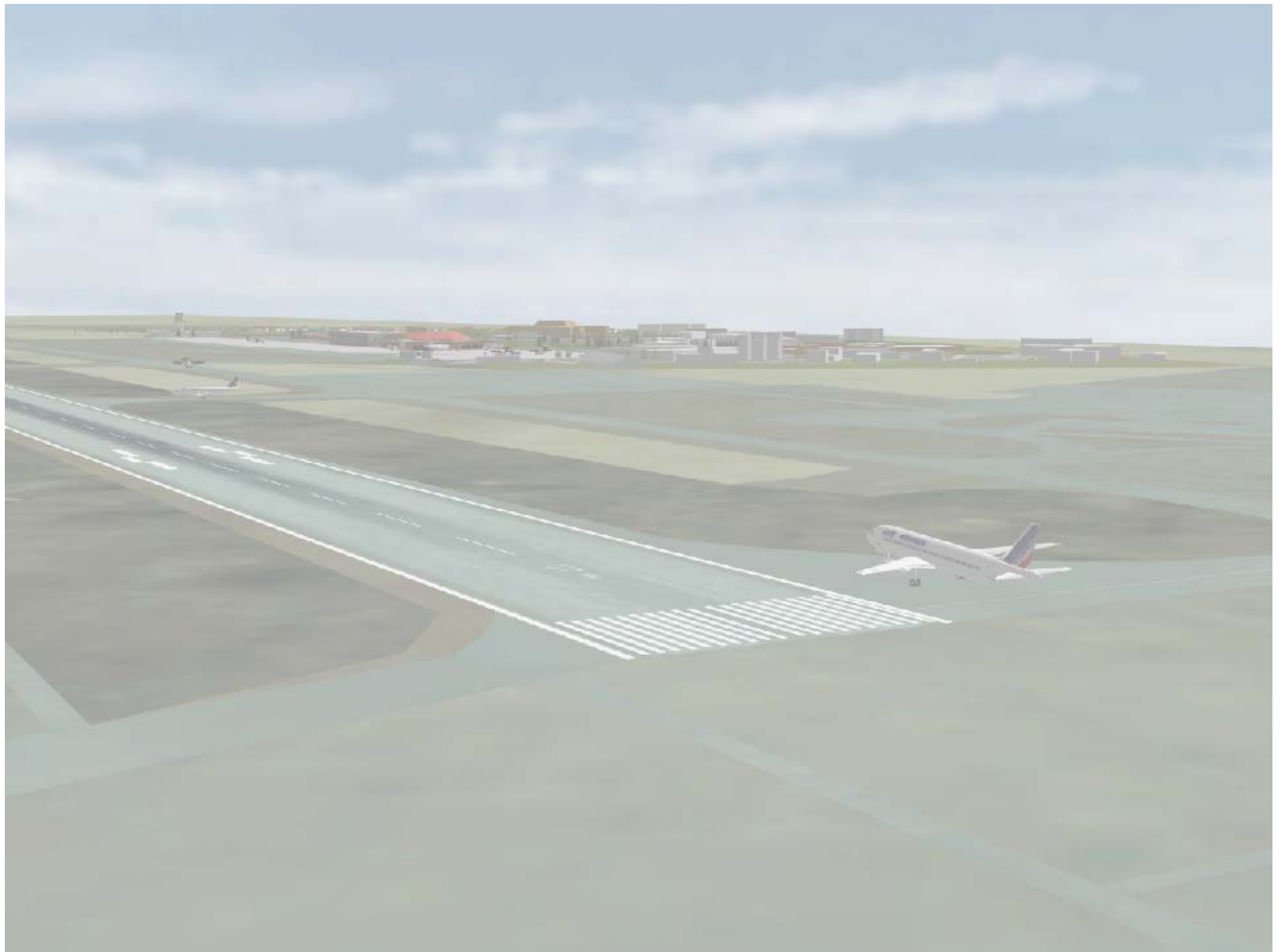




Contract N°: AST3-CT-2003-502817

Measurements on a real site



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1 Introduction

A measurement campaign at the airport of Toulouse/Blagnac has been conducted. The objective to gather real fieldstrength data for comparison with and validation of simulation data according to the scenarios defined in workpackage 3.3 has been achieved.

The integral part of the measurement campaign was the measurement of fieldstrength-values on locations spread over the airport area.

Additionally some measurements were conducted giving information about the reflection behaviour of both geometrically easy and complicated structured buildings for elementary validation of the software.

The proposal which enables to scale measurements experimentally will be realized on a time-scale which is, of course, behind the one of workpackage 4.4. On the other hand, the data are needed for validation and will be available till then supposed the scaled measurements are successful, so that no delay will occur for the project.

