

David Chelidze, Ph.D.

Professor of Mechanical Engineering and Applied Mechanics

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Research Profile

David Chelidze is Professor of Mechanical Engineering and Applied Mechanics and Director of the Nonlinear Dynamics Laboratory at The University of Rhode Island. His research integrates analytical, computational, and experimental approaches to nonlinear dynamics and vibrations, with emphasis on nonlinear modal analysis, nonlinear reduced-order modeling, nonlinear system identification, structural health monitoring, and damage prognosis. A central objective is to develop physically interpretable models that connect nonlinear dynamical-systems theory with measured behavior in engineered and natural systems. His contributions include experimental characterization of nonlinear normal modes, multivariate nonlinear time-series analysis, manifold-based model reduction, and geometry-induced nonlinear mechanisms for vibration mitigation, targeted energy transfer, and energy harvesting.

Research Areas

- Nonlinear dynamics and vibrations; experimental nonlinear modal analysis
- Nonlinear reduced-order modeling; nonlinear system identification
- Structural health monitoring and damage prognosis
- Geometry-induced nonlinear dynamics; energy transfer and harvesting

Representative Contributions

Experimental nonlinear modal analysis: methods for identifying and characterizing nonlinear modal behavior directly from measured vibration data.

Nonlinear system identification: multivariate signal-analysis and model-identification methods for extracting governing nonlinear dynamics from experiments.

Structural health monitoring: nonlinear time-series methods for damage detection, fatigue assessment, and prognosis under realistic operating conditions.

Geometry-induced nonlinear dynamics: kinematic mechanisms that create internal resonance and targeted energy transfer for passive vibration mitigation.

Nonlinear reduced-order modeling: manifold-based and data-driven models that retain essential nonlinear behavior while reducing computational cost.

Career Highlights

Scholarly publications listed in this CV	147
Google Scholar as of 08/2026: citations / h-index / i10-index	2,113 / 22 / 39
Scopus as of 08/2026: citations / h-index	1,395 / 19
Research funding	\$4.55 million
Ph.D. graduates / current graduate students	8 / 4

Education

- Ph.D.**, Engineering Science and Mechanics, Penn State University, University Park, PA 2000
Dissertation: *A nonlinear observer for damage evolution tracking*
Advisor: *Joseph Cusumano*
- M.S.**, Mechanical Engineering, Southern Illinois University at Carbondale, Carbondale, IL 1995
Thesis: *Nonlinear Response of Reinforced Concrete Beams*
Advisor: *Kambiz Farhang*
- Diploma**, Mechanical Engineering, Georgian Technical University, Tbilisi, Georgia 1992
Graduated with High Honors (Red Diploma). Specialization: Robotics.

Professional Appointments

- Professor**, Department of Mechanical, Industrial and Systems Engineering, The University of Rhode Island, Kingston, Rhode Island 2009–Present
Director, Nonlinear Dynamics Laboratory; Director of Graduate Studies (2009–2022)
- Visiting Professor**, Indian Institute of Technology Kanpur, India 11/2024
Department of Mechanical Engineering
- Visiting Professor**, Polytechnic University of Marche (UNIVPM), Ancona, Italy 09/2024
Department of Civil and Building Engineering and Architecture
- Visiting Professor**, Naval Undersea Warfare Center, Newport, Rhode Island 2013–2014
Mathematics Group, Naval Undersea Warfare Center Newport Division
- Associate Professor**, Department of Mechanical, Industrial and Systems Engineering, The University of Rhode Island, Kingston, Rhode Island 2005–2009
Director, Nonlinear Dynamics Laboratory
- Assistant Professor**, Department of Mechanical, Industrial and Systems Engineering, The University of Rhode Island, Kingston, Rhode Island 2000–2005
Established the Nonlinear Dynamics Laboratory
- Senior Engineer**, Preschutti and Associates, Inc., State College, Pennsylvania 2000

Research Summary

My research focuses on theoretical, computational, and experimental nonlinear dynamics and vibrations. The central themes are nonlinear modal analysis and experimental characterization of nonlinear normal modes; nonlinear reduced-order modeling and manifold-based reduction; nonlinear system and parameter identification; multivariate signal and time–frequency analysis; and damage diagnosis and prognosis in engineered systems. Current work examines geometry-induced internal resonance, nonlinear vibration absorption and energy transfer, vibration energy harvesting, and nonlinear acoustic and mechanical metamaterials. These efforts combine analytical mechanics, nonlinear dynamical-systems theory, numerical continuation, data-driven modeling, and carefully designed experiments to identify mechanisms, construct interpretable reduced-order models, and develop practical methods for prediction, control, and structural-health assessment.

Teaching Philosophy and Expertise

My teaching philosophy emphasizes physical intuition, conceptual understanding, rigorous analytical reasoning, and independent problem solving. I focus on the geometry and mechanics underlying mathematical formulations and connect analytical derivations with computation, visualization, and experiments. My goal is to teach students not only how to solve problems, but how to formulate unfamiliar ones, identify the essential physics, test assumptions, and interpret results. At the graduate level, I emphasize connecting fundamental concepts with contemporary research and developing independent researchers.

I teach Statics; Dynamics; Vibrations; Advanced Dynamics and Vibrations; Nonlinear Dynamics; Nonlinear Time Series Analysis; Structural Health Monitoring; and Experimental Nonlinear Dynamics.

