Exponent®
Engineering & Scientific Consulting

Ryan Harne, Ph.D., P.E., FASME

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Professional Profile

Dr. Harne's expertise is in mechanical engineering, with specializations in the fields of mechanical design, acoustics, vibration, manufacturing, and mechanical aspects of construction. Dr. Harne has a long practical history of applying his specializations to investigate the functioning and failure of mechanical components and systems, such as those in consumer products, industrial equipment and processes, building construction products and practices, manufacturing technology, automotive applications, and more.

Dr. Harne is a well-established expert in acoustics, with a particular focus on vibration, shock, and noise. He has authored over 30 peer-reviewed publications in the field and brings extensive knowledge of how these physical stimuli impact people, machines, and industrial processes. His work connects measurable acoustic and vibrational cues to perceptual and psychoacoustic responses, supporting applications such as auditory warnings, vehicle alerts, community noise assessments, and room acoustic evaluations. Over the course of his career, Dr. Harne has analyzed the effects of noise and vibration on machinery and manufacturing systems to support quality control, improve performance and/or efficiency, and investigate failures. He has also contributed to the development and implementation of noise and vibration mitigation strategies across a wide range of industries and technical applications.

Dr. Harne has applied his expertise in mechanical engineering and mechanical systems to numerous matters of industrial and occupational safety and product liability. He has investigated incidents involving engineering controls, occupational noise exposure, excavations, hazardous energy control, material handling, scaffolding, falls, confined spaces, machine guarding, cargo strapping and securing, and other workplace hazards. He has investigated reported defects and malfunctions in numerous consumer and industrial products, such as recreational equipment; doors, gates, and other building hardware; handheld devices; power tools; and more.

Dr. Harne has led investigations on the mechanical, electrical, and plumbing systems in construction, including changes to the functioning of these systems as a result of defects, construction practices, and natural hazards. He has particular experience investigating the design, operation, and failure of heating, ventilation, and cooling (HVAC) systems; septic systems; and the management of stormwater. He has also applied his expertise in the investigation of municipal wastewater treatment systems and facilities.

Prior to joining Exponent, Dr. Harne was a professor of mechanical engineering at The Pennsylvania State University (2020 to 2023) and at The Ohio State University (2015 to 2020), where he led research programs earning millions in grant revenue. His academic work culminated in over 100 publications (including in the journals Nature, Nature Communications, and Advanced Science), dozens of accolades for his research achievements, and invited presentations before heads-of-state, the US Department of Defense, and other international and domestic foundations. From 2018 to 2023, Dr. Harne was the Chief Technology Officer of HyperDamping, Inc., where he helped transition the company from applied

research idea of vibration damping technology, to minimum viable product, and finally to sustainable commercial revenue.

Academic Credentials & Professional Honors

Ph.D., Mechanical Engineering, Virginia Polytechnic Institute and State Univ, 2012

M.S., Mechanical Engineering, Virginia Polytechnic Institute and State Univ, 2009

B.S., Mechanical Engineering, Virginia Polytechnic Institute and State Univ, 2008

2023 U.S. Air Force Research Lab Faculty Fellowship. RXAS Soft Matter Materials Branch, Materials and Manufacturing Directorate, WPAFB, OH. May 2023.

Invited speaker for the 2023 SPIE Smart Structures & Non-Destructive Evaluation Conference. Long Beach, CA. March 2023.

Featured in ASME Magazine Article “If It Only Had A Brain”, November 2022, highlighting research accomplishments in the development of materials that think.

Invited speaker for the 2022 Gordon Research Conference “Imparting Intelligence in and Through Self-Learning Materials and Structures”. Ventura, CA. September 2022.

Invited speaker for the 2022 National Academy of Engineering China-America Frontiers of Engineering Conference. Irvine, CA. July 2022.

2021 U.S. Air Force Research Lab Faculty Fellowship. RXAS Soft Matter Materials Branch, Materials and Manufacturing Directorate, WPAFB, OH. May 2021.

