

# The Penn State Acoustics Program at 50

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*Reaching its golden anniversary in 2015, acoustics at Penn State has had a great journey over 50 years. Who set it up, what was the mission, and what have been some of the accomplishments to date?*

This is the story of the Graduate Program in Acoustics at The Pennsylvania State University (usually referred to as Penn State). In 2015-2016, the Penn State Acoustics Program is celebrating its 50th anniversary. With broad educational offerings aligned closely with the Acoustical Society of America (ASA), it is the only institution in the United States where one can earn a PhD in Acoustics. The purpose of this article is to document some of the history of the Graduate Program in Acoustics (often referred to below as “Penn State Acoustics”) over the 50 years, describe its mission, highlight some ongoing research and alumni accomplishments, and provide benchmarking information to others who are interested in the topic of education in acoustics. This article will describe the program’s conception, formation, and growth and then provide more details on its current status.

Penn State is a large university with many undergraduate and graduate programs. Detailed information on it is available from public websites (see, for example, <http://stats.psu.edu> and <http://www.psu.edu>). The largest campus is University Park, located in State College, PA, almost exactly in the center of Pennsylvania. This is the location of the Penn State Graduate Program in Acoustics. The current offerings include both residential education and distance education in Acoustics. The resident programs include a PhD degree in Acoustics, Master of Science degree in Acoustics, and Master of Engineering degree in Acoustics. In the 50 years of the Graduate Program in Acoustics, there have been over 200 PhD graduates, over 280 MS graduates, and over 180 Master of Engineering graduates. A large percentage of these graduates are still active in the field today. Where did this graduate program come from?

The Applied Research Laboratory (ARL) at Penn State ([www.arl.psu.edu](http://www.arl.psu.edu)) celebrates its 70th anniversary in 2015 and initiated the Acoustics Program and has sustained it during its entire 50 years. ARL is “an integral part of one of the leading research universities in the nation and serves as a University Center of Excellence in Defense Science, Systems, and Technologies with a focus in naval missions and related areas. As a Department of Defense (DoD)-designated US Navy University Affiliated Research Center (UARC), ARL maintains a long-term strategic relationship with the US Navy and provides support for the other services. ARL provides science, systems, and technology for national security, economic competitiveness, and quality of life through education, scientific discovery, technology demonstration, and transition to application.” Furthermore, “ARL maintains a long-term strategic relationship with the Naval Sea Systems Command and the Office of Naval Research.”

**Table 1: Proposers of the Penn State Graduate Program in Acoustics.**

John Johnson	Director of ORL, ASA Fellow, ASA President 1971-1972
Paul Kendig	ASA Fellow
Eugen Skudrzyk (pronounced Scool-rick)	ASA Fellow, Interdisciplinary Silver Medal in Theoretical and Applied Acoustics in 1983 and ASA Gold Medal posthumously in 1990
John Snowdon	ASA President 1977-1978, ASA Trent-Crede Medal in 1980,
Paul Michael	
John Brown	
Vernon Albers	ASA Fellow
John Lumley	
Robert Farwell	
Richard Zindler	
Miles Pigott	
Vernon Neubert	

## Formation of the Acoustics Program

The US Navy established the ARL at Penn State in 1945 just after the close of World War II when Harvard University decided to divest itself from the war effort, and the Harvard Underwater Sound Laboratory was disbanded by 1949. Many of the contributors to that laboratory came collectively to Penn State to establish the Ordnance Research Laboratory (ORL) as it was known at that time. Eric Walker was the first director of the laboratory from 1945 to 1951, and he later went on to be Penn State’s president from 1956 to 1970.



**Figure 1.** John Johnson, founder of the Penn State Graduate Program in Acoustics.

It was clear at that time that ARL scientists had tremendous expertise and wanted to contribute to Penn State’s education mission. John Johnson (**Figure 1**) was the Director of ORL in the early 1960s, and he led an effort to create an Intercollege Graduate Degree Program focused on acoustics. A proposal was made to the Graduate School in 1963. The Penn State scientists involved in this formation are listed in **Table 1**.