Honors and Awards

University Honors

Edmund and Dorothy Marshall Award for Faculty Excellence in Research 2007
College of Engineering, The University of Rhode Island

Professional Honors

CAREER Award, National Science Foundation 2003
For details, see Funded Research Projects

Jury Special Award for Best Georgian Website 2000
Open Society Georgia Fund, Tbilisi, Georgia

Second-Place Award for Best Noncommercial Georgian Website 1999
Open Society Georgia Fund, Tbilisi, Georgia

Patents

US-6567752-B2, "General method for tracking the evolution of hidden damage or other unwanted changes in machinery components and predicting remaining useful life," with Cusumano, J. P. and Chatterjee, A., Penn State University Invention Disclosure No. 2002-2208, Penn State Research Foundation, 2003.

USSR-1814970, "Supporting-guiding unit for long-sized part transportation," with Khachidze, N. A., Chelidze, G. D. and Khachidze V. N., Georgian Technical University Invention Disclosure No. 4824161, Bul. Iz., No. 18, 1993.

Publications

Peer-reviewed Journals

- [1] Ball tree structure-informed phase space warping: a robust algorithm for dynamic degradation tracking under variable speed conditions
Rui Yuan, Hengyu Liu, Yong Lv, Yuejian Chen, Xingkai Yang, Hewenxuan Li, **David Chelidze**
Advanced Engineering Informatics 71 (2026), p. 104288
DOI: [10.1016/j.aei.2025.104288](https://doi.org/10.1016/j.aei.2025.104288).
- [2] Advances and prospects of phase space reconstruction-based high-dimensional signal processing for fault diagnosis: A systematic review
Yong Lv, Hengyu Liu, Rui Yuan, Xun Dong, Yifei Wang, Hao Wu, **David Chelidze**
Mechanical Systems and Signal Processing 246 (2026), p. 113919
DOI: [10.1016/j.ymssp.2026.113919](https://doi.org/10.1016/j.ymssp.2026.113919).
- [3] Multifaceted Vibration Absorption of a Rotating Magnetic Nonlinear Energy Sink
Collin Treacy, Dalton Stein, **David Chelidze**
Mechanical Systems and Signal Processing 224 (2025), p. 112122
DOI: [10.1016/j.ymssp.2024.112122](https://doi.org/10.1016/j.ymssp.2024.112122).
- [4] Continuation of Nonlinear Normal Modes Using Reduced-Order Models Based on Generalized Characteristic Value Decomposition
Dalton L. Stein, **David Chelidze**
Nonlinear Dynamics 113 (2025), pp. 25-45
DOI: [10.1007/s11071-024-10239-0](https://doi.org/10.1007/s11071-024-10239-0).
- [5] Characteristic value decomposition: A unifying paradigm for data-driven modal analysis
He-Wen-Xuan Li, Dalton L. Stein, **David Chelidze**
Mechanical Systems and Signal Processing 222 (2025), p. 111769
DOI: [10.1016/j.ymssp.2024.111769](https://doi.org/10.1016/j.ymssp.2024.111769).
- [6] Irrational Nonlinearity Enhances the Targeted Energy Transfer in a Rotary Nonlinear Energy Sink
Collin Treacy, Dalton Stein, **David Chelidze**
Journal of Computational and Nonlinear Dynamics 19.6 (2024), p. 061001
DOI: [10.1115/1.4065193](https://doi.org/10.1115/1.4065193).

