Acoustic Field Prediction

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Introduction

Increasingly stricter government regulations and customer demands require silent products. As a consequence, manufacturers need tools to predict and validate the sound field generated by their products to comply with legislation and customer requirements.

Objective

Development of efficient measurement techniques and numerical algorithms to identify the acoustic sources of a product (acoustic source localization). For this purpose, a numerical tool is required to compute the sound field radiated by the structural surface vibrations of the product. Once the location of the sound sources is known, the product can be redesigned to reduce the radiated acoustic power.

Numerical method

The relation between acoustic sources (often surface vibrations) and the corresponding acoustic field is given by the Helmholtz integral equation. To solve this integral equation a novel adaptive boundary element method (BEM) solver has been developed [1]. This numerical tool can be used for both sound radiation and acoustic source localization purposes.

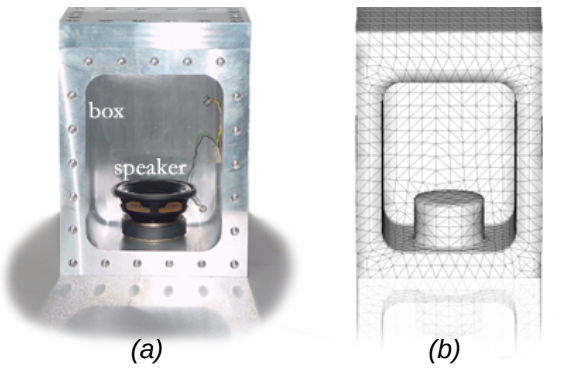

Figure 1 : Experiment (a) versus BEM model (b).

Experimental validation

After validation of the BEM solver with analytical solutions of simple test problems, an experimental setup of a rigid box as shown in Figure 1 has been made. The speaker generates an acoustic field inside the aluminum box which is radiated into the surrounding environment through a flexible plate. This plate is attached to the front of the rigid box. After measuring the vibration levels of the plate with a laser scanning method, a BEM computation of the acoustic field was made (Figure 2).

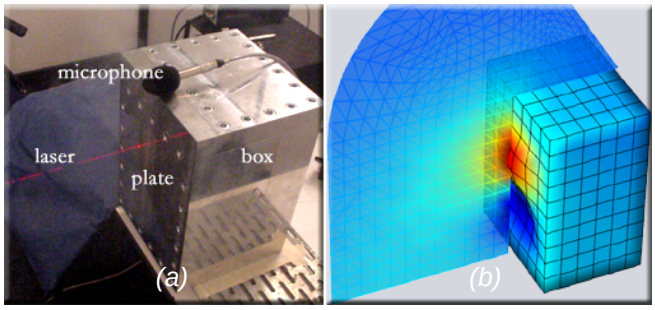

Figure 2 : Laser Doppler scan of surface velocity (a) and computed acoustic field (b) at 400 [Hz].

Figure 3 shows the good agreement between the computed and measured sound pressure at the microphone which is located on top of the box.

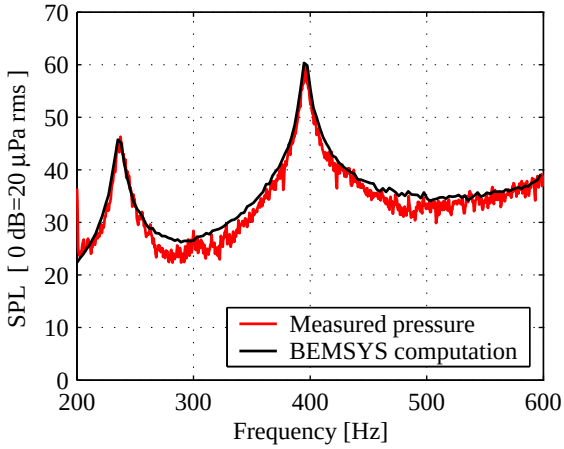

Figure 3 : Measured and computed field pressure on top of the box.

Future developments

Development and implementation of a toolbox for acoustic source localization purposes.

References

1. Visser R., *Computation of Near-Field Acoustic Quantities with an Adaptive Boundary Element Method*, Technical Report CTW-02/TMK-5400, University of Twente, March 2002.