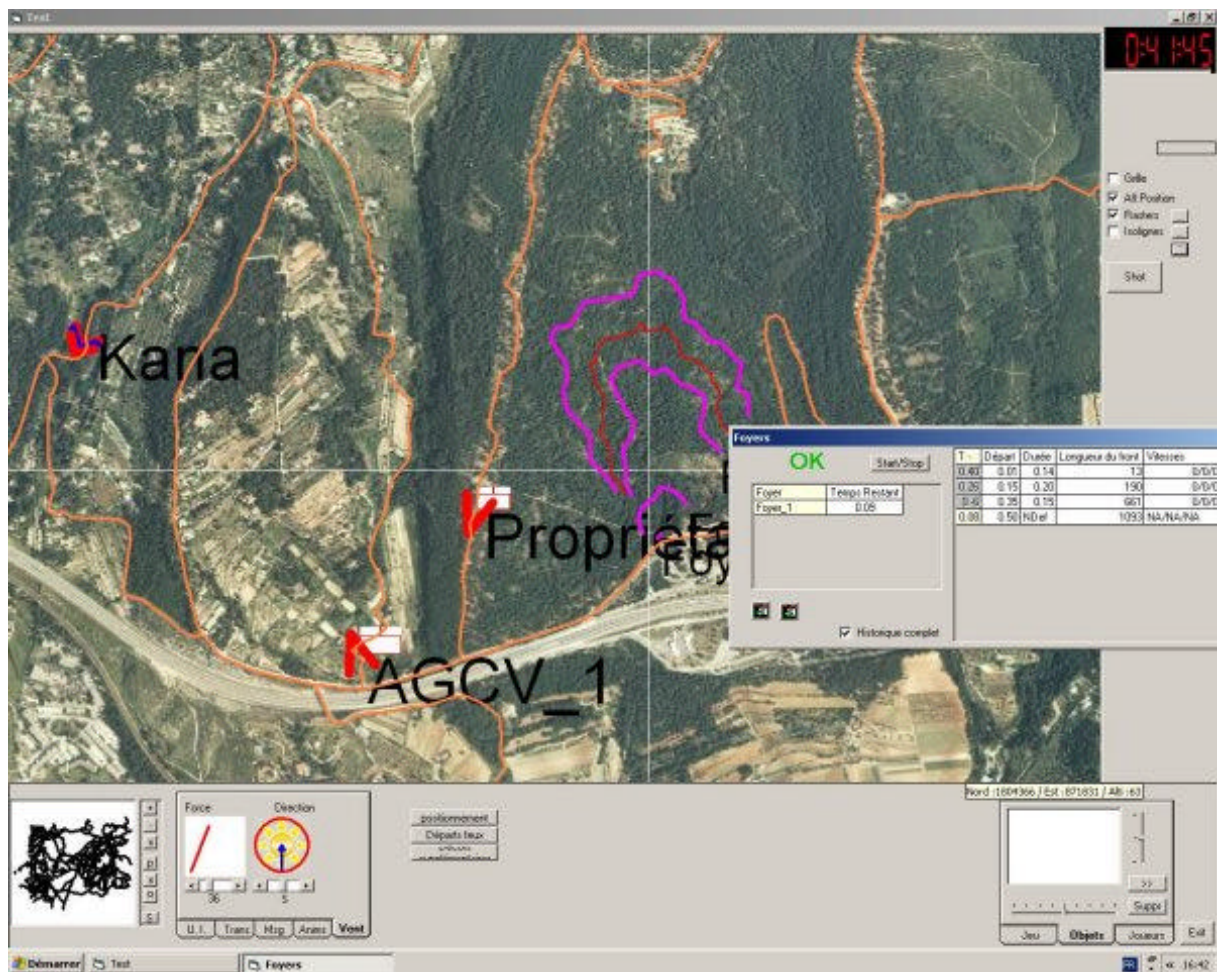
It uses a 2D display as main interface, background aerial image can be shifted to a standard Map view.

Ground Vehicule(s)

These posts simulate a ground vehicule, or a group of vehicule.
All ground vehicules stands have the following functionalities :
- ability to travel on roads / tracks
- moving map display, centered on user's position,
- compass,
- speed selector (with stop)
- direction of sight selector (free move left/right and up/down)
- U Turn

Some posts manage a group of vehicules : one user acts as a group leader. In this case some more functions are available, like separating some vehicules from the group, typically for managing a specific fire attack or for inquiry purpose (a lightweight vehicule goes ahead).

Main posts is this group are :
- GIFFs : Groupes d'Intervention Feu de Foret. Those are constituted of several water carrier / attack vehicules and a lightweight all terrain vehicule.
- COS : Coordination des secours.Chief of operation, the local Fire HQ. Only one vehicule
- AERO : Aero Officer, responsible for air coordination, guidance, and exclusion zone monitoring.

There can be any of these in a session, the limitation being the number of machines available …

Other vehicules available are numerous, ranging from all kinds of water carriers, ambulancies, medicalised vehicules, logistics, etc …

Since there's no pedagogic needs for all vehicules to be managed by students. So any vehicule may be 'automated'. For example a COS may ask for a water carrier, this vehicule will be automatically driven on the road network from it's starting point to the 'rendez-vous'. This enables a lot of operational vehicules on the operation field, without need to actually drive them.
Some simulations have needed more than 250 vehicules, while a session only counts 15 people …
The DIREX stands decides if a vehicule asked for is available or not, and decides from it's starting point (hence it's timed availability).