- [7] Subband Decomposition Based Output-Only Modal Analysis
D.L. Stein, H.-W.-X. Li, **David Chelidze**
Journal of Vibration and Acoustics 145.1 (2023), 011005 (12 pages)
DOI: [10.1115/1.4055135](https://doi.org/10.1115/1.4055135).
- [8] Smooth mode decomposition: Theory and its applications in full-field output-only modal analysis
He-Wen-Xuan Li, Piyush Wanchoo, Arun Shukla, **David Chelidze**
Mechanical Systems and Signal Processing 200 (2023), p. 110541
DOI: [10.1016/j.ymssp.2023.110541](https://doi.org/10.1016/j.ymssp.2023.110541).
- [9] Geometry-Informed Phase Space Warping for Reliable Fatigue Damage Monitoring
He-Wen-Xuan Li, **David Chelidze**
Structural Health Monitoring 23.2 (2024), pp. 1217–1244
DOI: [10.1177/14759217231174894](https://doi.org/10.1177/14759217231174894).
- [10] Experimental monitoring and modeling of fatigue damage for 3D-printed polymeric beams under irregular loading
H.-W.-X. Li, G. Lyngdoh, S. Doner, R. Yuan, **David Chelidze**
International Journal of Mechanical Sciences 233 (2022), p. 107626
DOI: [10.1016/j.ijmecsci.2022.107626](https://doi.org/10.1016/j.ijmecsci.2022.107626).
- [11] Fatigue life estimation of structures under statistically and spectrally similar variable amplitude loading
He-Wen-Xuan Li, **David Chelidze**
Mechanical Systems and Signal Processing 161 (2021), p. 107856
DOI: [10.1016/j.ymssp.2021.107856](https://doi.org/10.1016/j.ymssp.2021.107856).
- [12] Empirical Mode Analysis Identifying Hysteresis in Vortex-Induced Vibrations of a Bending-Dominated Flexible Cylinder
E. D. Gedikli, **David Chelidze**, J. Dahl
International Journal of Offshore and Polar Engineering 30.2 (2020), pp. 186–193
DOI: [10.17736/ijope.2020.mt27](https://doi.org/10.17736/ijope.2020.mt27).
- [13] Towards a Unified Interpretation of the ‘Proper’/‘Smooth’ Orthogonal Decompositions and ‘State Variable’/‘Dynamic Mode’ Decompositions
Arham Khan, Joseph Kuehl, **David Chelidze**
AIP Advances 10 (2020), p. 035225
DOI: [10.1063/1.5144429](https://doi.org/10.1063/1.5144429).
- [14] A novel method for bone fatigue monitoring and prediction
Michelle L. Cler, Joseph J. Kuehl, Carolyn Skurla, **David Chelidze**
Bone Reports 11 (2019), p. 100221
DOI: [10.1016/j.bonr.2019.100221](https://doi.org/10.1016/j.bonr.2019.100221).
- [15] A new approach to model reduction of nonlinear control systems using smooth orthogonal decomposition
Shahab Ilbeigi, **David Chelidze**
International Journal of Robust and Nonlinear Control 28.15 (2018), pp. 4367–4381
DOI: [10.1002/rnc.4238](https://doi.org/10.1002/rnc.4238).
- [16] Observed mode shape effects on the vortex-induced vibration of bending dominated flexible cylinders simply supported at both ends
Ersegun D. Gedikli, **David Chelidze**, Jason M. Dahl
Journal of Fluids and Structures 81 (2018), pp. 399–417
DOI: [10.1016/j.jfluidstructs.2018.05.010](https://doi.org/10.1016/j.jfluidstructs.2018.05.010).
- [17] Persistent Model Order Reduction for Complex Dynamical Systems Using Smooth Orthogonal Decomposition
Shahab Ilbeigi, **David Chelidze**
Mechanical Systems and Signal Processing 96 (2017), pp. 125–138
DOI: [10.1016/j.ymssp.2017.04.005](https://doi.org/10.1016/j.ymssp.2017.04.005).
- [18] Reliable Estimation of Minimum Embedding Dimension Through Statistical Analysis of Nearest Neighbors
David Chelidze
Journal of Computational and Nonlinear Dynamics 12.5 (2017), pp. 051024–12
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- [19] Multivariate Analysis Of Vortex-Induced Vibrations In a Tensioned Cylinder Reveal Nonlinear Modal Interactions

Ersegun D. Gedikli, Jason M. Dahl, **David Chelidze**
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- [20] Dynamic model for fatigue evolution in a cracked beam subjected to irregular loading
Son Hai Nguyen, **David Chelidze**
Journal of Vibration and Acoustics 139.1 (2016), pp. 014502–6
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Son Hai Nguyen, **David Chelidze**
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David B. Segala, **David Chelidze**
Journal of Dynamic Systems, Measurement, and Control 137.2 (2014), pp. 021011–8
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Michael Falco, Ming Liu, Son Hai Nguyen, **David Chelidze**
Journal of Vibration and Acoustics 136.4 (2014), pp. 041001–8
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David Chelidze
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Son Hai Nguyen, Mike Falco, Ming Liu, **David Chelidze**
Journal of Applied Mechanics 81.4 (2013), pp. 041004–8
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David B. Segala, Deanna H. Gates, Jonathan B. Dingwell, **David Chelidze**
Journal of Biomechanical Engineering 133.3 (2011), pp. 031009–8
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Joe Kuehl, **David Chelidze**
International Journal of Non-Linear Mechanics 45.1 (2010), pp. 42–55
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Jeffrey M Schiffman, **David Chelidze**, Albert Adams, David B Segala, Leif Hasselquist
Journal of Biomechanics 42.13 (2009), pp. 2196–9
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Miao Song, David B Segala, Jonathan B Dingwell, **David Chelidze**
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Ming Liu, **David Chelidze**
International Journal of Non-Linear Mechanics 43.6 (2008), pp. 521–526
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David Chelidze, Ming Liu
Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences 366.1866 (2008), pp. 729–45

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Journal of Vibration and Acoustics 130.1 (2007), pp. 011001–6
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Wenliang Zhou, **David Chelidze**
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Jonathan B Dingwell, Domenic F Napolitano, **David Chelidze**
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Ming Liu, **David Chelidze**
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David Chelidze, Ming Liu
Nonlinear Dynamics 46.1–2 (2006), pp. 61–72
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David Chelidze, Joseph P. Cusumano
Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences 364.1846 (2006), pp. 2495–2513
DOI: [10.1098/rsta.2006.1837](https://doi.org/10.1098/rsta.2006.1837).
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David Chelidze, Wenliang Zhou
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David Chelidze, Ming Liu
Journal of Sound and Vibration 281.3–5 (2005), pp. 887–904
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David Chelidze
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David Chelidze, Joseph P. Cusumano
Journal of Vibration and Acoustics 126.1 (2004), pp. 2–8
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Anindya Chatterjee, Joseph P. Cusumano, **David Chelidze**
Journal of Sound and Vibration 250.5 (2002), pp. 877–901
DOI: [10.1006/jsvi.2001.3963](https://doi.org/10.1006/jsvi.2001.3963).
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David Chelidze, Joseph P. Cusumano, Anindya Chatterjee
Journal of Vibration and Acoustics 124.2 (2002), pp. 250–257
DOI: [10.1115/1.1456908](https://doi.org/10.1115/1.1456908).
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Joseph P. Cusumano, **David Chelidze**, Anindya Chatterjee