2020 ASME CD Mote Jr. Early Career Award. August 2020.

2019 ASME Gary Anderson Early Achievement Award. September 2019.

2019 U.S. Air Force Research Lab Faculty Fellowship. RXAS Soft Matter Materials Branch, Materials and Manufacturing Directorate, WPAFB, OH. March 2019.

Invitation to participate in the ARO Workshop on “Meta-structures: Dynamics, Topology and Related Opportunities”. May 2018.

National Science Foundation (NSF) CAREER Award. March 2018.

Recognized by the ASME as a “Newsmaker” for the Society. October 2017. https://www.asme.org/topics-resources/society-news/asme-news/newsmakers

Invitation to participate in the NSF Workshop on “Acoustics: New Fundamentals and Applications”. October 2017.

2017 U.S. Air Force Research Lab Faculty Fellowship. RQHF Hypersonic Sciences Branch, Aerospace Systems Directorate, WPAFB, OH. May 2017.

2017 ASME Best Paper Award in Structures and Structural Dynamics.

2016 ASME Haythornthwaite Young Investigator Award, facilitated by the Applied Mechanics Division. October 2016.

Royal invitation to present “Energy-Generating Mechanical Trees” before H.S.H. Prince Albert II of

Monaco and His Excellency Bernard Fautrier, Vice President and CEO of the Prince Albert II of Monaco Foundation at The Ohio State University. August 2016.

Licenses and Certifications

Professional Engineer, North Carolina, #057108

Certification in Design of Onsite Wastewater Treatment Systems by NOWRA

OSHA #510 Occupational Safety And Health Standards For The Construction Industry

OSHA 30 Hour Outreach Training Program - General Industry

Academic Appointments

James F. Will Career Development Professor, Mechanical Engineering, The Pennsylvania State University, 2020-2023.

Professor, Mechanical Engineering, The Ohio State University, 2015-2020.

Postdoctoral Scientist, University of Michigan, 2012-2015.

Prior Experience

James F. Will Career Development Professor, Mechanical Engineering, The Pennsylvania State University, 2020-2023.

Principal, The Sound Enterprise, 2021-2023.

Professor, Mechanical Engineering, The Ohio State University, 2015-2020.

Chief Technology Officer, HyperDamping, Inc., 2018-2023.

Professional Affiliations

American Society of Mechanical Engineers (Fellow)

Member 8573272, American Society of Heating, Refrigerating and Air Conditioning Engineers, 2025-present

Member 1239916, Acoustical Society of America (ASA), 2010-11, 2016-present

Member 3438137, International Society for Optical Engineering (SPIE), 2013-present

Patents

US Patent Application # 63/249,084. “Integrated Circuit Design for Digital Computing and Information Processing of Mechanical Signals”. 13 April 2021.

International Patent Application # WO 2021/188671. “Apparatuses, Systems, and Materials for Stiffness and Damping Control Including Ribbed Geometry, and Associated Methods”.

International Patent Application # WO 2020/210395. “Materials Having Tunable Properties, and Related Systems and Methods”.

US Patent Application # US 2021/0285512. “Materials Having Graded Internal Geometry, and Associated Systems and Methods”

Patent # US 10/458,501. “Designs and Manufacturing Methods for Lightweight Hyperdamping Materials Providing Large Attenuation of Broadband-Frequency Structure-Borne Sound.”

Patent # US 10/546,572. “Folded Transducer Array for Compact and Deployable Wave-Energy Guiding System.”

Publications

Dr. Harne has published over 100 journal articles and an h-index of 31. A complete list of publications may be found at his Google Scholar webpage. A short list of significant, highly cited works is provided below.

C. El Helou, B. Grossmann, C.E. Tabor, P.R. Buskohl, and R.L. Harne. “Mechanical integrated circuit materials.” Nature. 608:699-703. Aug. 2022.

C. El Helou, P.R. Buskohl, C.E. Tabor, and R.L. Harne. “Digital logic gates in soft, conductive mechanical metamaterials.” Nature Communications. 12:1633. Mar. 2021.

