

# Tina M. Morrison, Ph.D.

tina.morrison@fda.hhs.gov

301-796-6310

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## Academic Experience

<b>Post Doctoral Fellow</b>	<b>Stanford University</b> <i>September 2006 – August 2008</i> <b>Advisor:</b> Dr. Charles A. Taylor	<b>Bioengineering</b> Cardiovascular Biomechanics
<b>Ph.D.</b>	<b>Cornell University</b> <i>August 2002 – May 2006</i> <b>Dissertation:</b> Three Problems in Nonlinear Dynamics with 2:1 Parametric Excitation <b>Advisor:</b> Dr. Richard H. Rand	<b>Theoretical and Applied Mechanics</b> Applied Mathematics Minor
<b>M.S.</b>	<b>The University of Connecticut</b> <i>June 2001 – July 2002</i> Summa Cum Laude <b>Thesis:</b> Vibration Characteristics of Solar Sails with Corner Forces <b>Advisor:</b> Dr. Kevin D. Murphy	<b>Mechanical Engineering</b> Applied Mechanics Concentration
<b>B.S.</b>	<b>The University of Connecticut</b> <i>August 1996 – May 2001</i> Magna Cum Laude	<b>Mechanical Engineering</b> Applied Mathematics Minor
<b>C.D.</b>	<b>E. C. Goodwin Technical School</b> Completed Certified Drafting Program in 1996	<b>Machine Drafting</b>

## Fellowships, Scholarships, and Honors

2009	Medical Device Fellowship Program Performance Award
2008	Medical Device Fellow at the Food and Drug Administration – Current Position
2008	American Heart Association Post Doctoral Fellow – Research Funding
2007	Stanford School of Medicine Dean’s Post Doctoral Fellow – Research Funding
2006	Cornell Undergraduate Engineering Education Grant Recipient
2006	H.D. Block Award for Excellence in Teaching Mathematics at Cornell
2005	Cornell University Provost Diversity Fellow – Research Funding
2003-2004	National Science Foundation IGERT Fellow – Research Funding
2003	NSF Graduate Student Research Fellow – Honorable Mention
2003	General Electric Merit Scholar – Research Funding
2003	Outstanding Teaching Assistant for the Department of Mathematics at Cornell
2001-2002	NASA Langley Graduate Student Research Fellow – Research Funding
2001-2002	Graduate of the Accelerated Master of Science & Engineering Program at UConn
2001	Third place in Senior Design Competition at the University of Connecticut
2000	NASA Langley Research Summer Scholar
2000	Outstanding ASME Officer for the Hartford Chapter, CT
1999	Inducted into Tau Beta Pi National Engineering Honor Society
1999	Inducted into Pi Tau Sigma Mechanical Engineering Honor Society
1997-2001	Walter J. Kenney Engineering Merit Scholarship – Full Tuition Scholarship
1996-2001	Pratt and Whitney Aircraft Merit Scholarship

## Research Experience

### Food and Drug Administration, Rockville, MD

September 2008 – Present

**Medical Device fellow** at the Center for Devices and Radiological Health

Office of Device Evaluation, Division of Cardiovascular Devices

- Reviewing (lead and engineering) a variety of peripheral vascular devices applications
  - Investigational device exemptions (IDE) and supplements
  - 510k pre-market notification and Pre Market Approval supplements
  - Computational modeling and pre-clinical bench-top testing protocols and reports
- Co-principal investigator on a Critical Path Initiative (CPI) FDA-funded grant titled “Leveraging the Simulation-Based Engineering and Medical Imaging Technology Revolutions for Cardiovascular Devices”
  - Funds and oversees four projects, two of which I am an active researcher (listed below)
- Lead investigator on CPI project: Characterization of Human Aortic Aneurysm Project (CHAP) – IRB Approved
  - Analyzing CT image data of human aortas retrieved from clinical centers across America to describe the diseased aortic anatomy of the clinically treated population
- Researcher on a CPI project: ASPECT-I: Assessment of plaque composition, dynamic biomechanics, and therapeutic outcomes in subjects with implanted vascular devices
  - Leading the regulatory effort on creating a computational model of a diseased peripheral vessel for finite element analysis of peripheral devices.