Their primary suggested areas of expertise for the new program included Physical Acoustics, Architectural Acoustics, Bioacoustics, Underwater Acoustics, and Shock and Vibration (known today as Structural Acoustics).

Although today the program touches on all of the ASA’s technical areas, the above thrusts are still the primary research concentrations at Penn State. A formal proposal to create the Graduate Program in Acoustics came forth in 1964 and was authored by V. Albers, G. Albright, F. Brickwedde, R. Brubaker, J. Lumley, and V. Neubert and chaired by J. Johnson. This proposal included additional details about both proposed new courses and existing courses at Penn State that would lead to MS and PhD degrees in Acoustics.

On the day before the graduate school faculty met to consider the proposal, the office of Dr. Johnson alerted all graduate faculty members about the upcoming meeting. On that day, all the ORL-affiliated graduate school members showed up at the graduate school faculty meeting and voted to unanimously approve the program creation. Eventually, the Penn State Board of Trustees approved the new program on June 11, 1965, and this is documented in a letter to Merritt Williamson, Dean of the Penn State College of Engineering, on that date.

As mentioned, the idea to establish acoustics at Penn State was originated by John Johnson, the director of the Navy-sponsored ORL at Penn State. The Navy was interested in educating people in underwater sound technology to develop and use submarines as well as to detect them. For this purpose, acoustics was ideal to achieve this goal. However, Johnson’s idea was much greater. He thought that the topic of education in acoustics should be much wider because we are using sound for many applications and living with sound that can be both pleasant and damaging. The relevant courses that the students could take were available in various departments in the University so that a complete program could be assembled.

To give some perspective, in 1965, the United States first sent ground troops into Vietnam, Lyndon Johnson was President of the United States, the Voting Rights Act was enacted, and the number 1 movie that summer and the Best Picture Oscar winner that year was *The Sound of Music*. Some of the top songs on the radio around that time were “Ticket to Ride” by the Beatles, “Help Me Rhonda” by the Beach Boys, and “Satisfaction” by the Rolling Stones.

## Mission of Penn State Acoustics

The Graduate Program in Acoustics strives to be the pre-eminent program for education and research in acoustics in the United States and in the world by providing innovative curricula to both resident and distance education students. The program works closely with industry and government laboratories to continuously evaluate and adjust our efforts to most effectively educate students and provide research solutions to current and relevant problems.

The mission of the Graduate Program in Acoustics is to further Penn State’s land grant mission of education, research, and outreach by (1) providing superior education in the science and applications of acoustics through residence, distance, and continuing education in a professional environment that enables students to lead productive careers in



Figure 2. Jiri Tichy and Barbara Crocken.

industry, government, and academia; (2) delivering a rigorous curriculum that stresses fundamental knowledge in analytical, computational, and experimental acoustics as well as emphasizing the interdisciplinary nature of acoustics through collaboration with other academic departments across Penn State; (3) growing the core research areas of the program and diversifying the research into new and emerging technology areas; and (4) supporting the Acoustics Program's faculty and students by providing an environment conducive to professional development and maximizing opportunities for faculty and students to broaden their impact in the acoustics community.

### Leadership of the Acoustics Program

The Penn State University Bulletins from years ago clearly state who provided leadership for the Graduate Program in Acoustics. Dr. Vernon Albers was the first head of Acoustics, and then Dr. Richard Rowlands took over in 1968. John



Figure 3. Kerri Smith, Carolyn Smith, Anthony Atchley, and Karen Brooks (now Karen Shields).



Figure 4. Victor Sparrow, Karen Thal, Christine Popovich, and Daniel Russell.

