ON THE CONSTRUCTION OF A COUPLED SOLVER FOR 2D BOUNDARY ELEMENT ACOUSTICS; INTRINSIC ERROR AND ITS MINIMIZATION

By

Alexander Cary Bockman

An Abstract of a Thesis Submitted to the Graduate

Faculty of Rensselaer Polytechnic Institute

in Partial Fulfillment of the

Requirements for the Degree of

MASTER OF SCIENCE

Major Subject: ARCHITECTURAL SCIENCES

Approved:

Dr. Ning Xiang, Thesis Adviser

Dr. Jonas Braasch, Thesis Adviser

Rensselaer Polytechnic Institute
Troy, New York

April 2009
(For Graduation May 2009)

ABSTRACT

A frequency dependent model for the absolute spatial and relative intensity distributions of acoustic pressure in two-dimensional geometries comprised of multiple subdomains and with boundary conditions of the second type is developed. This work doubles the scale of problems solvable within finite memory systems, and provides a blueprint for further extension by subdomain decomposition.

Errors for both the coupled and uncoupled solvers are measured against analytic solutions to geometries that are trivially coupled, i.e. where the domain is convex, in order to provide a dichotomy between resolution resolvable error, and error intrinsic to the coupled solver construction. Variation of placement of the virtual boundary between the subdomains with respect to the expected pressure distribution is determined to be a critical component of praxis. Error minimization is explored by implementation of an overdetermination strategy and a preliminary optimization study is conducted to provide a cost-benefit forecast. Furthermore, the incident pressure component of the model is improved upon by the modeling of diffraction into the dependent subdomain by solution of the complementary exterior problem.

Relative error between the coupled and uncoupled solvers is measured for a geometry that is non-trivially coupled with good agreement except trivially at nodes of near zero pressure, where relative measures experience singularity.