Exponent®
Engineering & Scientific Consulting


# Daniel Mennitt, Ph.D., P.E., INCE Bd. Cert.

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## Professional Profile

Dr. Mennitt specializes in acoustics and is skilled in the characterization, design, and modeling of acoustical environments and devices. His primary areas of expertise include noise and vibration control, environmental noise, signal processing, and auditory perception. Dr. Mennitt is board certified by the Institute of Noise Control Engineering.

Dr. Mennitt has applied his expertise to noise and vibration control of machines, buildings, infrastructure, medical devices, and consumer products. He has developed and implemented solutions to effectively reduce noise transmission to sensitive areas, isolate vibration, and support the development of quieter products. Dr. Mennitt routinely conducts testing to characterize acoustical quantities such as sound power, directivity, transmissibly, and frequency response. He also draws on analytical methods and numerical models to evaluate the mechanisms of sound generation, dominant sources, and transmission paths of components and systems. Dr. Mennitt's work is rooted in the human response to sound and vibration.

As a certified Occupational Hearing Conservationist, he has evaluated occupational noise exposure, hearing conservation programs, and the efficacy of mitigative measures to protect hearing in the workplace and other settings. His project experience has involved the design of experiments and implementation of signal processing to estimate perception, audibility, loudness, annoyance, sound quality, and other psychoacoustic metrics. Dr. Mennitt's signal processing experience also extends to active sonar applications, adaptive noise and echo control, and development of algorithms for signal detection, estimation and classification.

Dr. Mennitt has worked extensively with federal agencies and other organizations to assess environmental noise and the consequences of noise exposure to humans and ecological systems. Prior to joining Exponent, he worked at Colorado State University in partnership with the National Park Service's Natural Sounds and Night Skies Division to manage acoustical environments. His research involved the spatiotemporal patterns of environmental sound on landscape scales, impacts of noise exposure, acoustical transducers, bioacoustics, flow noise, and predictive modeling. Dr. Mennitt has designed acoustical devices and methods for data acquisition, calibration, and monitoring sound in extremely quiet environments. While at Colorado State University, Dr. Mennitt also taught a course on acoustics, noise, and signal processing.

Dr. Mennitt's experience in computational acoustics includes deterministic time and frequency domain simulations of acoustic propagation as well as applications that exploit statistical learning. He led a multidisciplinary team to pioneer technology that uses geospatial data to generate comprehensive maps of environmental sound levels and noise exposure on continental scales. He has worked with academia, government, and industry to translate these estimates to implications for land management, ecological, epidemiological, military, and commercial applications.

 

Dr. Mennitt's background is in mechanical engineering. He performed his doctoral work at Virginia Tech's Vibration and Acoustics Laboratory, developing terrestrial sonar systems for localization and tracking of acoustic sources in free-field and cluttered environments. During this research, he developed robust statistical methods for classification of acoustical signals and fusion of information from distributed sensor networks. He has also created tools for signal detection, beamforming, adaptive filtering, speech processing, and other signal processing applications with free field and diffracting microphone arrays. While at the Vibration and Acoustics Laboratory, he conducted testing with anechoic and reverberation rooms, intensity probes, impedance tubes, modal impact hammers, accelerometers, and shakers. Other graduate work included applications in spatial audio, active noise control for signal enhancement, architectural acoustics, music production, and audio engineering. His training and expertise in audio engineering helps Dr. Mennitt conduct educated and critical observations to address acoustical issues.

## Academic Credentials & Professional Honors

Ph.D., Mechanical Engineering, Virginia Polytechnic Institute and State Univ, 2008

B.S., Mechanical Engineering, Virginia Polytechnic Institute and State Univ, 2004

The Robert Bradford Newman Medal for Merit in Architectural Acoustics, 2005

Best Paper By A Young Presenter, 153rd Meeting of the Acoustical Society of America, 2007.

## Licenses and Certifications

Professional Engineer, Colorado, #PE.0058367

Professional Engineer, Wisconsin, #48642-6

Board Certified

Certified Occupational Hearing Conservationist

## Academic Appointments

Research Scientist III, Department of Electrical and Computer Engineering, Colorado State University, 2018-2019

Research Scientist II, Department of Electrical and Computer Engineering, Colorado State University, 2015-2018

Research Scientist I, Department of Electrical and Computer Engineering, Colorado State University, 2010-2015

Graduate Research Assistant, Department of Mechanical Engineering, Virginia Polytechnic Institute and State University, 2004-2008

## Professional Affiliations

Acoustical Society of America

Institute of Noise Control Engineering

American Society for Testing and Materials: ASTM Committee E33 on Building and Environmental Acoustics

## Patents

US Patent No. 10,966,011. Adaptive coupler for calibration of arbitrarily shaped microphones, issued March 30, 2021.

