A BEM Implementation of Topological-Shape Sensitivity Method for Acoustics

Agustín Sisamón[a], Adrián P. Cisilino[a]*, Silja C. Beck[b] and Sabine Langer[b]

[a] Mechanics of Materials Division – INTEMA
Faculty of Engineering, Universidad Nacional de Mar del Plata
Av. Juan B. Justo 4302, Mar del Plata, Argentina
cisilino@fi.mdp.edu.ar, http://www.intema.gov.ar

[b] Institut für Konstruktionstechnik, Technische Universität Braunschweig,
Langer Kamp 8, 38106 Braunschweig, Germany
s.langer@tu-braunschweig.de, http://www.ikt-bs.de

ABSTRACT

This work introduces a boundary element method (BEM) implementation of the topological-shape sensitivity method (TSSM) for acoustics based on the formulations by Feijóo [1] and Carpio and Rapún [2]. The TSSM for acoustics requires the solution of the forward, inverse and adjoint scattering problems. The implementation takes advantage of the inherent characteristics of BEM to effectively solve the forward and adjoint acoustic problems for infinite domains. It is also numerically efficient, as it re-uses the matrices assembled for the solution of the forward problem for the computation of the adjoint problem.

The implemention has the capability to perform identification and optimization analysis over empty domains as well as domains with pre-existent scatterers. The objectives for the identification and optimization problems are to achieve a prescribed sound pressure at a given region of the problem domain. The topological derivative is evaluated within the optimization domain at the locations of a regularly placed set of internal points. The locus of the points giving extreme values for the topological derivative indicates the optimum positions for the placement of sound-hard scatterers that minimize the cost function.

The capabilities of the method are demonstrated by solving a number of identification and optimization problems.

REFERENCES

[1] Feijóo GR "A new method in inverse scattering based on the topological derivative", *Inverse Probl* 20(6):1819–1840 (2004).

[2] Carpio A, Rapún ML " Topological derivatives for shape reconstruction". *Inverse Probl. Imagining* 1943:85–133 (2008).