

**Committee Acceptance Form for
Electronic Thesis or Dissertation**

This form serves as the official record of manuscript approval by the student's advisory committee and is submitted to the Graduate School with the final manuscript paperwork. It is not included in the electronic publication (ETD). The form must have original signatures of the advisory committee chair and all members. A dissenting member should put the word "dissent" between the Name and Signature lines when signing below.

Name of Candidate (print) BIAO BIAO ZHANG CWID (print) 11152398

Degree Level (e.g., Ph.D.) PhD Date of Defense MAY 7, 2012

Degree Program (e.g., Higher Education Administration) MECHANICAL ENGINEERING

Manuscript Title Structural configuration study for an
acoustic wave sensor

The undersigned confirm that we have reviewed this document and examined the student regarding its content. We agree that this document conforms to acceptable standards of scholarly presentation in scope and quality and that the attainments of this student are such that we recommend the conferral of degree.

Thesis or Dissertation Committee:

Name (print)	Signature
<u>W. Steve Shepard Ph.D (Chair)</u>	<u>[Signature]</u>
<u>Mark E. Barkey Ph.D</u>	<u>[Signature]</u>
<u>Keith A. Williams Ph.D</u>	<u>[Signature]</u>
<u>Xiangrong Shen Ph.D</u>	<u>[Signature]</u>
<u>Jialai Wang Ph.D</u>	<u>[Signature]</u>

Signature of Department Chair or Graduate Program Director [Signature]

Review and Acceptance of the ETD: I have reviewed the final electronic version (PDF) of the above-mentioned document and determined that it is an accurate representation of the content of the document reviewed and accepted by the committee and that its form and style are ready for publication.

Biaobiao Zhang
(Signature of Student)

BIAO BIAO ZHANG May 7, 2012
(Print Name and Date)

[Signature]
(Signature of Thesis or Dissertation Committee Chair)

W. Steve Shepard 5/7/12
(Print Name and Date)

The student must mail or deliver the completed form to the Graduate School, 102 Rose Administration Building.

Graduate School Administrator _____ Date Signed _____

Graduate Dean _____ Date Signed _____

Doctoral Final Defense Form

TO THE DEAN OF THE GRADUATE SCHOOL:

We, the undersigned, report that as a committee we have examined

STUDENT NAME: Biaobiao Zhang CWID: 11152398

upon the work completed in the subjects assigned, namely:

MAJOR: Mechanical Engineering

and find that the student's attainments are such are not such that the student be recommended for the

DEGREE: Ph.D.

[Signature]
Mark E. Bentley
Tom Work
Kate Albini
[Signature]

I dissent from the foregoing report:

Date: May 7, 2012

THE UNIVERSITY OF ALABAMA GRADUATE SCHOOL
DOCTORAL QUALIFYING EXAMINATION FORM

TO THE DEAN OF THE GRADUATE SCHOOL:

We, the undersigned, report that as a committee we have examined

STUDENT NAME: Biaobiao Zhang CWID: 11152398

upon the work completed in the subjects assigned, namely:

MAJOR: Mechanical Engineering

and find that the student's attainments are such are not such that the student be recommended for the

DEGREE: PhD

[Signature]
Mark E. Bamberg
[Signature]
[Signature]

I dissent from the foregoing report:

Date: May 7, 2012

ABSTRACT OF DISSERTATION

The University of Alabama Graduate School

Degree: Doctor of Philosophy

Major Subject: Mechanical Engineering

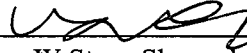
Name of Candidate: Biaobiao Zhang

Title of Dissertation: Structural configuration study for an acoustic wave sensor

A continuous structure has several response characteristics that make it a candidate for a sensor used to locate an acoustic source. Primary goals in developing such a sensor structure are to ensure that the response is rich enough to provide information about the impinging acoustic wave and to detect the direction of travel without being too sensitive to background noise. As such, there are several factors that must be examined with regard to sensor configuration and measurement requirements. This dissertation describes a set of studies that examine various configuration requirements for such a sensor. Some of the parameters of interest include the size, or aperture of the structure, boundary conditions, material properties, and thickness. The response of the structure to transient sinusoidal wave excitations will be examined analytically. The time-domain response of an Euler-Bernoulli beam excited by a traveling sinusoidal excitation is obtained based on modal superposition and verified by using a finite element method. Then, an approach using simple basis functions will be applied to achieve the goal of more efficient response and force identification. The moving force will be identified in the time domain by extending previous inverse approaches. The Tikhonov regularization technique provides bounds to ill-conditioned results in the identification problem. Both simulated displacement

and velocity are considered for use in the inverse. To evaluate the method and examine various configurations, simulations with different numbers of sinusoidal half-cycles exciting the sensor structure will be studied. Various levels of random noise are added to the simulated displacements and velocities responses in order to study the effect of noise in moving wave load identification. Such a new approach in acoustic sensing will have wide applications in the areas of security and disaster recovery.

Abstract approved: Chairperson of


Dissertation Committee 
W. Steve Shepard, Jr., Ph.D.

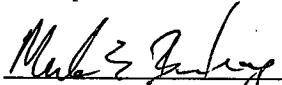
Head of Department
or College 
K. Clark Midkiff Ph.D.

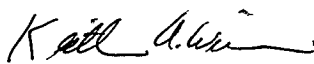
Date _____ Dean of the
Graduate School _____
David A. Francko Ph.D.

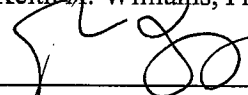
Submitted by Biaobiao Zhang in partial fulfillment of the requirement for
the degree of Doctor of Philosophy specializing in Mechanical Engineering

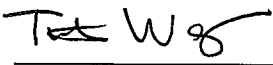
Accepted on behalf of the Faculty of the Graduate School by the
dissertation committee:

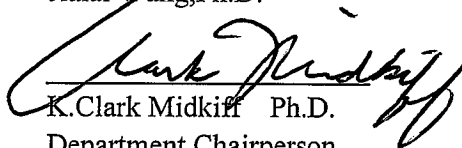

W. Steve Shepard, Jr., Ph.D.
Chairperson


Mark E. Barkey, Ph.D.


Keith A. Williams, Ph.D.


Xiangrong Shen, Ph.D.


Jialai Wang, Ph.D.


K. Clark Midkiff Ph.D.
Department Chairperson

5/7/12
Date

David A. Francko Ph.D.
Dean of the Graduate
School

Date