



Exponent®
Engineering & Scientific Consulting

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

Managing Engineer | Mechanical Engineering
Atlanta
+1-678-412-4834 | rharne@exponent.com

Professional Profile

Dr. Harne's expertise is in mechanical engineering, with specialization in the fields of acoustics, vibration, mechanical design, materials, and manufacturing. He has years of experience applying this knowledge to consumer products, industrial equipment and processes, building construction products and practices, manufacturing technology, automotive applications, and more.

Dr. Harne has a comprehensive and applied knowledge of the effects that vibration, shock, and noise have on people, machines, and processes. He is able to correlate such stimuli to human perception and psychoacoustic metrics to forecast human responses to acoustic and vibration cues, such as for auditory warnings, vehicle alerts, community noise and vibration, and the suitability of room acoustics. Dr. Harne has significant experience analyzing the impact of noise and vibration on machines and industrial processes for sake of quality control, maintaining performance and efficiency, and investigating failure.

He has unique expertise in the design, development, and commercialization of vibration- and noise-reducing polymers. These products have been applied in building construction, automotive vehicles and components, consumer goods, and more. Dr. Harne has extensive experience with manufacturing processes pertaining to polymers, including extrusion molding, compression molding, injection molding, transfer molding, thermoforming, casting, and foam molding.

Dr. Harne has expertise in ultrasound, medical acoustics, and bubble acoustics. He has worked on numerous projects ranging from acoustic cavitation and lithotripsy, to ultrasound imaging, high-intensity focused ultrasound, and understanding the roles of vibration and acoustics in pharmaceuticals and cold chain processes.

Dr. Harne has experience in the areas of industrial and occupational safety matters regulated by OSHA. He has investigated incidents involving occupational noise exposure, falls, confined spaces, equipment malfunctions, and other workplace hazards. Dr. Harne has particular knowledge regarding workplace hazards in manufacturing and supply chain settings, given direct experience managing such activities in past work.

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 fundamental and applied research problems earning millions in grant revenue. His academic work culminated in over 100 publications (including in 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

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 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 disturbances and failures. 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 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 suite of rubber components for vibration and shock damping for commercial, construction, and industrial applications, including manufacturing and installation methods for the same. 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:

- Analyzing community reactions to construction noise and vibration
- Analyzing community reactions to pickleball noise
- Analyzing 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
- Analyzing classroom and auditorium acoustics and optimizing for speech intelligibility
- Analyzing vibration in cold chain and supply chain settings to mitigate damage to pharmaceuticals and consumer goods
- Analyzing equipment noise and consumer product noise complaints

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

- Monitoring vibration 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

Medical Devices and Acoustics

- Experience in the area of medical ultrasound for imaging, therapy, high-intensity focused ultrasound ablation, shockwaves, cavitation, and lithotripsy.
- Experience in underwater sound, acoustic source localization, and other practices of SONAR and time-of-flight (ToF) measurement technologies.
- Developed software tools for acoustic image reconstruction, acoustic source localization, acoustic signal classification, and other requirements.
- Extensive experience designing and characterizing acoustic arrays for acoustic cameras, acoustic monitoring, loudspeaker arrays, and other transmission and receiving applications.

Manufacturing and Construction

Experience with building construction practices for residential, wood-framed structures, including with framing requirements, electrical and plumbing codes, and site requirements such as grading, septic systems, municipal water, site-specific wells, and underground utilities.

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

Industrial and Occupational Safety

- Investigating incidents of noise exposure in occupational and community settings
- Investigating falls, incidents in confined spaces, equipment malfunctions, and other workplace hazards
- Investigating incident involving building foundation construction
- Investigating incidents associated with high-temperature and high-pressure manufacturing processes

Intellectual Property

- Experience in patent formulation, management, and litigation pertaining to mechanical systems and acoustics.

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