Johnson became a temporary head of Acoustics (1971-1973), followed by Jiri Tichy in 1973 (Figure 2). Jiri was head of Acoustics until 1995 when Anthony Atchley (Figure 3) took over and ran the program until 2010, although he also assumed a role as an Associate Dean in the College of Engineering in 2008. Vic Sparrow (Figure 4) assumed the leadership of the program in 2010.

Critical to the mission of the Acoustics Program has been excellent staff members who closely interacted with the graduate students, beginning with Ruth Tallman in the 1960s. Barbara Crocken took over from 1980 until 1992 when Karen Brooks (now Karen Shields; see Figure 3) took the position. Carolyn Smith served as secretary for the program under both Drs. Tichy and Atchley until 2010 when Karen Thal became the primary support person. Christine (Kris) Popovich has provided support for distance education students for the last 15 years.

### Distance Education

The Acoustics Distance Education Program started in 1987, again at the request of the US Navy. It was not possible to bring faculty to multiple Navy sites and industry to provide acoustics classes, so what else could be done? Dr. Richard (Dick) Stern (the founding editor of *Acoustics Today*) and Dr. Jiri Tichy worked with Dr. Alan Stuart to set up a satellite link where acoustics courses could be broadcast from a room in the Mitchell Building on the Penn State campus (now demolished and replaced by the Smeal Business Building) that was essentially a television studio. There was a forward-facing camera and a document camera that faced down onto a large table immediately in front of the sitting instructor. The instructor could then mark on large pieces of poster board or prewritten notes with markers and pens, and this is what went out over the air. A studio producer had to appropriately switch between the view of the instructor and the notes. In 1992, satellite delivery was augmented with a system called PictureTel that could use telephone lines instead of a satellite. Beginning in 1994, the transition began to use VHS videotape. The studio was used to make a master videotape and that master was taken to the local public television station to make 20 or more copies simultaneously. Those VHS copies then could be sent via an overnight express carrier to each of the students taking the class. The satellite was discontinued in 1997 and PictureTel ended in 2003. VHS tape delivery was used for almost 12 years, until about 2006 when exclusive Internet delivery of classes became possible. Video streaming over the Internet began as early as 2002, but it took a few more years before broadband Internet connections were widely available.

An additional course delivery approach was utilized: CD-ROMs. This was for a set of specific courses for a certificate program in Noise Control Engineering. Funded through a grant from the Sloan Foundation, a series of four courses was created in the mid- to late-1990s using techniques very close to what today is called online education. No live streaming or recordings of lectures were involved. Instead, all of the course materials were packaged into lessons that students could work through on their own time at their own pace (asynchronous delivery). The project was proposed and initiated by Dr. Alan Stuart, many faculty members contributed, and the project was completed and delivered by Dr. Courtney Burroughs. The Noise Control Engineering certificate program was very successful. But technology changes quickly, and the components of the program didn't easily transition from CD-ROM to Internet delivery.

The switch to video-streaming delivery of courses brought about a number of improvements in the educational experience for both distance education and resident students. Before this, we ran essentially two programs, resident courses during the day and distance education courses during the evening. Although the instructors were the same for both sets of courses, the limitations of delivery technology made for a different learning experience for the two sets of students. The advent of streaming meant that distance education students could, if their schedules permitted, attend class in real time with the resident students. If not, they still benefitted from the questions posed by the resident students and the discussions between the instructor and the class. Resident students also benefitted from the questions posed by their distance education counterparts, most of whom were working professional acousticians and approached the course material from a more experienced perspective. Ready access to archived lectures stored on a server benefitted both sets of students.

The widespread availability of broadband Internet and digital delivery of courses also lowered the barrier of entry to accessing the curriculum. The high cost of satellite and PictureTel infrastructure limited access to students who worked for employers who could afford the investment in the technology. That barrier is largely removed now. Students can access courses from almost anywhere in the world, leading to a more diverse and enriching educational environment.

