A three-dimensional acoustic Boundary Element Method formulation with viscous and thermal losses based on shape function derivatives

Sound waves in fluids are subject to viscous and thermal losses, which are particularly relevant in the so-called viscous and thermal boundary layers at the boundaries, with thicknesses in the micrometer range at audible frequencies. Small devices such as acoustic transducers or hearing aids must then be modeled with numerical methods that include losses.

In recent years, versions of both the Finite Element Method (FEM) and the Boundary Element Method (BEM) including viscous and thermal losses have been developed. This paper deals with an improved formulation in three dimensions of the BEM with losses which avoids the calculation of tangential derivatives on the surface by finite differences used in a previous BEM implementation. Instead, the tangential derivatives are obtained from the element shape functions. The improved implementation is demonstrated using an oscillating sphere, where an analytical solution exists, and a condenser microphone as test cases.

General information
State: Published
Organisations: Department of Electrical Engineering, Acoustic Technology
Contributors: Cutanda Henriquez, V., Andersen, P. R.
Number of pages: 15
Publication date: 2018
Peer-reviewed: Yes

Publication information
Journal: Journal of Computational Acoustics
Volume: 26
Issue number: 3
ISSN (Print): 0218-396X
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 0.66 SJR 0.388 SNIP 0.787
Web of Science (2017): Impact factor 0.741
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 0.7 SJR 0.376 SNIP 0.676
Web of Science (2016): Impact factor 0.74
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 0.71 SJR 0.626 SNIP 0.673
Web of Science (2015): Impact factor 0.542
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 0.96 SJR 0.665 SNIP 0.963
Web of Science (2014): Impact factor 0.852
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 0.96 SJR 0.595 SNIP 1.205
Web of Science (2013): Impact factor 0.792
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 0.62 SJR 0.327 SNIP 0.72
Web of Science (2012): Impact factor 0.69
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 0.35 SJR 0.259 SNIP 0.48
Web of Science (2011): Impact factor 0.381
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1