Peer-reviewed Conference Proceedings

- [45] Simultaneous Estimation of Multiple Backbone Curves using Smooth Coordinate Tracking
Dalton Stein, **David Chelidze**
Proceedings of the Third International Nonlinear Dynamics Conference, 2023.
- [46] Identification of Variable Amplitude Fatigue Loading Based on Bivariate Probability Mass Functions
He-Wen-Xuan Li, **David Chelidze**
Proceedings of the ASME 2019 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference, Anaheim, California, 2019, V006T09A047 (10 pages)
DOI: [10.1115/DETC2019-97488](https://doi.org/10.1115/DETC2019-97488).
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Ersegun Deniz Gedikli, **David Chelidze**, Jason M. Dahl
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Shahab Ilbeigi, **David Chelidze**
Rotating Machinery, Hybrid Test Methods, Vibro-Acoustics & Laser Vibrometry, Volume 8: Proceedings of the 34th IMAC, A Conference and Exposition on Structural Dynamics 2016, Orlando, FL, USA, January 25–28, 2016, 2016, pp. 447–455
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Shahab Ilbeigi, **David Chelidze**
Nonlinear Dynamics, Volume 1: Proceedings of the 33rd IMAC, A Conference and Exposition on Structural Dynamics, Orlando, FL, USA, February 2–5, 2016, 2016, pp. 377–385
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- [54] Fatigue Dynamics Under Statistically and Spectrally Similar Deterministic and Stochastic Excitations
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David Chelidze

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Proceedings of the ASME IDETC: 22nd International Conference on Design Theory and Methodology; Special Conference on Mechanical Vibration and Noise, Montreal, Quebec, Canada, August 15–18, 2010, 2010, pp. 1007–1012
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- [61] Linear and Nonlinear Smooth Orthogonal Decomposition to Reconstruct Local Fatigue Dynamics: A Comparison
David B. Segala, **David Chelidze**, Deanna Gates, Jonathan Dingwell
Proceedings of the ASME IDETC: 22nd International Conference on Design Theory and Methodology; Special Conference on Mechanical Vibration and Noise, Montreal, Quebec, Canada, August 15–18, 2010, 2010, pp. 763–770
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David B. Segala, **David Chelidze**, Deanna Gates, Jonathan Dingwell
Proceedings of the ASME 2009 IDETC: 7th International Conference on Multibody Systems, Nonlinear Dynamics, and Control, San Diego, CA, USA, August 30–September 2, 2009, 2009, pp. 1593–1599
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- [63] Tracking Muscle Fatigue Markers Through Nonlinear and Multivariate Analysis of Motion Kinematics
David B. Segala, **David Chelidze**, Jeffrey M. Schiffman, Deanna Gates, Jonathan Dingwell
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- [120] Chaotic Atomic-Force Microscope
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- [134] A study of measurement noise in chaotic signals
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- [140] Spectral properties of signals from a gear-pair transmission with evolving damage
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- [143] Tracking parameter drift in a vibro-impact system
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Proceedings of the First International Symposium on Impact and Friction of Solids, Structures and Intelligent Machines, Ottawa, Canada, June 27–30, 1998, 2000, pp. 159–162
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- [146] Using Phase Space Reconstruction to Track Parameter Drift in a Nonlinear System
 Joseph P. Cusumano, **David Chelidze**, Norm K. Hecht
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 DOI: [10.1121/1.418806](https://doi.org/10.1121/1.418806).
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Technical Reports

- [1] Determination of an Optimal Control Strategy for a Generic Surface Vehicle
 Thomas A Wettergren, David B Segala, David Chelidze, NUWCDDIVNPT, June 18, 2014