## Publications

Ferguson L.A., Taff B.D., Blanford J.I., Mennitt D.J., Mowen A.J., Levenhagen M., White C., Monz C.A., Francis C.D., Barber J.R., Newman P., “Understanding park visitors’ soundscape perception using subjective and objective measurement,” PeerJ 12 (2024):e16592.

M. Senzaki, J. R. Barber, J. N. Phillips, N. H. Carter, C. B. Cooper, M. A. Ditmer, K. M. Fristrup, C. McClure, D. J. Mennitt, L. P. Tyrrell, J. Vukomanovic, A. A. Wilson and C. D. Francis, “Sensory pollutants alter bird phenology and fitness across a continent,” Nature 587 (2020):605-609.

D. Paksarian, K. E. Rudolph, E. K. Stapp, G. P. Dunster, J. He, D. J. Mennitt, and K. Merikangas, “Association of Outdoor Artificial Light at Night With Mental Disorders and Sleep Patterns Among US Adolescents,” JAMA Psychiatry 77 (2020):1266-1275.

DM Dominoni et. al., "Why conservation biology can benefit from sensory ecology," Nature Ecology & Evolution, 4 (2020): 502-511.

R. T. Buxton, M.F. McKenna, D. J. Mennitt, E. Brown, K. Fristrup, K.R. Crooks, L. M. Angeloni, G. Wittemyer, "Anthropogenic noise in US national parks - sources and spatial extent," Frontiers in Ecology and the Environment 17 (2020): 559-564.

D. J. Mennitt, "An adaptive coupler for the calibration of the arbitrarily shaped microphones," Applied Acoustics 154 (2019):114-120.

K.E. Rudolph, A. Shev, D. Paksarian, K.R. Merikangas, D.J. Mennitt, P. James, and J. A. Casey, "Environmental noise and sleep and mental health outcomes in a nationally representative sample of urban US adolescents," Environmental Epidemiology, 3 (2019): e056.

D. J. Mennitt, K. Fristrup, and B. Notaros, “Characterization of gain and directivity of exponential horn receivers,” The Journal of the Acoustical Society of America, 142 (2017):3257-3266.

C. D. Francis, D. Taff, P. Newman, C. White, C. A. Monz, M. Levenhagen, A. R. Petrelli, L. C. Abbott, J. Newton, S. Burson, C. B. Cooper, Kurt M. Fristrup, C. McClure, D. J. Mennitt, M. Giamellaro, J. R. Barber, “Acoustic Environments Matter: Synergistic benefits to humans and ecological communities,” Journal of Environmental Management, 203 (2017):245-254.

J. A. Casey, R. Morello-Frosch, D. J. Mennitt, K. M. Fristrup, E. L. Ogburn, and P. James, “Race/Ethnicity, Socioeconomic Status, Residential Segregation, and Spatial Variation in Noise Exposure in the Contiguous United States,” Environmental Health Perspectives, 125 (2017):1-10.

R. T. Buxton, M. F. McKenna, D. J. Mennitt, K. M. Fristrup, K. Crooks, L. Angeloni, and G. Wittemyer, “Noise pollution is pervasive in US protected areas.” Science 356, no. 6337 (2017):531-533.

D. J. Mennitt and K. Fristrup, "Influential factors and spatiotemporal patterns of environmental sound levels in the contiguous United States," Noise Control Engineering Journal, 64 (2016):342-353.

D. J. Mennitt, K. Fristrup, and K. Sherrill, "A geospatial model of ambient sound pressure levels in the contiguous United States," The Journal of the Acoustical Society of America 135 (2014):2746-2764.

D. J. Mennitt, K.M. Fristrup, "Obtaining calibrated sound pressure levels from consumer digital audio recorders," Applied Acoustics 73 (2012):1138-1145.

K. M. Fristrup, and D. J. Mennitt. “Bioacoustical monitoring in terrestrial environments.” Acoustics Today 8(2012):16-24.

D. J. Mennitt, and M. Johnson, "Multiple-array passive acoustic source localization in urban environments," The Journal of the Acoustical Society of America, 127.5 (2010): 2932-2942.

M. Ermann, M. R. F. Kidner, and D. J. Mennitt, "Mapping the sound field of a 400 seat theater," Building Acoustics 13.3 (2006):199-210.