A lightweight vehicule, facing another group and a plane.

Note that a student hasn't access to the 3D commands, those are usually hidden. As a matter of fact, the Direx is able to set any User Interface component availability and functionality for each student.

An automatized water carriers group on the way to a 'rendez vous' point.

Note that there's no interface available, since this shot has been taken while 'spying' the view of another automated vehicule : it's possible to open windows, tracking the actual view of any user or automated vehicule … but this is only available to the pedagogic team, for evaluation purposes.

Note that the vehicules do have headlights. Night operation is possible, the headlights are functional.

The burned area is greyed out, while some vegetation patches remained unburned, either because there was nothing to burn, or as the result of an action (water bombing or ground attack)

In the far plane, you may see a water bombing on the fire front.

Airborne Vehicule(s)

Airplanes and helicopters are managed a bit differently. Each 'air' application is set up of two application :
- flight dynamics and navigation
- simple CAVE visualisation system.

An air simulation stands uses one machine for flight dynamics, and one machine for each cave display. There can be any number of display synchronised on a plane or helicopter. Usually 3 to 6 displays are used, to reconstruct a cockpit view.

Helicopters stands are two seat : one for the pilot, and one for an eventual passenger (chief of operation or AERO officer usually)

A Canadair CL 415 as seen from an helicopter central screen.

Note that there's a group on the ground.
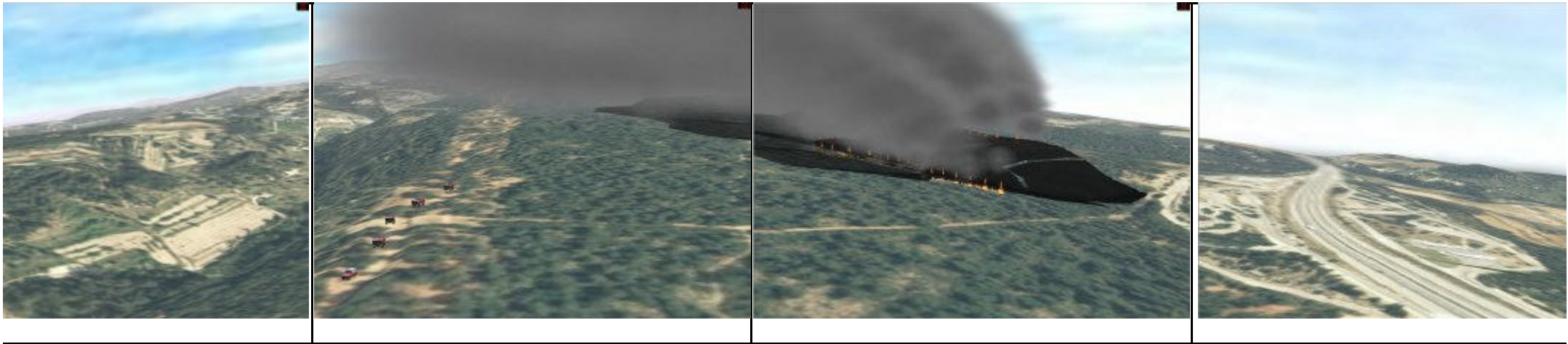
5 screens for a plane view :
- 1 screen for flight instrumentation and dynamics handling
- 4 screens for covering a 200° panoramic view.

A little distorsion can be seen, since the screens are not placed in the same plane (like the shots above), but are circling the user (over 200] in this case).

There are 3 planes supported : Fokker, Trakker and Canadair (all water bombers)
And 3 Helicopters : Aerospatiale EC 145 two versions, and water bomber

Last water bombing of a Trakker before night falls … (Tactical display shot)

A trakker comin too late … and off target

Various specific interfaces

Some simulation posts don't require a 3D display.
That's the case for higher level commandment headquarters, that are linked to the others thru radio links.
A local radio system is used for session vocal communications handling. It's just the same used in real situations.

Some posts do require a 2D Map display, like 2D tactical displays (equivalent to the DIREX application, but without controls).

That's the case for Transit and Dispatch management.

This post handles vehicules asked for by students to carry out their task. For example water carriers, or medicalised vehicules, or any number of ground attack groups to be placed at strategic points over the fire.

In the real world, someone receives those vehicules in a parking in the vincinity of the fire, and then dispatches them were needed / asked. In the simulation, most of those vehicules are automated. They are sent by the DIREX, and they arrive to the 'Transit point'.

From there, the 'Transit point' simulation posts, enables a student to define their way (avoiding obstacles, fire, encumbered paths) to their 'point de rendez vous' where they should meet the student that asked for them.

< TODO : stick a transit shot >

Tactical Displays

There are two kinds of tactical displays, 2D and 3D ones.
2D tactical displays are very similar to DIREX main view
3D Tactical displays are very similar to AirPlanes displays, but each user or automated vehicule carries a sign for retrieval.
This application is 'spy enable': it enables a user (from the pedagogic staff), to spy any other user actual view.
So, in real time, an instructor knows where any student is, knows what he is looking at, and hears what the student is hearing.

A few Tactical displays shots :

GIF3_

This work has been carried out for French Civilian Defense training schools.
Thanks to their staff for their patience and pedagogic science, that enabled me to enter into forest fire fighting world.

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