genesis
all dimensions of Sound

Helicopter Sound Environment Simulator

GENESIS carried out in 2001 for **EUROCOPTER** the audio section of a real-time helicopter flight simulator, including:

- **Ambient sound generation** in the cockpit using real-time sound synthesis,
- **Intercom** for 8 users and operators, wearing headsets,
- **3D spatialization** of sound sources over headphones using binaural synthesis.

The audio system has been integrated within the simulator of the Technical Direction of EUROCOPTER.

Integrating the sound environment into the simulator brings two main improvements:

*It **increases the realism** of the simulation, by giving coherent information to the whole human mechanism of perception, in particular piloting clues like engine or rotor sounds,*

*It brings new functionalities, like **3D sound spatialization**.*

*The implementation was made on a **standard PC** with **Linux OS**, combined with **professional audio devices**. GENESIS took in charge the whole process of specification, conception, production and installation, regarding **software** developments as well as **hardware** integration, including **audio wiring**.*

GENESIS' expertise in the fields of signal processing, acoustics, psychoacoustics, sound wiring and software development made it possible to produce a system that perfectly suits the needs and benefits from the most recent technologies.

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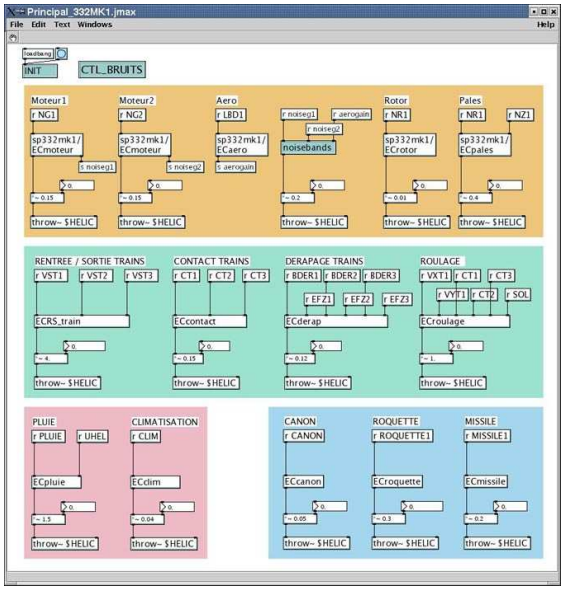
TECHNICAL FEATURES

Ambient sound generation

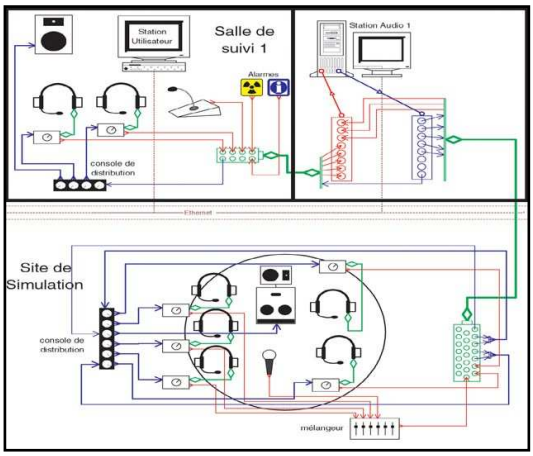
The audio system receives the flight parameters through a network interface and generates in real time the **whole set of helicopter sounds**: engines, rotors, aerodynamic noise, air-conditioning, on-land wheeling (runway, field), weapons (missile, rockets…), rain.



Each sound is generated by a **sound synthesis** algorithm developed from the analysis of real recordings. The algorithms are controlled by the flight parameters (engine speed, rotor speed, horizontal speed…) with a **response time lower than 50 ms**.

This technique, contrary to sampling methods, allows to make each sound evolve in a **continuous** and **instantaneous** way, according to the current parameters, and to get a **modular** system in which each sound source can be set individually.

Sounds are reproduced over **headphones**, reinforced by a **subwoofer** which reproduces low frequencies with high fidelity.



Intercom

Users in the simulator (pilot, copilot, observers) and operators in the monitoring room must be able to communicate with each other, and in an adjustable way.

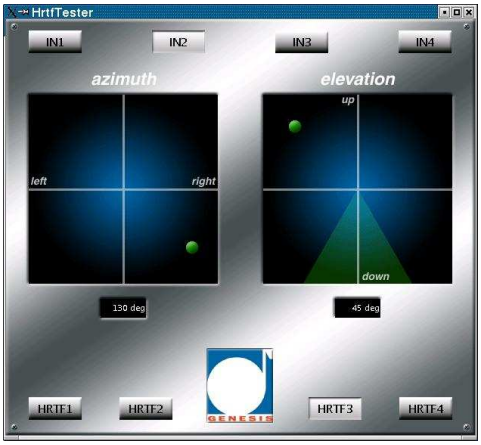
Each one wears a headset. The audio system inputs the signals from all the microphones and then outputs the mixed and processed signals towards each headphone, making intercom possible.

Each listening system is independent and the mixing/routing of signals can be set by a software. One system can control up to 8 speakers and several systems can be linked in order to allow intercom over the whole simulation center (up to 24 speakers).

3D Spatialization

Spatialization makes it possible to give a virtual position in space to a sound source.

We have used a spatialization technique over **headphones** called real-time **binaural synthesis**, with a specific implementation allowing to spatialize several sources simultaneously. For each source, the calculator transmits in real time to the audio system the wanted azimuth, elevation and distance, making it possible to create continuous movements.



This feature is used on the one hand to give different positions in space to the different speakers and therefore increase intelligibility, and on the other hand, to give the pilot additional information, for instance by signaling an external helicopter with an alarm sound which follows its position.

This project has been carried out with the collaboration of Room Acoustics and Real Time teams of IRCAM (Paris).

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