**Conference Proceedings**

K. Spak and D. J. Mennitt, “Vibration specifications and standards as part of EPC contracts,” VIATC 45th Vibration Institute Annual Training Conference (2023).

D. J. Mennitt, M. F. McKenna, and K. M. Fristrup, "Continental perspectives of noise exposure and its effects," INTER-NOISE and NOISE-CON Congress and Conference Proceedings, 255 (2017):1168-1172.

D. J. Mennitt and K. Fristrup, "Influential factors and spatiotemporal patterns of environmental sound levels," INTER-NOISE and NOISE-CON Congress and Conference Proceedings, 250 (2015):2029-2040.

D. J. Mennitt, K. Fristrup, K. Sherrill, and L. Nelson, "Mapping sound pressure levels on continental scales using a geospatial sound model," INTER-NOISE and NOISE-CON Congress and Conference Proceedings, 1 (2013):1-11.

D. J. Mennitt, P. Gillett, J. Carneal and M. Johnson, "Tracking Noise Sources Using Multiple Mobile Microphone Arrays," Thirteenth International Congress on Sound and Vibration, Vienna, Austria (2006):1-8.

**Technical reports**

D. J. Mennitt and B. J. Ikelheimer, "Geospatial sound modeling for military and community noise metrics," Prepared for the United States Army (2017).

**Presentations**

D.J. Mennitt, D. Joyce, and K. Fristrup, "Benefits and challenges of using consumer audio equipment for unattended acoustical monitoring," The Journal of the Acoustical Society of America, 144, 1828 (2018).

J. A. Casey, A. Shev, D. Paksarian, K. R. Merikangas, D. J. Mennitt, and K. E. Rudolph, "Association between exposure to noise and sleep and mental health outcomes in a nationally-representative sample of U.S. adolescents," 2018 Annual Conference of the International Society for Environmental Epidemiology (2018).

K. Fristrup, M.F. McKenna, and D.J. Mennitt, "Forecasting increases in recreational value that would result from restoration of natural soundscapes in National Parks," The Journal of the Acoustical Society of America, 143, 1806 (2018).

M. F. McKenna, D. J. Mennitt, M. Thompson, J. Stanley, S. Van Parijs, K. M. Fristrup, and L. Hatch, "Including acoustical features in marine ecological prediction," NOAA-Navy Workshop: Soundscape Metrics to Support Marine Protected Area Management, Woods Hole Oceanographic Institution, MA (2018).

D. J. Mennitt, "Classification of wind induced pseudo noise using low resolution features," National Park Service, Natural Resource Stewardship and Science, Fort Collins, CO (2017).

D. J. Mennitt, Megan F. McKenna, and Kurt M. Fristrup, "Continental perspectives of noise exposure and its effects," INTER-NOISE and NOISE-CON Congress and Conference Proceedings, 255 (2017):1168-1172.

D. J. Mennitt and K. Fristrup, "Gain and directivity of exponential horn receivers," The Journal of the Acoustical Society of America 140, 3140 (2016).

D.J. Mennitt and K. Fristrup, "Anomaly detection and other practical considerations for estimating acoustical metrics from time series data," The Journal of the Acoustical Society of America, 140, 3424 (2016).

D. J. Mennitt and K. M. Fristrup, "A geospatial approach to mapping environmental sound levels across the United States," American Society for Photogrammetry and Remote Sensing, Geobytes (2016).

J. A. Casey, R. Morello-Frosch, D. J. Mennitt, K. M. Fristrup, and P. James, "The distribution of noise pollution along racial and socioeconomic lines in the United States," 28th Annual Conference of the International Society of Environmental Epidemiology, Rome, Italy (2016).

P. James, R. Banay, D. J. Mennitt, K. Fristrup, J. Africa, J. Hart, F. Laden, "Noise and Cardiovascular Disease in a Nationwide Cohort Study," 28th Annual Conference of the International Society of Environmental Epidemiology, Rome, Italy (2016).

R. T. Buxton, M. McKenna, E. Brown, D. J. Mennitt, K. Fristrup, K. Crooks, L. Angeloni, G. Wittemyer, "Noise Exposure in U. S. Protected Areas," American Association for the Advancement of Science, Washington DC (2016).

D. J. Mennitt, L. Hatch, K. M. Fristrup, M. Thompson, D. Cholewiak, M. F. McKenna, P. Auster and S. Van Parijs, "A geospatial approach to exploring the soundscape of Stellwagen Bank National Marine Sanctuary," Oceanoise 2015, Vilanova i la Geltrú, Spain (2015).

