Résultats de référence pour le rayonnement acoustique des plaques

4 cas-tests de calcul et 1 cas-test expérimental

17 juillet 1996

Auteurs :
Les participants de la Commission de Validation des Progiciels de calcul vibroacoustique regroupés sous le nom C. VALOR.

Diffusion publique
ABSTRACT

"There are nowadays dozens of available vibroacoustic software with various degrees of integration, featuring methods from the simplest arithmetic calculation to the most updated numerical methods. The method used by some of these software is sometimes not well referenced, and most of the time, its validity domain is not clearly indicated." Facing this state of the art in 1992 at a symposium organised by SFM\(^1\) in Senlis (Prediction of noise emitted by vibrating structures), a working group supported by SFM and SFA\(^2\), was created involving most of the french speaking experts on vibroacoustic calculations. This working group was named "Commission de validation des progiciels de calcul vibroacoustique", and is represented by C. VALOR, a pseudonym, since 1995 in various events such as conferences and workshops. Over 40 scientists and research & development engineers coming from private companies, research institutes and universities have participated in the commission, meeting four times a year.

The task of the working group was to organise the validation of software by comparison between various methods and/or with experiments. The whole audible frequency range is covered [20 Hz-20kHz] for "usual" size objects, so that the three vibroacoustic frequency domains (low, medium and high frequency) are investigated, using appropriate methods. Therefore, all kinds of methods have been used : analytical, numerical and statistical energetical.

After two years of groundwork and two years of active discussions, it was decided to publish this first synthesis report, concerning plate radiation in air. Other calculation cases, including a cylinder, a box, acoustic excitation and underwater radiation are now examined by the commission.

Calculation cases

Calculation or experimental cases were decided to be academic ones. There are many reasons for the choice of simple shape cases, that may seem far from industrial problems :

- Complexity of the studied structure must be such that it is possible to fully understand its behaviour.
- Vibroacoustic calculations are always time consuming, but the most expensive part of numerical modelling is data input.
- Academic cases result from the amalgamation of various real industrial examples.
- Academic cases allow the use of fully or partially analytical methods, that provide safer results.

\(^1\) Société Française des Mécaniciens [French Society of Mechanical Engineers]

\(^2\) Société Française d’Acoustique [French Society of Acoustics]
Calculation cases are described in a self-explanatory way, in order that anyone—even with basic knowledge of vibroacoustic problems—can perform the calculations without help. 4 calculation cases and one experimental case are reported here.

Presentation of results

Depending on the method used, calculations can access various quantities: cinematic, energetic, local or global etc. In order to comply with most user demands, spatial averaged energetical quantities (as plate energy or radiated power) were calculated, either in narrow band (up to 5 kHz) or third octave.

All quantities to be calculated are defined in chapter 2.

To make comparisons easier, a standardised graphic representation has been defined for narrow band as well as third octave. This was not the easiest task of the commission!

For better clarity, results are presented in decibels versus frequency. Two narrow band scales are necessary to cover the considered range with reasonable visual accuracy: [0-1000 Hz] and [0-5000 Hz]. For third octave results only one graph covers the range [20 Hz-20 kHz].

Graphic representation is defined in chapter 3.

Synthesis methodology

For each calculation case some of the participants provided results. 11 participants gave results for one or more of the five cases reported here. They are mentioned in the following pages. The results are cited by the participant in a report for each calculation case (see References p.112), with a short referenced description of the method used. Some of the participant produced results using many methods. These methods are not described in this report. This is not important as the spread of results is not discussed.

For each calculation case, a preliminary report was made, including all available results. The preliminary report was used as a basis for the selection of a set of curves, from which envelope curves are deduced. For further comparison, a typical curve (reference) is extracted from the selected set. This set of selected curves, as well as envelope and reference curves are given in the synthesis report. In the synthesis report, all results are anonymous.
Text intentionally not furnished (115 pages)

Texte intentionnellement non fourni (115 pages)