M. Pishvar and R.L. Harne. “Foundations for soft, smart matter by active mechanical metamaterials.” Advanced Science. 7:2001384. Sept. 2020.

S. Cui and R.L. Harne. "Soft materials with broadband and near-total absorption of sound.” Physical Review Applied. 12:064059. Dec. 2019.

S. Alharbi, S. Chaudhari, A. Inshaar, H. Shah, C. Zou, R.L. Harne, and A. Kiourti. "E-textile origami dipole antennas with graded embroidery for adaptive rf performance.” IEEE Antennas and Wireless Propagation Letters. 17:2218-2222. Dec. 2018.

C. Lan, L. Tang, and R.L. Harne. “Comparative methods to assess harmonic response of nonlinear piezoelectric energy harvesters interfaced with AC and DC circuits.” Journal of Sound and Vibration. 421:61-78. May 2018.

R.L. Harne, Z. Deng, and M.J. Dapino. “Adaptive magnetoelastic metamaterials: a new class of magnetorheological elastomers.” Journal of Intelligent Material Systems and Structures. 29:265-278. Jan. 2018.

R.L. Harne and K.W. Wang. Harnessing Bistable Structural Dynamics: for Vibration Control, Energy Harvesting and Sensing. Wiley. Chichester, United Kingdom. 2017. 408 pages.

R.L. Harne, Y. Song, and Q. Dai. "Trapping and attenuating broadband vibroacoustic energy with hyperdamping metamaterials.” Extreme Mechanics Letters. 12:41-47. Feb. 2017.

R.L. Harne and D.T. Lynd. "Origami acoustics: using principles of folding structural acoustics for simple and large focusing of sound energy.” Smart Materials and Structures. 25:085031. July 2016.

R.L. Harne, A. Sun, and K.W. Wang. “Leveraging nonlinear saturation-based phenomena in an L-shaped vibration energy harvesting system.” Journal of Sound and Vibration 363:517-531. Feb 2016.

R.L. Harne, M. Thota, and K.W. Wang. "Concise and high-fidelity predictive criteria for maximizing performance and robustness of bistable energy harvesters.” Applied Physics Letters. 102:053903. 2013.

R.L. Harne and K.W. Wang. "A review of the recent research on vibration energy harvesting via bistable

systems.” Smart Materials and Structures. 22:023001. 2013

A short list of significant presentations is given below.

R.L. Harne. "If I Only Had a Brain: Making Materials that can Muse". SPIE Smart Structures & Non-Destructive Evaluation Conference. March 14, 2023.

R.L. Harne. "Mechanical Materials that Sense, Think, React, and Learn.” Johns Hopkins University. March 29, 2022.

R.L. Harne. "The Science and Applications of Mechanical Metamaterials." U.S. Government STEP Smart Materials and Intelligent Systems Seminar. October 7, 2021.

R.L. Harne. “Soft, Autonomous Engineered Matter.” National Science Foundation Program Board. February 17, 2021.

R.L. Harne. "Smart Mechanical Matter." ASME SMASIS 2020 Conference. Virtual Keynote. September 15, 2020.

R.L. Harne. “Multifunctional Material Systems with Tunable Properties to Mitigate Vibration, Shock, and Sound.” Fiat Chrysler Automobiles. Auburn Hills, Michigan. October 19, 2018.

R.L. Harne. “Dynamic Behavior of Elastomeric Metastructures and Metamaterials Subjected to Shock and Vibration.” ARO Workshop on “Meta-structures: Dynamics, Topology and Related Opportunities”. Atlanta, Georgia. May 18, 2018

R.L. Harne. "Multifunctional Material Systems with Tunable Properties to Mitigate Vibration, Shock, and Sound.” Ford Motor Company. Dearborn, Michigan. May 2, 2018

R.L. Harne. “Impedance-based Analysis and Response Prediction of Aerostructural Systems in Combined, Extreme Loading Environments.” AFRL-University Collaborative Center in Structural Sciences, Air Force Research Laboratory. Dayton, Ohio. October 18, 2017.