D. J. Mennitt, E. Brown, and K.M. Fristrup, "Assessing the condition of acoustical resources across the National Park Service Units," 2015 George Wright Society Conference on Parks, Protected Areas, and Cultural Sites, Oakland, CA (2015).

M. F. McKenna, K. M. Fristrup, and D. J. Mennitt, "Predicting historic and current sound levels from point measurements: a geospatial model," Science for Parks, Parks for Science: The Next Century, Berkeley, CA (2015).

K. Fristrup, D. Joyce, E. Lynch, M. Mckenna, D. J. Mennitt, "Monitoring and modeling sound levels at landscape scales in U. S. National Parks," Ecology and acoustics: emergent properties from community to landscape, Paris, France (2014).

D. Risch, P. Auster, D. Cholewiak, K. Fristrup, L. Hatch, M. McKenna, D. Mennitt, M. Thompson, and S. Van Parijs, "Monitoring bio-acoustic activity & geospatial models of ambient sound: Applications in a marine sanctuary," Ecology and acoustics: emergent properties from community to landscape, Paris, France (2014).

C. Walker, S. Buxner, D. J. Mennitt, C. Cooper, S. O'Connor, and S. M. Pompea, "Using NGSS to Shape Research Projects with Citizen-Science Data," Astronomical Society of the Pacific Annual Meeting, Burlingame, California (2014).

D. J. Mennitt, K. Fristrup, and K. Sherrill, "A geospatial model of ambient sound pressure levels in the continental United States," The Journal of the Acoustical Society of America 132, 1926 (2012).

D. J. Mennitt, "Spatial variation of natural ambient sound pressure levels in Rocky Mountain National Park." The Journal of the Acoustical Society of America 129, 2617 (2011).

M. Ermann, J. Carneal, D. Mennitt, C. Jackson, B. Karmarkar, M. Helveston, and P. Clay, "Sound transmission loss of nontraditional building materials and redundancies," The Journal of the Acoustical Society of America 122(5) (2007).

D. J. Mennitt, M. Johnson, and J. Carneal, "Coarse classification of acoustic signals using temporal and spectral characteristics," Journal of the Acoustical Society of America 121(5):3046 (2007).

J. Carneal, M. Johnson, D. J. Mennitt, and P. Gillett, "Localization and tracking noise sources with autonomous vehicles: from node processing to central command fusion and tracking," Acoustical Society of America's North Carolina Chapter, Raleigh, NC (2006).

D. J. Mennitt, "Numerical accuracy of virtual acoustic prototyping: determination of the minimum size of the evaluation sphere to achieve accurate local simulation," Acoustical Society of America's North Carolina Chapter, Raleigh, NC (2006).

D. J. Mennitt, J. Redenshek, A. Tawney "Acoustical mapping of the lyric theater," Acoustical Society of America's North Carolina Chapter, Blacksburg, VA (2005).

## Project Experience

**Noise Control Engineering**

- Conducted acoustical measurements and developed models to characterize the sound emission of noise sources associated with machines, consumer electronics, consumer products, medical devices, and other equipment. Identified the dominant noise sources and transmission paths using models in conjunction with experimental sound and vibration data.
- Determined the mechanisms of sound generation in a micro-electromechanical system using numerical and analytical models of acoustic radiation.
- Prescribed and evaluated acoustical enclosures and treatments to provide sufficient noise reduction for a consumer electronics device within design constraints.
- Evaluated occupational noise exposure, hearing conservation programs, and the efficacy of mitigative measures to protect employee hearing.
- Applied analytical models of sound emission characteristics to inform test methods for ultrasonic acoustic sources and evaluated the effects of exposure to ultrasound.
- Optimized a constrained layer damping treatment to attenuate structureborne noise in an acoustical enclosure.
- Determined the root cause of impact noise and vibration in a machine and specified mitigation to control noise.
- Characterized the acoustic performance of a wearable electronic device and conducted measurements to evaluate regulatory compliance with national and international standards.
- Measured the dynamics of a lightweight structure in a consumer product using laser doppler vibrometry to solve problems related to fatigue and NVH (noise, vibration, and harshness).

**Flow Induced Noise and Vibration**

- Conducted and evaluated acoustical measurements to characterize the sound power of noise sources in HVAC equipment; identified feasible strategies to reduce the A-weighted noise level and increase speech intelligibility in classrooms.
- Determined the dominant noise transmission paths in a fan enclosure using analytical calculations and experimental sound and vibration data.

