ERCIM "ALAIN BENSOUSSAN"
FELLOWSHIP PROGRAMME

ERCIM
European Research Consortium
for Informatics and Mathematics

Scientific Report

First name / Family name	Kiran Chandra Sahu
Nationality	Indian
Name of the *Host Organisation*	NTNU, Norway
First Name / family name of the *Scientific Coordinator*	Prof. Peter Svensson
Period of the fellowship	01/10/2016 to 30/09/2017

I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

During the fellowship period, I was working on two problems parallelly. One of them is to calculate the sound radiation from unbaffled vibrating plates. Problems concerning a plate placed in a rigid baffle can be easily solved and analytical solutions exist for the same. However, in reality, structures are finite which makes the sound waves diffract off and around the edges. Diffraction generally has a low-pass filter effect which implies that sound due to edge diffraction can't be neglected at low frequencies. This phenomenon can be efficiently and accurately modeled with an edge source integral equation (ESIE) [A. Asheim, U. P. Svensson, J. Acoust. Soc. Am. 133 (2013) 3681-3691]. The modeling is based on a separation of the radiated sound into three terms: a geometrical-acoustics term (which equals the infinite-baffle solution), a term which represents first-order diffraction, and a last term which considers the second and higher-order edge diffraction. The first two terms are available explicitly, however, the last term is calculated trough the solution of an integral equation.

And the other one is to study the flutter echo phenomenon, that is, the transient vibration excited by short sound pulses between two parallel walls. To an observer near to one of the walls, the flutter echoes always sound as if they originate from the farther wall. In this work, the phenomenon of fluttering is studied using the "Edge Diffraction Toolbox" developed by Prof. Peter Svensson at NTNU, for the Matlab software. Also, experiments have been carried

out in an anechoic room to verify the results. The method of geometrical acoustics used by the engineers is more useful in solving most of the practical problems. However, where interference and diffraction are of primary importance, method of geometrical acoustics gives erroneous results.

II – PUBLICATION(S) DURING YOUR FELLOWSHIP

K. C. Sahu, U. P. Svensson and S. R. Martin (2017). Sound radiation efficiency of unbaffled plates using an edge source integral equation, 173rd Meeting of the Acoustical Society of America and the 8th Forum Acusticum, Boston, USA.

ABSTRACT: The accurate prediction of sound radiation from unbaffled vibrating plates remains a challenging problem. Finite structures make the sound waves diffract off and around the edges, an effect which is particularly strong at low frequencies. This phenomenon can be modeled with an edge source integral equation (ESIE) [A. Asheim, U. P. Svensson, J. Acoust. Soc. Am. 133 (2013) 3681-3691]. The modeling is based on a separation of the radiated sound into a geometrical-acoustics (GA) term, which equals the infinite-baffle solution, and diffraction of first- and higher orders. Expressions for the GA term and first-order diffraction are available explicitly, whereas higher-order diffraction is calculated through the solution of an integral equation. We present a method with a combination of time- and frequency-domain modeling which gives particularly efficient modeling. In this study, the sound radiation efficiency is targeted so only the sound field at the plate is computed. Thereby the numerically challenging receiver positions of the ESIE method at visibility zone boundaries are avoided. The results of the present study are compared with published results [A. Putra, D.J. Thompson, Applied Acoustics 71 (2010) 1113-1125] and close agreement is found, for a number of vibration modes.

For your information, two journal articles is planned to be written from this one year fellowship. Work is in the completion stage, however, the writings would take some time, which would be done after the fellowship period, and this is agreed with the supervisor.

III – ATTENDED SEMINARS, WORKHOPS, CONFERENCES

Attended the 173rd Meeting of the Acoustical Society of America and the 8th Forum Acusticum, Boston, USA in June 2017.

IV – RESEARCH EXCHANGE PROGRAMME (REP)

I made one week visit to Warsaw University of Technology, Poland in May 2017 in order to work with Prof. Stanisław Karczmarzyk. We got to know each other's work, and I presented my work at the Faculty of Automotive and Construction Machinery Engineering.