### Stanford University, Stanford, CA

September 2006 – August 2008

**Postdoctoral fellow** in the group of Professor Charles A. Taylor

Department of Bioengineering, Cardiovascular Biomechanics Research Laboratory

- Developed and applied methods to quantify *in vivo* deformations of normal and aneurysmal thoracic aortas from 4D-CT imaging data to characterize the biomechanical environment and understand aging and the progression of disease of the aorta
- Lead engineer on research project funded by Medtronic Vascular to quantify motion of thoracic aorta
  - Provided guidance and leadership to two graduate students in Dr. Taylor’s lab
- Provided material properties from wall motion data for fluid-structure interaction computer models of thoracic aorta incorporating variable wall properties from 4D-CT image data

### Cornell University, Ithaca, NY

January 2003 – May 2006

**Research assistant** in the group of Professor Richard H. Rand

Department of Theoretical and Applied Mechanics

**Dissertation:** *Three Problems in Nonlinear Dynamics with 2:1 Parametric Excitation*

Theoretical and computational study of parametric excitation in concert with physical phenomena relevant to engineering design and evaluation:

- 2:1:1 Resonance in the Quasi-Periodic Mathieu Equation: linear system with two drivers
- 2:1 Resonance Near a Hopf Bifurcation: nonlinear system with linear viscous damping
- 2:1 Resonance of a Nonlinear Delayed Mathieu Equation: nonlinear system with time-delay

### McGill University, Montréal, QC Canada

May 2004

**IGERT research fellow** attending summer school

Centre for Nonlinear Dynamics, Biological Systems

- Completed the course: *Systems Biology Dynamics: from Genes to Organisms*
- Studied dynamics of cardiac arrhythmias, delay differential equations that model cell cycles, and models of gene expression dynamics

**University of Maryland, College Park, MD**

August 2003

**IGERT research fellow** in the group of Professor Rajarshi Roy

Department of Physics, Solid State Physics Laboratory

- Investigated spatial-temporal chaos and patterns in a 1D solid state laser array
- Confirmed theoretical predictions with experimental observations

**NASA Langley Research Center, Hampton, VA**

July 2001 – July 2002

**Graduate research fellow** in the group of Dr. Keith Belvin

Vibrations Laboratory, in collaboration with the University of Connecticut

Research assistant in the group of Professor Kevin D. Murphy

Department of Mechanical Engineering, Dynamics and Vibrations Laboratory

- Studied the vibration characteristics of a square solar sail with corner-point loads that mimicked cross-boom loading on the sail
- Utilized various analytical and numerical methods to analyze the mode shapes and natural frequencies of the square sail with corner-point loading at various angles and magnitudes

**University of Connecticut, Storrs, CT**

September 2000 – July 2001

**Research assistant** in the group of Professor Kevin D. Murphy

Dynamics and Vibrations Laboratory

- Designed an experiment to study the instabilities in a periodically-excited string subject to a knife-edge amplitude restraint – impact dynamics
- Created a Labview GUI to display and output the amplitude and frequency of the string pre-and post-knife-edge impact

**NASA Langley Research Center, Hampton, VA**

May 2000 – August 2000

**Langley Research Summer Scholar** in the group of Daniel McGowan

Mechanics and Materials Laboratory

- Tailored composite materials for structural applications utilizing finite element analysis; validated models with experiments
- Studied buckling and stability of thin-walled cylindrical composite shells
- Participated in weekly lectures pertaining to future space and nanotechnology
- Published research results in NASA Langley Journal

## Teaching Experience

**Center for Devices and Radiological Health, Silver Spring, MD**

March 2010

**Instructor** in Division of Cardiovascular Devices (DCD)

- Prepared two courses for my colleagues in DCD on computational modeling
  - Finite Element Analysis (FEA) for Lead Reviewers – described what FEA is and how it is applicable to the regulatory review process of devices for a variety of applications
  - Reviewing an FEA Report –described the challenges of reviewing an FEA report and discussed methods for improvement and consistency across the reviews in DCD

**Stanford University, Stanford, CA**

October 2007

**Guest Lecturer** in Cardiovascular Biomechanics Course

- Lectured on abdominal aortic, thoracic aortic, and cerebral aneurysms
- Lectured vessel wall constituents and the affects of aging on blood vessels and cardiac output

**Master's Thesis Advisor** for a Mechanical Engineering Student

May 2007 – Present

- Developed and guided research project for master's student
- Continuing to provide guidance and leadership of two graduate student's in Dr. Taylor's lab

- Facilitator** and organizer in the Bioengineering Department January 2007 – December 2007
- Organized weekly guest lecturers for Introduction to Bioengineering Research
  - Facilitated research discussion between the graduate students and guest speaker