Invited papers and talks

- [1] Applying Characteristic Value Decomposition in Modal Identification and Nonlinear Model Order Reduction
Invited Seminar, Mechanical and Aerospace Engineering, Indian Institute of Technology Hyderabad, India, November 27, 2024
- [2] Applying Characteristic Value Decomposition in Modal Identification and Nonlinear Model Order Reduction
Invited Seminar, Department of Mechanical Engineering, Indian Institute of Science, Bangalore, India, November 25, 2024
- [3] Applying Characteristic Value Decomposition in Modal Identification and Nonlinear Model Order Reduction
Invited Seminar, Department of Mechanical Engineering, Indian Institute of Technology Kanpur, India, November 7, 2024
- [4] Applying Characteristic Value Decomposition in Modal Identification and Nonlinear Model Order Reduction
Invited Seminar, Department of Civil, Environmental and Building Engineering, and Architecture, Polytechnic University of Marche, Ancona, Italy, September 26, 2024
- [5] Dynamical Systems Perspective on Structural Health Monitoring and Digital Twins
Invited Talk, Digital Twins Symposium, University of Rhode Island, Kingston, RI, August 23, 2024
- [6] Higher-Order Decompositions for Modal Identification and Model or Data Reduction
Invited Seminar, University of Delaware, Newark, DE, December 6, 2019
- [7] Past and Current Research Topics in the Nonlinear Dynamics Laboratory
Wuhan University of Science and Technology, Hubei, China, June 12, 2018
- [8] Structural Health Monitoring and Vibration Analysis
National Institute for Undersea Vehicle Technologies Industry Day, UConn Avery Point Campus, Groton, CT, March 16, 2018
- [9] Fatigue Life Prediction Under Complex Loads
Invited Seminar, Department of Mechanical Engineering, Baylor University, Waco, TX, March 20, 2015
- [10] Optimal Path Planning at Discrete Depths
Invited Seminar, Naval Undersea Warfare Center, Newport, RI, May 8, 2015
- [11] Smooth Subspace Projection for Nonlinear Noise Reduction
Invited Seminar, Naval Undersea Warfare Center, Newport, RI, June 12, 2013
- [12] Nonlinear Oscillations and Structural Health Monitoring
Invited Talk, Third International Forum of Georgian Scientist, Shota Rustaveli National Science Foundation, Batumi, Georgia, September 29, 2012
- [13] Nonlinear smooth manifold identification for dynamical model and data reduction
Invited Seminar, Department of Mechanical Engineering, University of Massachusetts at Amherst, February 24, 2012
- [14] Multivariate analysis for characterizing multiscale dynamical systems
Invited talk, Nonlinear Vibrations Workshop, Duke University, Durham, NC, May 27–28, 2010
- [15] Invited Discussion Panel Member
NSF CAREER Workshop, University of Rhode Island, Kingston, RI, May 27, 2009
- [16] Time Series Analysis for Diagnosis and Prognosis
Invited talk, One-day Nonlinear Vibrations Workshop, Duke University, Durham, NC, June 6, 2008
- [17] Identifying Physiologic Fatigue Using Phase Space Warping and Smooth Orthogonal Decomposition
Invited seminar, Psychology Methods Group Talk, University of Rhode Island, Kingston, RI, April 16, 2008
- [18] Diagnosis and Prognosis of Machines and Humans: A Dynamical Systems Perspective
Invited seminar, Theoretical & Applied Mechanics Department, Cornell University, Ithaca, NY, October 10, 2007
- [19] Diagnostics and Prognostics for Machines and Humans
Invited talk, College of Engineering Advisory Council Meeting, University of Rhode Island, Kingston, RI, April 28, 2007
- [20] Reconstructing Fatigue Dynamics from Vibration Measurements
Invited seminar at AFRL/MLL, Wright-Patterson Air Force Base, Dayton, Ohio, November 15, 2006
- [21] Reconstructing Drift Dynamics from Nonstationary Measurements
Invited seminar at Natick Soldier Systems Center, Natick, Massachusetts, November 1, 2006

- [22] Reconstructing slow-times dynamics from fast-time measurements
Invited seminar, Graduate School of Oceanography, University of Rhode Island, Bay Campus, April 7, 2006
- [23] Smooth orthogonal decomposition: basic properties and applications
Invited seminar, Institute of Geophysics of the Academy of Sciences of Georgia, Tbilisi, Georgia, August 15, 2005
- [24] Smooth Orthogonal Decomposition and Slow-Time Phase Space Reconstruction
Invited seminar, Mechanical Engineering Department, Virginia Tech, Blacksburg, VA, April 13, 2005
- [25] Dynamical systems perspective on damage diagnosis and prognosis
Invited seminar, United Technologies Research Center, Hartford, Connecticut, March 14, 2005
- [26] Data Driven Damage Diagnosis and Prognosis
Demo talk, Naval Surface Warfare Center – Carderock Division, Philadelphia, Pennsylvania, November 5, 2004
- [27] Multi-Mode Damage Diagnosis and Prognosis
Foxboro demo presentation, Invensys Process Systems, Foxboro, Massachusetts, April 9, 2004
- [28] Phase Space Warping: a New Framework for Damage Diagnosis and Prognosis
Invited lecture, Planning meeting, Migma Systems Inc., Walpole, Massachusetts, October 1, 2003
- [29] Dynamical Systems Approach to Damage Diagnosis and Prognosis
Invited lecture, Prognostics group meeting, General Dynamics, Groton, Connecticut, September 18, 2003
- [30] Phase Space Warping: Reconstructing Dynamics of Damage
Invited seminar, Brown University, Providence, Rhode Island, September 17, 2003
- [31] Phase Space Warping: Uncovering the Dynamics of Drift
Invited seminar, URI/GSO Chaos Group Meeting, Narragansett Bay Campus, University of Rhode Island, August 4, 2003
- [32] Chaos in the Real World
Seminar presentation, URI/GSO Chaos Group Meeting, Narragansett Bay Campus, University of Rhode Island, July 28, 2003
- [33] Failure Prognosis Using Nonlinear Short-Time Prediction and Multi-Time Scale Recursive Estimation
Invited seminar, Department of Mechanical Engineering and Applied Mechanics, University of Rhode Island, Kingston, Rhode Island, September 25, 2001.
- [34] A New Machinery Diagnostic/Prognostic Method for Tracking and Predicting Damage Evolution
Invited seminar, Department of Physics, University of Rhode Island, Kingston, Rhode Island, January 26, 2001
- [35] Material Damage Evolution Tracking
MURI IPD modeling efforts meeting, ARL-CATO Park Building, State College, Pennsylvania, September 27, 1999

Research Funding

Funding Summary

Combined research support in U.S. dollars	\$4,548,153
Externally sponsored funding attributable to URI/DC	\$4,238,795
Principal-investigator funding	\$3,031,281
Co-principal-investigator funding	\$1,187,513
Federal funding	\$4,158,795
Industry funding	\$30,000
Internal and institutional funding	\$309,358
Foreign-currency award, reported separately	GEL 100,000