But measurements on a real runway can't give the interesting information, especially the disturbances at the height of approaching airplanes, which was learned only during the detailed discussions and preparations of the measurement campaign.

1.1 Passive fieldstrength measurements

The equipment for measuring the electric fieldstrength consists basically of the receiving antenna connected to an EMI (electromagnetic interference) test receiver. The EMI test receiver can be understood as a spectrum analyzer with a tracking filter at its input allowing signal strengths not to be influenced by signals of frequencies which lie close to the measured one. With this feature it is even possible to resolve the spectrum of signals that are amplitude-modulated with very low frequencies like the Instrument-Landing-System (ILS).

According to the respective emitting sources their receiving parameters like frequency ranges, intermediate-frequency bandwidth and measuring time are adapted at the EMI test receiver. Passive measurements were performed with a directional antenna as well as with an azimuthally omni-directional antenna. The use of such a directional antenna will probably obtain information on reflections on airport buildings. The omni-directional antenna is only used in vertical polarisation due to its geometrical structure.

The GPS-coordinates of the respective measurement locations can only be given within an accuracy of 5m with the EGNOS-correction system enabled (Euro Geostationary Navigation Overlay Service).

The power detected at the input of the EMI test receiver is related with the actual fieldstrength value within the dimensions of the receiving antenna by its antenna factor.

A common method for measuring the antenna factor is the substitution method where the detected power thru the receiving antenna is directly compared with the data of a calibrated electric field probe.

Each measurement data needs to be post-processed with applying the antenna factor to it.

In addition to the directional and omni-directional measurements at each location, some omni-directional measurements have been performed within the range of GPS' accuracy to get an idea of how the electric fieldstrength fluctuates around some given measurement location's coordinates.

The modulated ILS-signal at different angles has been measured in order to derive the difference in depth of modulation the value of which yields the horizontal guidance signal for approaching

aircrafts. The results of these measurements can be used as comparison to the mathematical description of the ILS-source and also as synthesis data for a scaled ILS-system. The validation purpose of these passive measurement data is on the one hand the direct comparison of the simulation's and measurement's fieldstrengths levels, but also the difference between signal levels due to their respective measurement locations.

These passive measurements can only be used as an integral validation of the computed fieldstrength distribution at the airport at a number of frequencies from different specified sources.

1.2 Active reflection measurements

Active measurements are useful for validation of reflections on airport buildings in an elementary way. With a so-called bistatic antenna setup the reflections on single buildings have been measured for vertical, horizontal and cross-polarization. A bistatic antenna setup is needed since monostatic reflection-measurements lack of dynamics due to the antenna input-mismatch which is much larger than the reflected signal. The difference between signal strength of antenna crosstalk and reflected signal in a bistatic antenna setup is much smaller and therefore makes it possible to evaluate only the reflected signal by time-domain-gating the frequency spectrum via Fourier-transform. Active measurements were conducted in the frequency range from 350 MHz to 950 MHz and from 1100 MHz to 2000 MHz since low frequencies are supposed to be the most critical ones for simulation

1.3 Scaled measurements

The scenario with ILS-configuration cannot be measured meaningfully on the real Blagnac site since flight-traffic does not allow to have more than 3-5 hours to measure reflections from an A340 plane positioned on a taxiway and measuring on a runway. Due to such a short period of time only a few measurement points would have been possible according to the effort and time for moving measurement equipment or positioning the plane.

But most important is the restriction of measurements to a height of around 4m since the receiving antenna can't be positioned beyond that. Consequently it cannot give the very information of the reflections of the plane on a taxiway to an approaching plane in the air at realistic heights.

An additional workaround to even validate such scenarios was proposed. In particular the ILS scenario with an aircraft on the taxiway disturbing a guidance beam of the ILS to misguide an approaching aircraft is known in some rare cases to the control tower operators.

Such signal distortions depend only on the ratio of the dimensions of the disturbing object and corresponding distances and the wavelength of the signal as long as the reflecting properties are metal-like.

The measurement-conditions with a scaled scenario are well controllable since they take place either in a semi-anechoic chamber or at an open area measuring site.

According to DAC's (Direction Aviation Civile Sud) experience the MLS is influenced mostly by airport buildings and not by planes nearby.

Finally it should again be mentioned that this workaround is the only possibility to yield experimental data, since corresponding real airport measurements are not feasible for the given reasons. If, on the other hand, the scaled measurements will prove to be technically and practically feasible this will open a new and very flexible way to mimic ILS disturbances for many situations.