**Cornell University, Ithaca, NY** June 2006 – August 2006

- Visiting Lecturer** in the Mathematics Department for 10-week Summer Session
- Conducted daily lectures on Differential Equations for engineering students
  - Integrated the Hyper-Interactive Teaching Tool with course lectures to create an active learning environment in the classroom
  - Developed a database of ‘Good Questions’ for Differential Equations which foster active learning in the classroom
  - Presented research proposal and received grant from the Dean of Undergraduate Engineering to develop innovative teaching methods for engineering mathematics

**Teaching Assistant** in the Mathematics Department January 2006 – May 2006

- Conducted weekly review/study sections for Intro to Differential Equations
- Prepared weekly recitation handouts that outlined the week’s key concepts
- Administered two workshops on DFIELD/PPLANE and Macsyma computer algebra software

**Course Liaison** for Academic Excellence (AE) Workshops, Math Dept January 2006 – May 2006

- Maintained continuity between the AE Workshop and the classroom experience
- Communicated regularly with AE facilitators, course instructor and all TAs for Introduction to Differential Equations
- Facilitated content breakout sessions, helped create problems for workshops, offered teaching advice and served as a mentor to the undergraduate AEW facilitators

**Teaching Assistant** in the Mathematics Department September 2002 – December 2002

- Conducted weekly review/study sections for Calculus I – Differentiation and Integration
- Prepared weekly recitation handouts that outlined the week’s key concepts

**Durfee Tutoring Project, Ithaca, NY** January 2006 – May 2006

**Mathematics and Physics Tutor** – Volunteer

- Tutored and mentored two Ithaca High School students in Mathematics and Physics twice per week
- Acted as an alternative source of encouragement for success while providing one-on-one teaching

**Smalley Academy, New Britain, CT** September 2004 – May 2005

**Science Partner** – Volunteer

- Invited to teach monthly Science lectures to three 4<sup>th</sup>-grade classrooms
- Prepared presentations and class experiments related to Space and the Solar System
- Provided enthusiasm about Science and learning to inner city school children

**University of Connecticut, Storrs, CT** September 1998 – May 1999

**Resident Assistant** in Co-ed freshman dormitory - Towers

- Referral agent and confidant to residents pertaining to all topics of concern
- Organized and participated in a combination of monthly programs and dormitory activities: academic, social and personal
- Delegated and maintained university policy within the residence halls

**Mentor** for Pre-Engineering Program September 1996 – May 1998

- Guided middle school and high school women and racial minority students through various hands-on engineering projects
- Enhanced their understanding of math and engineering through weekly lectures
- Coordinated academic and social events with the Engineering Diversity Department

## Industry Experience

### **Boston Scientific, Watertown, MA**

October 2005 – May 2006

**Research assistant** in the group of Srinath Tupil

Vascular Surgery, Abdominal Aortic Division

- Developed test methods to simulate *in vivo* conditions for coronary and aortic stents and endovascular grafts utilizing Intra Vascular Ultra Sound equipment
- Validated a radial force tester used to measure the radial force of braided and covered nitinol stents
- Researched the failure mechanisms of the biomaterial ePTFE by testing its bursting, pulsatile and tensile capabilities

### **Pratt and Whitney Aircraft, Hartford, CT**

May 1999 – June 2001

**Engineering assistant** (part-time) in the group of Michael S. Mills

Applied Mechanics Laboratory for United Technologies Corporation

- Provided strength and modal analysis of turbine blades to improve testing techniques utilizing finite element analysis (FEA)
- Completed two FEA classes: Linear and Nonlinear Dynamic Analysis and Linear, Buckling and Normal Modes
  - Accrued 500 plus hours in MSC/PATRAN and NASTRAN FEA packages
- Designed and modeled mounting fixtures in three-dimensions for an assortment of external engine components
- Conducted experimental vibration analysis of various engine turbine and fan blades and brackets

### **Pratt and Whitney Aircraft, Hartford, CT**

Summers in 1997 and 1998

**Engineering intern** in the Airfoil Drafting Division

- Provided mechanical designs of fan blades, tools, dies and fixtures using Unigraphics software
- Contributed to the product development process using three-dimensional modeling
- Demonstrated interpersonal and teaming abilities combined with good written and oral communication skills for design reviews