Externally Sponsored Projects

Years	Sponsor / project	Role	Amount
2024–2026	Office of Naval Research (NIUVT COMP 83) <i>Characteristic Value Decomposition and Control-Based Framework for Robust and Efficient Nonlinear Reduced-Order Modeling</i>	PI	\$441,000 URI/DC (\$594,000 total)

2024–2026	Office of Naval Research (NIUVT COMP 81) <i>Nonlinear Energy Sink for Efficient Vibration Absorption over a Broad Range of Forcing Amplitudes and Frequencies</i>	PI	\$406,000 URI/DC (\$559,000 total)
2024–2026	Office of Naval Research (NIUVT COMP 72) <i>Enhancing Real-Time Hybrid Simulation Capabilities to Facilitate Multi-Shaker Shock Testing of Critical Components and Systems</i>	Co-PI	\$153,913 URI/DC (\$675,947 total)
2022–2024	Office of Naval Research (NIUVT COMP 39) <i>Digital Twinning through Cyber-Physical System Integration</i>	Co-PI	\$160,000 URI/DC (\$500,000 total)
2023	Rhode Island Innovation Initiative <i>Improving Sensor-Noise Robustness in Continuous Thickness and Velocity Measurements during Hot and Cold Rolling of Metals</i>	PI	\$50,000
2023–2025	Office of Naval Research (NIUVT COMP 59) <i>Design of Tunable Multifunctional Metamaterials for Simultaneous Manipulation of Sound and Vibrations at Different Amplitudes</i>	PI	\$140,000 URI/DC (\$400,000 total)
2023–2027	Office of Naval Research (NIUVT GUID 4) <i>GUIDANCE in Smart Materials and Structures for Vibration and Shock</i>	Co-PI	\$375,000 URI/DC (\$2,316,406 total)
2020–2022	Office of Naval Research (NIUVT SEED 23) <i>Physics-Informed Reduced-Order Modeling (PI-ROM)</i>	PI	\$100,000 URI/DC (\$200,000 total)
2020–2023	Office of Naval Research (NIUVT COMP 24) <i>Mechanical Characterization of Bolted Joints with Different Interface Conditions</i>	Co-PI	\$100,000 URI/DC (\$400,000 total)
2020–2022	Office of Naval Research (NIUVT COMP 06) <i>Intelligent Wave Guiding and Vibration/Shock Mitigation of Naval Structures</i>	Co-PI	\$152,000 URI/DC (\$600,000 total)
2016–2020	National Science Foundation (1561960) <i>Characterization, Modeling, and Prediction of Fatigue Damage under Variable-Amplitude Loading</i>	PI	\$308,502
2011–2016	National Science Foundation (1100031) <i>A New Framework for Nonlinear Dynamical Model Reduction</i>	PI	\$250,000
2011–2014	Shota Rustaveli National Science Foundation, Georgia <i>Modification of the Mechanical and Electrical Properties of Metallic and Polymeric Material Surfaces through Laser Processing</i>	Co-PI	GEL 100,000
2009–2010	U.S. Army / Natick Soldier RD&E Center, through Battelle <i>Phase-Space Warping and Smooth Orthogonal Decomposition to Track and Predict Human Physiologic Fatigue</i>	PI	\$84,400
2008–2011	National Science Foundation (0758536) <i>Rational Models and Dynamical Characterization of Fatigue Using Phase-Space Warping and Smooth Orthogonal Decomposition</i>	PI	\$300,000
2007–2009	U.S. Army / Natick Soldier RD&E Center, through Battelle <i>Nonlinear Analysis to Predict Human Physiological Fatigue</i>	Co-PI	\$141,600 URI/DC
2005–2008	National Institutes of Health (1R21EB003425-01A1) <i>Tracking Fatigue-Related Changes in Motor Coordination</i>	Co-PI	\$105,000 URI/DC (\$275,000 total)
2004–2006	Missile Defense Agency, Phase II STTR, through Migma Systems, Inc. <i>Data-Driven Damage Diagnosis and Prognosis</i>	PI	\$375,000 URI/DC (\$750,000 total)
2003–2004	Missile Defense Agency, Phase I STTR, through Migma Systems, Inc. <i>Data-Driven Damage Diagnosis and Prognosis</i>	PI	\$35,000 URI/DC (\$70,000 total)
2003–2009	National Science Foundation (CMS-0332263) <i>REU for CAREER: Phase-Space Warping and Stochastic Interrogation</i>	PI	\$10,000
2003–2008	National Science Foundation CAREER (CMS-0237792) <i>Phase-Space Warping and Stochastic Interrogation: A New Paradigm for Damage Diagnosis and Prognosis</i>	PI	\$403,202
2002–2003	NIH/NCRR RI-BRIN (RR16457) <i>Phase-Space-Warping-Based Diagnosis of Long-Term Changes in Human Coordination</i>	PI	\$20,001
2002	Preschutti & Associates, Inc. <i>Enabling Technologies for Aircraft Failure Prognosis</i>	PI	\$15,000
2000–2001	Preschutti & Associates, Inc. <i>Identifying Imminent Failures in Aircraft and System Components</i>	PI	\$15,000
2000	U.S. Air Force Research Laboratory, Phase I SBIR, through Preschutti & Associates, Inc. <i>Aircraft Prognostics: Identifying Imminent Failures in Aircraft and System Components</i>	PI	\$98,177