- Investigated a flow induced resonance in a steam pipeline and designed noise controls to reduce structural vibration.
- Designed acoustic absorbers to control flow noise in a medical device which could not use typical porous materials.
- Measured meteorological, sound, and vibration data to determine the root cause of wind-induced flow noise and vibration affecting outdoor infrastructure; implemented mitigation to control noise emissions.

**Environmental Noise and Vibration**

- Conducted environmental noise assessments of industrial facilities, construction activities, utilities, and transportation projects in regard to the potential for community noise complaints and other environmental impacts.
- Designed, executed, and analyzed acoustic field surveys of ambient conditions outdoors in urban communities and remote areas. Typical applications have included noise source characterization, assessment of existing conditions, and post-construction noise emissions for regulatory compliance.
- Modeled acoustic propagation from noise sources to estimate the potential impacts to local communities, determine compliance with regulations, and assess mitigation strategies.
- Prepared noise control plans for construction activities including underground power transmission lines and drilling operations.

**Building Acoustics**

- Designed experiments and conducted path analyses to determine the root cause of noise and vibration transmission in a residential apartment building; implemented mitigation to effectively isolate vibration and reduce noise transmission to sensitive areas in a building.
- Conducted field measurements of airborne and ground-borne noise and vibration arising from rail systems to evaluate human exposure and response in buildings.
- Developed numerical models and conducted field measurements to assess the transmission loss of building facades and highway noise abatement strategies.
- Evaluated the potential effects of sound and vibration on sensitive equipment in commercial buildings and offshore platforms from transportation and machinery sources.
- Evaluated the potential effects of vibration and regenerated noise on people in a residential building.
- Assessed HVAC noise controls in commercial buildings and vehicles to resolve deficiencies and mitigate occupant annoyance.

**Auditory Perception**

- Evaluated the audibility of sound sources including vehicles, aircraft, and warning signals (alarms) under various environmental conditions.
- Measured the attenuation of active noise cancelling headphones and the attenuation of passive hearing protection devices in the laboratory to determine their capability to reduce noise exposure.
- Assessed the effect of hearing protection devices on recognition of warning signals in background noise.
- Recreated impulsive events to evaluate their subjective perception using psychoacoustic metrics including time-varying loudness.
- Devised screening criteria for acceptable sound quality of a quieter product based on acoustical metrics and spectral data.

- Instrumented and analyzed the interior sound field of vehicles to evaluate the driver's auditory experience and related NVH (noise, vibration and harshness) metrics.
- Design of experiments to assess speech intelligibility of a telecommunications device.
- Analyzed the characteristics of sources to assess human response to vibration in vehicles.

**Signal Processing**

- Formulated signal processing algorithms and designed filters for detection, classification, and enhancement of audio signals such as speech.
- Identified noise mitigation strategies and engineered techniques to improve the accuracy and robustness of an active sonar system.
- Designed octave band and fractional-octave-band digital filter banks to efficiently calculate sound pressure levels from audio data; demonstrated performance in accordance with national standards.
- Conducted a vibroacoustic analysis of drivetrain components and identified the mechanism of noise generation in a vehicle using coherent output power techniques.
- Designed and implemented array signal processing algorithms such as adaptive beamforming and generalized sidelobe cancellers.
- Evaluated the accuracy of a multirate signal processing system using a heterodyne receiver.
- Conducted forensic audio analyses and prepared courtroom exhibits.

**Nondestructive Testing and Failure Analysis**

- Evaluated medical ultrasound devices including hydrophone measurement of high intensity therapeutic shock waves to demonstrate compliance with regulatory guidance.
- Analyzed measurement data to assess piping vibration sources and the risk of vibration induced fatigue failure in natural gas and water pipelines.
- Engineered instrumentation and protocols to assess the effect of vibration on nondestructive evaluation of gas pipelines that account for vibroacoustic interaction of pipe shell and fluid dynamics.
- Provided design analysis for the development of a sonar system operating underground using numerical models and field data.
- Characterized the performance of piezoelectric transducers including phased arrays for ultrasound imaging and acoustic source localization.
- Instrumented turbomachinery and analyzed condition monitoring data to identify component failure and determine maintenance requirements.
- Instrumentation and testing of vehicles to evaluate component function and acoustic transmission. Conducted experimental modal analysis of vibrating structures to determine root cause of failure in conjunction with finite element analyses.
- Conducted failure analysis of a piezoelectric transducer and enclosure.
- Conducted measurements with a laser doppler vibrometer and shaker table to determine the effects of vibration on thermal performance of a consumer electronic device.

## Peer Reviews

Noise Control Engineering Journal

Journal of the Acoustical Society of America

Environment International Journal