## Publications

### Peer-Reviewed

- \*Kolochalama, V.B., \***Morrison, T. M.**, Lochner, D. L., Zuckerman, B. D., Baldwin, J. T., Grossman, L.W., Demir, S. S., Taylor, C. A., and Edelman, E.R., “Optimizing the use of computational modeling to support the evaluation of cardiovascular devices”, *awaiting sign-off for Nature Biotechnology* 2010
  - \* First two authors contributed equally to this article
- **Morrison, T. M.**, Choi, G., Zarins, C. K., and Taylor, C.A., “Circumferential and longitudinal cyclic strain of the human thoracic aorta: Age-related changes”, *in press J of Vasc Surg* 2009
- **Morrison, T. M.** and Rand, R., ‘Instabilities in a Nonlinear Delayed Mathieu Equation’, *Nonlinear Dynamics*, 50:341-352, 2006
- Rand, R. and **Morrison, T.**, ‘2:1:1 Resonance in the Quasi-Periodic Mathieu Equation’, *Nonlinear Dynamics*, 40:195-203, 2005
- Rand, R., Barcilon, A. and **Morrison, T.**, ‘Parametric Resonance of Hopf Bifurcation’, *Nonlinear Dynamics*, 39:411-421, 2005
- Murphy, K. and **Morrison, T. M.**, ‘Grazing Instabilities and Post-Bifurcation Behavior in an Impacting String’, *Journal of the Acoustical Society of America*, 11(2):884-892, 2002

## Technical Reports

- **Morrison, T. M.**, and Taylor, C.A., ‘Circumferential Cyclic Strain in Patients with Descending Thoracic Aortic Aneurysm: Implications for Endovascular Device Design’, submitted to Proceedings of the ASME 2009 Summer Bioengineering Conference, June 17-21, Lake Tahoe, Nevada, USA, SBC2009-204872
- **Morrison, T. M.**, Choi, G., Segalova, P.A., Zarins, C. K., and Taylor, C.A., ‘Age-related Changes in the Biomechanical Cyclic Strain of the Human Thoracic Aorta’, Proceedings of the ASME 2008 Summer Bioengineering Conference, June 25-29, Marriott Resort, Marco Island, Florida, USA, SBC2008-192028
- Segalova, P.A., **Morrison, T. M.**, and Taylor, C.A., ‘Quantifying Dynamics of the Ascending Thoracic Aorta in Patients with and without Aneurysms using 4D – CT’, Proceedings of the ASME 2008 Summer Bioengineering Conference, June 25-29, Marriott Resort, Marco Island, Florida, USA, SBC2008-191942
- **Morrison, T. M.** and Rand, R., ‘Instabilities in a Nonlinear Delayed Mathieu Equation’, Proceedings of the 11<sup>th</sup> Biennial Conference on Nonlinear Vibrations, Stability and Dynamics of Structures, Blacksburg, VA, August 14-17, 2006
- Rand, R., Barcilon, A. and **Morrison, T.**, ‘Parametric Resonance of Hopf Bifurcation’, Proceedings of the 2005 ASME Design Engineering Technical Conferences, 20th Biennial Conference on Mechanical Vibrations and Noise, Long Beach, CA, Sept. 24-28, paper no. DETC2005-84016, 2005
- **Morrison, T.** and Murphy, K., ‘Free Vibrations of Rectangular Solar Sails’, Proceedings of the 8<sup>th</sup> Intl Conf on Recent Advances in Structural Dynamics, South Hampton, UK, July, paper no. 47, 2003
- **Morrison, T.** and McGowan, D., ‘Tailoring Composites for Engineering Applications’, *NASA LARSS Publication*, p. 610-618, 2000

## Conferences and Invited Seminars

- 2/2010 1<sup>st</sup> International Conference on Computational Modeling of Congenital Heart Disease  
*Invited Speaker* LaJolla, CA  
‘Regulatory strategies to support the development of devices to treat congenital heart disease’
- 6/2009 2<sup>nd</sup> Annual workshop on Computer Methods for Cardiovascular Devices  
*Organizer and Invited Speaker* Rockville, MD  
i. ‘Optimizing the use of computational modeling to support the regulatory approval of cardiovascular devices’  
ii. ‘Cardiovascular Devices and Computational Modeling - A Generic Stent Example’
- 9/2008 FDA/Office of Science and Engineering Laboratories White Oak, MD  
*Invited Seminar Speaker*  
‘Cyclic Strain, Curvature and Branch Vessel Angles in the Human Thoracic Aorta’
- 9/2008 FDA’s Critical Path Initiative Meeting sponsored by DIA Bethesda, MD  
*Keynote Speaker: Dr. Charles Taylor, Dr. Morrison delivered presentation*  
‘Leveraging Medical Imaging and Computer Methods in Cardiovascular Device Design and Evaluation’  
NOTE: Presentation and delivery were cited in *The Gray Sheet* Vol. 34, No. 38, p. 10
- 8/2008 Department of Biomedical Engineering at Texas A&M College Station, TX  
*Invited Seminar Speaker*  
‘Dynamics of the Human Thoracic Aorta: Age-related Changes’
- 6/2008 2008 ASME Summer Bioengineering Conference Marco Island, FL

