

Accepted Manuscript

A hybrid numerical-asymptotic boundary element method for high frequency scattering by penetrable convex polygons

S.P. Groth, D.P. Hewett, S. Langdon



PII: S0165-2125(17)30158-0

DOI: <https://doi.org/10.1016/j.wavemoti.2017.12.008>

Reference: WAMOT 2217

To appear in: *Wave Motion*

Received date: 20 July 2017

Revised date: 14 December 2017

Accepted date: 20 December 2017

Please cite this article as: S.P. Groth, D.P. Hewett, S. Langdon, A hybrid numerical-asymptotic boundary element method for high frequency scattering by penetrable convex polygons, *Wave Motion* (2017), <https://doi.org/10.1016/j.wavemoti.2017.12.008>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

A hybrid numerical-asymptotic boundary element method for high frequency scattering by penetrable convex polygons

S. P. Groth^{a*†}, D. P. Hewett^b and S. Langdon^a

^aDepartment of Mathematics and Statistics, University of Reading,
Whiteknights PO Box 220, Reading, RG6 6AX, United Kingdom.

^bDepartment of Mathematics, University College London,
Gower Street, London, WC1E 6BT, United Kingdom.

December 21, 2017

Abstract

We present a novel hybrid numerical-asymptotic boundary element method for high frequency acoustic and electromagnetic scattering by penetrable (dielectric) convex polygons. Our method is based on a standard reformulation of the associated transmission boundary value problem as a direct boundary integral equation for the unknown Cauchy data, but with a nonstandard numerical discretization which efficiently captures the high frequency oscillatory behaviour. The Cauchy data is represented as a sum of the classical geometrical optics approximation, computed by a beam tracing algorithm, plus a contribution due to diffraction, computed by a Galerkin boundary element method using oscillatory basis functions chosen according to the principles of the Geometrical Theory of Diffraction. We demonstrate with a range of numerical experiments that our boundary element method can achieve a fixed accuracy of approximation using only a relatively small, frequency-independent number of degrees of freedom. Moreover, for the scattering scenarios we consider, the inclusion of the diffraction term provides an order of magnitude improvement in accuracy over the geometrical optics approximation alone.

Keywords: Helmholtz equation, transmission problem, high frequency, boundary element method, Geometrical Theory of Diffraction, acoustic and electromagnetic scattering.

*Present address: Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge, Massachusetts 02139, United States of America.

†Corresponding author. Email address: samgroth@mit.edu

Download English Version:

<https://daneshyari.com/en/article/8256775>

Download Persian Version:

<https://daneshyari.com/article/8256775>

[Daneshyari.com](https://daneshyari.com)