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Publication date:
2017

Document Version
Publisher's PDF, also known as Version of record

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Citation (APA):

Cutanda Henriquez, V., Barrera Figueroa, S., & Andersen, P. R. (2017). Boundary Element Method with Viscous and Thermal Losses: A Calibration Microphone Test Case. Abstract from 13th International Conference on Theoretical and Computational Acoustics, Vienna, Austria.

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ICTCA
2017
VIENNA

13th International
Conference on
Theoretical and
Computational
Acoustics

Book of Abstracts

30. Juli - 03. August 2017



Editors:

Piotr Borejko
Manfred Kaltenbacher
Florian Toth

Published by:

Institute of Mechanics and Mechatronics, Faculty of Mechanical and Industrial Engineering
Institute of Building Construction and Technology, Faculty of Civil Engineering
TU Wien
Vienna, Austria
<http://ictca2017.conf.tuwien.ac.at>

ISBN:

978-3-200-05210-9

Credits:

Cover design: Ruth K. Tscherne
L^AT_EX editors: F. Toth, C. Junger, S. Floss, S. Gombots, I. Lazarov, S. Schoder, F. Egner

Printed in Vienna by Druck & Medienwerk GmbH

July 2017

Boundary Element Method with Viscous and Thermal Losses: A Calibration Microphone Test Case

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A Boundary Element Method implementation including viscous and thermal losses of sound waves at the boundaries was proposed [1,2] and applied successfully to a number of cases, e.g. acoustic metamaterials and measurement microphones [3,4]. As other implementations employing the Finite Element Method, the BEM with losses is based on the linearized Navier-Stokes equations with no flow. In this presentation, a full three-dimensional BEM model of a one-inch condenser microphone designed for primary calibration, the B&K 4160, will be used for the discussion of the shortcomings of the BEM with losses [5]. This test case is particularly challenging due to its size, internal intricacy and strong coupling of internal, external and membrane domains. This model will be compared with other simpler BEM models of condenser microphones. Based on the results, possible paths for further improvement of the BEM implementation with losses will be suggested.

References

- [1] V. Cutanda Henríquez and P. M. Juhl, *An axisymmetric boundary element formulation of sound wave propagation in fluids including viscous and thermal losses*, Journal of the Acoustical Society of America **134**(5) (2013), 3409–3418.
- [2] V. Cutanda Henríquez and P. M. Juhl, *Implementation of an acoustic 3D BEM with visco-thermal losses*, Proc. Internoise 2013, 15–18 September 2013, Innsbruck, Austria.
- [3] V. Cutanda Henríquez and P. M. Juhl, *Modelling measurement microphones using BEM with visco-thermal losses*, Proc. Joint Baltic-Nordic Acoustics Meeting, 18–20 June 2012, Odense, Denmark.
- [4] V. Cutanda-Henríquez, P. R. Andersen, J. S. Jensen, P. M. Juhl, and J. Sánchez-Dehesa, *A numerical model of an acoustic metamaterial using the Boundary Element Method including viscous and thermal losses*, Journal of Computational Acoustics 25, 1750006 (2016).
- [5] V. Cutanda Henríquez, S. Barrera Figueroa and P. M. Juhl, *Study of the acoustical properties of a condenser microphone under an obliquely incident plane wave using a fully coupled three-dimensional numerical model*, Proc. Internoise 2015, 9–12 August 2015, San Francisco, USA.

Thursday, 10:55, **GM3** Vortmann Lecture Hall, Building BD