*Podium Presenter with Technical Publication*

‘Age-related changes in the biomechanical cyclic strain of the human thoracic aorta using 4D-CT’ – Design of Biomechanical Devices Symposium

- 2/2008 Cardiovascular Institute Retreat Stanford, CA  
*Poster Presenter: Age-related changes in the biomechanical cyclic strain of the human thoracic aorta using 4D-CT*
- 10/2007 8<sup>th</sup> Annual Biomedical Computation at Stanford Symposium Stanford, CA  
*Poster Presenter: Quantification of the in vivo motion of the descending thoracic aorta*
- 10/2007 Life in Motion: Bio-X Symposium Stanford, CA  
*Poster Presenter: Quantification of the in vivo motion of the descending thoracic aorta*
- 6/2007 2007 SEM Conference – Bioengineering Technical Division Springfield, MA  
Methods presented on extracting deformation of thoracic aorta from image data
- 8/2006 11<sup>th</sup> Biennial Conf. on Nonlinear Vibrations, Stability and Dynamics of Structures Blacksburg, VA  
*Podium Presenter with Technical Publication*  
‘Instabilities in a Nonlinear Delayed Mathieu Equation’ – Nonlinear Dynamics
- 9/2005 20<sup>th</sup> Biennial ASME DETC: Vibrations and Nonlinear Dynamics Long Beach, CA  
*Podium Presenter with two Technical Publications*  
i. ‘2:1:1 Resonance in the Quasi-Periodic Mathieu Equation - DETC2005-84015’  
ii. ‘Parametric Resonance of Hopf Bifurcation - DETC2005-84016’
- 1/2004 Dynamics Days: International Conference on Chaos and Nonlinear Dynamics Bethesda, MD  
*Poster Presenter: Spatiotemporal Chaos in Solid State Lasers*
- 7/2003 8<sup>th</sup> International Conference on Recent Advances in Structural Dynamics South Hampton, UK  
*Podium Presenter with Technical Publication*  
‘Vibration Characteristics of Solar Sails’ – 8th Preceding No. 47

## **Professional Affiliations and Service**

- 2009-Present Technical Expert on the ISO Standards Task Force for Vascular Prostheses  
o Revising the Finite Element Analysis section for ISO 25539-1
- 2009-Present Leader of the Finite Element Analysis Working group in the Office of Device Evaluation
- 2007-Present ASTM International – Active Member: Non-radial force standards
- 2007-Present FDA/NIH/NSF Workshop on Computer Methods for Cardiovascular Device Design and Evaluation – Executive Member of Conference Organizing Committee 2008-2010
- 2007-Present V.I.B.E. Athletics Nonprofit Organization– Board of Directors, Hartford, CT
- 2007-2008 Consultant on cardiovascular mechanics and devices for Heart Strong, LLC
- 2007-2008 Cardiovascular Institute, Stanford – Member
- 2006-2007 Mechanical Engineering Women’s Group – Organizer/Member
- 2006-2007 Women in Science and Engineering –Member
- 2006 Durfee Tutoring Project – Volunteer, Ithaca, NY
- 2004-2006 Smalley Academy Science Partner – Mentor and Volunteer, New Britain, CT
- 2003-2004 Habitat for Humanity – Cornell Chapter, Ithaca, NY
- 2001-2002 Alumni Advisor for Phi Sigma Rho – Women in Engineering Sorority, UConn
- 1999-2001 Chair of the UConn Chapter of American Society of Mechanical Engineers
- 2000-2001 Vice Chair of the Tau Beta Pi UConn Chapter
- 1999-2000 Chair of the Pi Tau Sigma UConn Chapter
- 1997-Present American Society of Mechanical Engineers – Active Member
- 3/2007 Reviewed a manuscript for Biomedical Engineering Online
- 1/2007 Reviewed a manuscript for Journal of Biomechanics
- 9/2005 Reviewed a technical publication for ASME DETC conference proceeding