R.L. Harne. “From Origami to Metamaterials: Waves Into and Out Of Tunable, Adaptive Structural and Material Systems.” Department of Mechanical Engineering, Virginia Tech. Blacksburg, Virginia. April 14, 2017.

R.L. Harne. “Vibration Energy Transfer in Solids and Structures: Perspectives and Projections.” ARO Workshop on “The Future of Vibration Energy Transfer in Solids and Structures: Needs and Opportunities”. University of Washington. Seattle, Washington. October 18, 2016.

R.L. Harne and Q. Dai. "Energy-Generating Mechanical Trees.” In the audience of H.S.H. Prince Albert II of Monaco at the Sustainability Research Luncheon. The Ohio State University, The Ohio Stadium. Columbus, Ohio. August 31, 2016.

R.L. Harne. "Creating Exceptional and Adaptive Vibroacoustic Performance and Functionality in Structural/Material Systems.” Materials and Manufacturing Directorate, Air Force Research Laboratory. Dayton, Ohio. March 18, 2016.

R.L. Harne. "Energy Transfer Principles Drawn from Understanding the Dynamics of Bistable Structures.” NSF Workshop on “Energy Transport and Control in Solids and Structures”. Arlington, Virginia. May 27, 2015.

Project Experience

Noise and Vibration

Extensive project experience identifying the root causes of vibration, shock, and noise. Applications have included:

- Vibration and noise produced by durable household goods, such as washing machines, dishwashers, and refrigerators
- Noise produced by fans in various consumer products, industrial settings, and in automotive vehicle interiors, such as for air filters, HVAC and ventilation, cooling systems, and other forced convection systems
- Vibration and noise resulting from recreational activities like weightlifting, boxing, treadmill use, and other machines
- Vibration and human discomfort resulting from whole-body vibration in transportation systems associated with chassis construction, subframe design, interfaces, mounts, and bushings
- Vibration in medical equipment resulting in operational errors or patient discomfort
- Analyzing seat suspension and seat cushioning design to reduce transmitted vibration to vehicular occupants in passenger vehicles, commercial vehicles, and tractor trailer cabs
- Shock and impact induced by hail and other falling objects on asphalt shingle roofs
- Vibration problems in down-hole applications associated with gas and oil drilling
- Vibration produced by engines, pumps, and other reciprocating machinery

Developed rubber components for vibration and shock damping. Applications have included:

- Air compressors
- Air filtration mounts
- Automotive seat suspensions
- Bulb seals, door seals, and sealing solutions for insulated glass units (IGUs) and windows
- Fitness flooring products
- Flooring underlayment, isolators, and dampers
- HVAC mounts and isolators
- Lawnmowers
- Pneumatic chipping guns, hammer drills, and other hand-held power tools
- Subframe inserts and bushings
- Washing machine dampers and noise attenuation methods

Extensive experience analyzing community noise and vibration complaints resulting from construction, commercial, industrial, and recreational activities, and proposing remediation plans to alleviate outstanding concerns. Applications have included:

- Community reactions to construction noise and vibration
- Community reactions to noise from commercial, industrial, and municipal activities
- Community reactions to pickleball noise
- Complaints associated with vibration- and shock-induced noise resulting from fitness facilities, such as due to weight drops, treadmills, and use of other exercise equipment
- Classroom and auditorium acoustics and optimizing for speech intelligibility
- Vibration in cold chain and supply chain settings to mitigate damage to pharmaceuticals and consumer goods
- Equipment noise and consumer product noise complaints

Extensive experience analyzing the audibility of sounds, including alarms, warnings, and other acoustic alerts. Applications have included:

- Audibility of vehicular warnings, such as passenger vehicle horns, vehicle backup alarms, vehicle equipment and component sounds, and train horns
- Audibility of device warning sounds, such as from medical equipment and consumer electronics
- Audibility of alerts as predicted by data-driven and theoretical models of human hearing and cognitive response