Internal Grants

Years	Sponsor / project	Role	Amount
2010	The University of Rhode Island, Office of the Vice President for Research and Economic Development <i>Health Behavior Monitoring and Intervention Research Center</i>	Co-PI	\$160,000

2002	Champlin Foundation <i>A Broad-Based Enhancement of the Mechanical Engineering Undergraduate Laboratories</i>	Co-PI	\$129,811
2002	The University of Rhode Island Council for Research <i>Multidimensional Damage Diagnosis and Prognosis</i>	PI	\$4,549
2002	The University of Rhode Island Foundation <i>Crack-Size Measurement Instrumentation for an Experimental Two-Well Magnetoelastic Oscillator</i>	PI	\$2,000
2001	The University of Rhode Island Council for Research <i>An Experimental Method for Multimode Damage Evolution and Failure Prognosis</i>	PI	\$6,498
2001	The University of Rhode Island Foundation <i>An Experimental System to Study Multimode Damage Evolution</i>	PI	\$2,000
2001	The University of Rhode Island Foundation <i>A New Laboratory for Vibrations and Mechanical Systems</i>	PI	\$4,500

Research Mentorship

I have mentored graduate students, postdoctoral researchers, visiting scholars, and undergraduate researchers whose careers have progressed to academia, national laboratories, and industrial research organizations.

Mentorship Summary

Ph.D. graduates	8
Current Ph.D. students	1
M.S. graduates	12
Current M.S. students	3
Postdoctoral researchers supervised	3
Visiting scholars hosted	1
Current undergraduate researchers	2
Undergraduate research alumni listed	2

Known Alumni Career Outcomes

Academia	6
National laboratories	2
Industry	9
Current position not listed	3

Current Research Group

Ph.D. Students

Jason Smith, Ph.D. candidate, *Experimental Nonlinear Dynamics & Reduced-Order Modeling* Expected 2028

M.S. Students

Riju Chatterjee, M.S. candidate, *Nonlinear Energy Sinks for Vibration Absorption* Expected 2026

Alexander E. Travison, M.S. candidate Expected 2028

Scott Booth, M.S. candidate, *Experimental Identification of Nonlinear Manifolds and Associated Linear Control* In progress

Undergraduate Researchers

Ryan Desacia, undergraduate researcher Current

Sebastian Forero, undergraduate researcher Current

Ph.D. Alumni

Dalton Stein, Ph.D., *Nonlinear Oscillations in Structural Dynamics: Computational Techniques, Data-Driven Tools, and Model Order Reduction*; Sandia National Laboratories 2026

Hewenxuan Li, Ph.D., *On Data-Driven Fatigue Damage Monitoring and Prediction in Nonlinear Mechanical Systems*; Assistant Professor, Rochester Institute of Technology 2022

Shahab Ilbeigi, Ph.D. , <i>A New Framework for Model Reduction of Complex Nonlinear Dynamical Systems</i> ; Senior Machine Learning Scientist, Symbotic	2017
Son Hai Nguyen, Ph.D. , <i>Coupled Field Dynamic Model of Fatigue Evolution</i> ; Professor and Deputy Head of Department, Hanoi University of Science and Technology	2013
David Segala, Ph.D. , <i>Novel Nonlinear Multivariate Analysis in Biological and Physiological Modeling</i> ; Manager, Data Analytics, Pratt & Whitney	2011
Joseph J. Kuehl, Ph.D. , <i>Finite-Time Invariant Manifold Detection from Experimental Phase-Space Trajectories</i> ; Associate Professor of Mechanical Engineering, University of Delaware	2009
Wenliang Zhou, Ph.D. , <i>Multivariate Analysis in Vibration Modal Parameter Identification</i> ; Director of Product Management, Maxar Technologies	2006
Ming Liu, Ph.D. , <i>Multidimensional Damage State Identification Using Phase-Space Warping</i> ; Research Associate Professor, Joint Department of Biomedical Engineering, UNC–Chapel Hill and NC State University	2005
M.S. Alumni	
Kevin Perri, M.S. , <i>Experimental Fatigue Characterization and Vibration-Based Failure Prediction for Material Optimization of an Automotive Half-Shaft</i>	2026
Collin Treacy, M.S. , <i>Targeted Energy Transfer in a Bistable Rotary Nonlinear Energy Sink</i> ; Ph.D. candidate, University of Michigan	2024
Benjamin Aldrich, M.S. , <i>Three-Inch Untethered, Instrumented Test Shape</i> ; Naval Undersea Warfare Center, Newport	2015
Jan Eilbrecht, M.S. , <i>Time-Optimal Control of an Unmanned Ocean-Surface Vessel</i> ; Senior Function and Software Development Engineer, Bosch	2014
Michael Falco, M.S. , <i>Rational Models and Dynamical Characterization of Fatigue Using Phase-Space Warping and Smooth Orthogonal Decomposition</i> ; Engineering Manager, Sensata Technologies	2011
Yutao Liu, M.S. , <i>Experimental Characterization of Material Fatigue Dynamics Based on Phase-Space Warping</i> ; Mechanical Engineer, H&R Technology, Inc.	2008
Miao Song, M.S. , <i>Reconstructing Fatigue-Related Changes in Human Coordination</i> ; Human Factors and HMI Research Engineer, Honda Research Institute USA	2008
Fei He, M.S. , <i>Nonlinear Model Reduction Based on Smooth Orthogonal Decomposition</i> ; Associate Professor, Texas A&M University–Kingsville	2008
Lucian Dobrot, M.S. , <i>Transition-Probability-Based Damage Identification</i> ; Engineering Manager, Xylem Inc.	2006
Martin Lugmair, M.S. , <i>Damage Identification in a Variable-Forcing Environment</i> ; Mechanical Design Engineer, Berliner Glas	2005
Domenic Napolitano, M.S. , <i>Identifying Task- and Fatigue-Related Changes in Human Coordination</i>	2005
Jeffrey Sefranek, M.S. , <i>Phase-Space-Warping-Based Tracking of Delamination</i>	2004

