

**SOUND ENERGY EVOLUTION IN TWO-DIMENSIONAL ENCLOSURES  
AS DETERMINED WITH A FINITE DIFFERENCE TIME DOMAIN METHOD**

By

Zackery Belanger

A Thesis Submitted to the Graduate  
Faculty of Rensselaer Polytechnic Institute  
in Partial Fulfillment of the  
Requirements for the Degree of

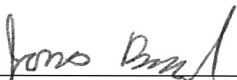
MASTER OF SCIENCE

Major Subject: ARCHITECTURAL SCIENCES

Approved by the  
Examining Committee:

---

Dr. Ning Xiang  
Thesis Advisor



---

Dr. Jonas Braasch, Member



---

Johannes Goebel, Member

Rensselaer Polytechnic Institute  
Troy, New York

November 2012  
(For Graduation December 2012)

## ABSTRACT

*Measurements and simulations conducted for the purpose of extracting or constructing impulse responses are inextricably dependent on a limited number of receiver locations. Wave based simulations offer an opportunity to discard this dependency and assess an entire evolving sound field. In this work, a finite difference time domain method is implemented to simulate an evolving sound field in a range of enclosure geometries with reflective boundaries. The distribution of energy is monitored statistically as mixing and ergodic states are approached, and evidence is presented for the predictability of this evolution based on room geometry alone. A system for importing geometries from the Rhinoceros 3D CAD software, using the Grasshopper parametric environment, is also presented. A form known as the Barnett Billiard Table in mathematics is included in this study, as is a related form introduced as the Divergent Concert Hall, both of which exhibit exceptional behavior even without the presence of diffusive treatment*