Developed vibration- and wave-based structural health monitoring hardware and software to monitor symptoms of system wear, fatigue, and failure. Applications have included:

- Vibration and wave transmission through cellular poroelastic foams
- Ultrasound imaging and analysis of damage and failure attributes in cellular glass (FOAMGLAS)
- Detection of cracks and defects in solids and composites using wave-based monitoring methods

Developed materials to resist blast penetration under extreme high strain-rate dynamic loads. Applications have included:

- Blast resistance of polyurea composites, and development of manufacturing methods for the same
- Impact resistance of asphalt shingles, and design of damage-tolerant shingle underlayment

Industrial and Occupational Safety and Product Liability

Experience investigating numerous incidents of industrial and occupational safety or product liability such as:

- Incidents of noise exposure in occupational and community settings
- Falls, incidents in confined spaces, equipment malfunctions, and other workplace hazards
- Incidents involving hazardous energy control and lockout/tagout
- Securing, strapping, and tying down cargo
- Machine safety, including guarding, controls for automated devices, and various manufacturing equipment
- Incidents regarding safety training and site responsibilities
- Alleged failures or defects in consumer and building products such as exercise equipment, automatic doors, power tools

HVAC, Plumbing, and Wastewater Management

Experience investigating mechanical aspects of construction including:

- Heating, ventilation, and cooling (HVAC) design, installation, and performance in residential, commercial, and industrial facilities
- Design, installation, and operation of plumbing or drain systems in residential structures for wastewater flows
- Design, installation, and operation of septic systems for wastewater management, including septic tanks, drain fields, sand mounds, and suitable soil percolation
- Investigations into the design and operation of municipal wastewater treatment facilities

Medical Devices and Underwater Acoustics

Experience investigating the safe and effective operation and use of medical devices, including ultrasound-based equipment, such as:

- Medical ultrasound devices for imaging, therapy, high-intensity focused ultrasound ablation, shockwaves, cavitation, and lithotripsy.
- Medical ultrasound devices for imaging, therapy, high-intensity focused ultrasound ablation, shockwaves, cavitation, and lithotripsy.
- Medical devices for endoscopy, balloon angioplasty, and other devices used for minimally invasive procedures.

Experience investigating numerous problems of underwater acoustics such as:

- Underwater sound, acoustic source localization, and other practices of SONAR and time-of-flight (ToF) measurement technologies.
- Acoustic image reconstruction, acoustic source localization, acoustic signal classification, and other requirements.
- Acoustic arrays for acoustic cameras, acoustic monitoring, loudspeaker arrays, and other transmission and receiving applications.

Manufacturing

Experience in the design and manufacture of polymers and rubber using a variety of industrial molding processes:

- Extrusion molding
- Compression molding
- Injection molding
- Transfer molding
- Thermoforming
- Casting
- Foam molding

Intellectual Property

Experience in the management, prosecution, and protection of intellectual property, including efforts such as:

- Patent formulation and claim construction pertaining to mechanical devices, consumer products, manufacturing technology, and acoustic systems
- Patent infringement and assessment of infringed claim limitations
- Patent invalidity and analysis of prior art

Editorships & Editorial Review Boards

Associate Editor, 2020-present, ASME Journal of Vibration and Acoustics

Associate Editor, 2017-2023, The Journal of the Acoustical Society of America, Proceedings of Meetings on Acoustics, Signal Processing in Acoustics

Peer Reviews

Science Advances

Nature Communications, Nature Scientific Reports

Advanced Materials and Adv. Mat. family of journals

ASME Journal of Vibration and Acoustics and other ASME Journals

Applied Physics Letters

Smart Materials and Structures

Extreme Mechanics Letters

Journal of Sound and Vibration

The Journal of the Acoustical Society of America

Proceedings of the Royal Society A

Journal of Intelligent Material Systems and Structures

International Journal of Solids and Structures

Mechanical Systems and Signal Processing