Postdoctoral Researchers Supervised

Hewenxuan Li, Ph.D. , <i>Generalized characteristic value decomposition</i>	2022
Son Hai Nguyen, Ph.D. , <i>Dynamical-systems perspectives on fatigue and nonlinear time-series analysis</i>	2014–2017
Ming Liu, Ph.D. , <i>Data-driven damage diagnosis and prognosis</i>	2005–2006

Visiting Scholars Hosted

Rui Yuan, visiting Ph.D. scholar, Wuhan University of Science and Technology; currently Associate Professor of Mechanical Engineering at WUST

2016–2017

Undergraduate Research Alumni

Ethan Maione, undergraduate researcher

Alumnus

Ryan Hirsch, undergraduate researcher

Alumnus

Professional Leadership and Service

Professional leadership through editorial service, competitive proposal review, conference organization, journal refereeing, external academic review, professional activities, and institutional governance supporting nonlinear dynamics, vibrations, and mechanical engineering.

Editorial Leadership

- Editor, *Dynamics*.
- Associate Editor, *Nonlinear Engineering*.
- Associate Editor, *Mathematical Problems in Engineering*.
- Editorial Board Member, *International Journal of Mechanics and Solids*.

Research Proposal Review Service

- National Science Foundation: numerous review panels, including Sensors and Sensing Systems (SST/CMS) and Civil, Mechanical and Manufacturing Innovation (CMMI); most recent service recorded in September 2023.
- U.S. Army Research Office, Mathematics Division.

Journal and Scholarly Refereeing

- *Journal of Biomechanics*; *Nonlinear Dynamics*; *Mechanical Systems and Signal Processing*; *Journal of Sound and Vibration*; *International Journal of Non-Linear Mechanics*; *Journal of Vibration and Control*; *ASME Journal of Vibration and Acoustics*; *Measurement Science and Technology*; *International Journal of Mechanical Sciences*; *Structural Health Monitoring*; *EURASIP Journal on Advances in Signal Processing*; and *IEEE Transactions on Systems, Man, and Cybernetics: Part B*.
- Scholarly reviews for the Indian Institute of Science, John Wiley & Sons, and numerous ASME IDETC and IMECE conferences.

Conference Leadership

- Co-Organizer, Symposium on *Multiscale Data Analysis*, 16th U.S. National Congress of Theoretical and Applied Mechanics, State College, Pennsylvania, June 27–July 2, 2010.
- Chair and session organizer for symposia and technical sessions at ASME, ASA, IASTED, SPIE, and SES conferences.

External Academic Service

- Served as an external opponent/examiner for Ph.D. dissertations at universities in India, Australia, and Norway.
- Regularly invited to present research seminars and discuss research collaboration with national and international universities, institutions, and companies, including the Polytechnic University of Marche and Wuhan University of Science and Technology.

University Service

Served as Director of Graduate Studies for the Mechanical Engineering M.S. and Ph.D. programs, Systems Engineering M.S. program, and Industrial and Systems Engineering Ph.D. program, 2009–2022. Developed assessment metrics and reports for the thesis-based M.S. program; authored and annually updated the [Graduate Student Guide](#); coordinated graduate admissions reviews; advised graduate students prior to selection of research advisors; and administered off-campus, part-time non-thesis M.S. programs with Raytheon and Electric Boat.

- Chair, Fluid Mechanics Faculty Search, 2020.
- Chair, Mechanical Systems/Robotics Faculty Search, 2016.

- Chair, Computational Mechanics Faculty Search, 2014.
- Director of Graduate Studies, 2009–2022.
- Adviser, **ΠΤΣ** Rhode Island **ΣΠ**, 2009–2011.
- Jerry Rhoads Scholarship Committee, 2004–present.
- Department Graduate Committee, 2003–present.
- Department Research Committee, 2003–present.
- Mechanical Systems Area Committee, 2000–present.
- Department Laboratory Committee, 2004–2010.
- Co-Director, Center for Health Monitoring and Intervention.

Professional Workshops

Workshop on Nonlinear System Identification with Applications to Structures with Mechanical Joints, Chicago, IL, August 12, 2012.

2nd Nonlinear Vibrations Workshop, Duke University, Durham, NC, May 27–28, 2010. Multivariate Analysis for Characterizing Multiscale Dynamical Systems.

Professional Consulting

Feeney Law Group, Scientific Advisor, Boston, MA.

Ultimo, Inc., Engineering Consulting, Scituate, RI, 2015–2019.

Outreach

My laboratory is actively involved in **outreach to high-school students** to expose them to engineering research and design. During the summers of 2021 and 2022, we hosted four female high-school seniors from East Greenwich High School for practical engineering internships. Their projects included three-dimensional solid modeling, electrical circuit design and testing, mechatronic component design, 3D printing and assembly, and implementation of integrated design projects.