



ABCDE



Scientific Report

First name / Family name

Meritxell/ Genescà Francitorra

Nationality

Spanish

Name of the *Host Organisation*

NTNU

First Name / family name
of the *Scientific Coordinator*

Peter/ Svensson

Period of the fellowship

05/03/2012 – 04/03/2013



I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

The scientific activity during the fellowship period has been focussed on developing and testing a system to acoustically locate aircraft in the surroundings of an airport. This system is conceived to be later integrated in an aircraft noise monitoring system and make it independent from non-acoustical data such as RADAR, which is now used in the noise events identification stage. Several research groups have developed and tested different four-microphone spherical array configurations using time difference of arrival techniques (TDOA) to find the direction of an aircraft. Four is the minimum number of microphones required to unambiguously find the direction of a source in a 3D space. The classical TDOA techniques that rely on the cross-correlation function are based on a single source free field model, thus when the source is over a reflective ground the performance of such techniques diminishes. The main goal of the scientific activity reported here is to overcome this problem by showing how the use of virtual directive microphones attenuates the amplitude of the reflections so that the classical cross-correlation techniques can still be applied providing good results.

The outcome of the study is an array consisting of four virtual directive microphones arranged at the vertex of a regular tetrahedron. Each virtual directive microphone is obtained by synthesizing the signals of a pair of omnidirectional microphones, thus the total number of microphones in the physical array is eight. This arrays allows to find the sound source direction even in presence of ground reflections using simpler TDOA techniques.

The scientific activity carried out can be divided in the following tasks and timing:

- Task 1 (1.5 month) Review of the literature about existing passive acoustic methods to locate sound sources
- Task 2 (1.5 month) Review of the literature on correlation techniques and sound intensity measurements
- Task 3 (1 month) Write a mathematical model to simulate the performance of a microphone array of directive microphones using TDOA
- Task 4 (1 month) Write of a mathematical model to simulate the performance of a microphone array of directive microphones using sound intensity measurements
- Task 5 (1 month) Use of previous models to evaluate different array geometries
- Task 6 (1 month) Experimental study on the generation of first order directive microphones by synthesizing the signals of two omnidirectional microphones
- Task 7 (2 month) Design and construction of an adjustable array of virtual directive microphones
- Task 8 (1 month) Indoor experimental test and data analysis of the microphone array for direction finding using time difference of arrival techniques
- Task 9 (1 month) Paper, presentations and report writing to document the study

II – PUBLICATION(S) DURING YOUR FELLOWSHIP

- Genescà M., Svensson P. Development of a microphone array for direction finding of low frequency, airborne sound sources using time difference of arrival, to be published in the Proceedings of Scandinavian Symposium of Physical Acoustics, Geilo, Norway 2013
- Genescà M., Svensson P. Direction measurement of airborne sound sources over a reflective ground using an array of virtual directional microphones, to be published in the Proceedings of the AIA-DAGA Conference on Acoustics, Merano, Italy 2013



The work for the last publication was done as part of the ERCIM project but the actual conference presentation is done after the ERCIM period and is funded from elsewhere.

III – ATTENDED SEMINARS, WORKHOPS, CONFERENCES

- ABCDE Seminar, Sophia Antipolis, France, 24-26 October 2013
- Scandinavian Symposium of Physical Acoustics, Geilo, Norway 4-6, February 2013

IV – RESEARCH EXCHANGE PROGRAMME (REP)

- EPFL, Lausanne, Switzerland, 10-14 September 2013
Local scientific coordinator: Hervé Lissek
During this research exchange the fellow gave a presentation about the scientific activity done, and intended to do during this fellowship. She also discussed with researchers that had recently achieved the PhD degree about the procedure and benefits of applying for an ABCDE ERCIM grant. During the stay, the fellow collaborated with the local PhD student Patrick Marmoli whose thesis was focussed on developing a method to track road vehicles using also TDOA methods. Marmoli and the fellow exchanged ideas and also some experimental data.
- UPC, Terrassa, Spain, 11-15 February 2013
Local scientific coordinator: Jordi Romeu Garbí
During this research stay the fellow discussed with the local scientific coordinator cooperation possibilities between the Acoustics Group at NTNU and at UPC. The fellow also assisted the local PhD student Sara Martín Román in an experimental test aimed at locate a scale model of an aircraft using a set of microphones distributed within the area of acoustic influence of the aircraft.