### Current Offerings

New in 2015, the Master of Science degree may be obtained through two tracks. The first track is a traditional approach where students are supported by assistantships or fellowships and work with a faculty member on a Master of Science thesis in a period of about two years. The second track is a new 1-year resident Master's program where the students take all of the 30 required course credits in one calendar year and complete a scholarly paper (considerably shorter than a thesis) toward the end of that year under the supervision of an assigned faculty member. The 1-year option was added this last year because many graduate schools across the United States are going to such 1-year programs. The 1-year options are very popular with international students and are in synchronization with the student-driven rental housing lease availability in State College.

The Master of Engineering in Acoustics degree currently is targeted at distance education students who take identical

courses to the resident students via online resources available at Penn State. The Master of Engineering in Acoustics degree is more project based and course based compared with the research-based (and resident only) Master of Science in Acoustics degree. At the time of this writing, it is still possible for resident students to earn a Master of Engineering degree while in residence, but this is being reconsidered by the faculty of the Acoustics Program.

Acoustics at Penn State is an Intercollege Graduate Degree Program (IGDP) in the Graduate School. IGDPs are formed when faculty members from two or more colleges collaborate on offering a graduate degree program, and this well describes Penn State Acoustics. Currently, the majority of the approximately 40 faculty members are from the College of Engineering and the Applied Research Laboratory, but there are other participating faculty members from the PSU Colleges of Health and Human Development, Science, and Earth and Mineral Sciences. Penn State Acoustics currently is “administratively aligned” with the Department of Aerospace Engineering and receives bookkeeping and information technology support through Aerospace. The Department Head of Aerospace Engineering is the supervisor of the Director of the Graduate Program in Acoustics, but Acoustics maintains separate courses, policies, budgets, and classroom, laboratory, and office space. The majority of the office and classroom space is provided by the Applied Research Laboratory.

The curriculum of the Acoustics Program has been under continual development from 1965 to 2015. Currently, the Graduate Program in Acoustics offers a set of required core acoustics courses offered every year and a number of specialty or elective courses that are taught every two or three years depending on student interest and the availability of financial resources and faculty time. The titles and numbers of the core courses have changed little over the last 25 years, but the content is always kept up to date (see **Table 2**).

The specialty and elective courses are all taught at least once during any 3-year period. Some are offered through the Acoustics Program and others are led by other Penn State Departments (see **Table 3**).

Additional information on these courses is available on the Acoustics Program website at [www.acs.psu.edu](http://www.acs.psu.edu).

### Recent Hiring

When Vic Sparrow was hired as interim head of the program in 2010, it became apparent that the program needed

**Table 2:** Core courses in acoustics at Penn State in 2015

ACS 501	Elements of Acoustics and Vibration (Fundamentals I)
ACS 502	Elements of Waves in Fluids (Fundamentals II)
ACS 505	Experimental Techniques in Acoustics
ACS 513	Digital Signal Processing
ACS 514	Electroacoustic Transducers
ACS 515	Acoustics in Fluid Media (continuation of ACS 502)
ACS 516	Acoustic Data Measurement and Analysis
ACS 590	Colloquium

**Table 3:** Elective courses in acoustics at Penn State in 2015 and recent years.

AE 309	Architectural Acoustics
AE 458	Advanced Architectural Acoustics and Noise Control
ACS 519	Sound-Structure Interaction
ACS/EMCH 521	Stress Waves in Solids
EMCH 523	Ultrasonic Nondestructive Evaluation
ACS 530	Flow Induced Noise
ACS 537	Noise Control Engineering
ACS/EMCH 542	Physical Principles in Biomedical Ultrasonics
ACS 597	Topics in Linear Physical Acoustics
ACS 597	Computational Acoustics
ACS 597	Outdoor Sound Propagation
ACS 597	Nonlinear Acoustics
ACS 597	Acoustics of Musical Instruments
ACS 597	Architectural Acoustics Theory and Research Methods
ACS 597	Spatial Sound and 3-D Audio
ACS 597	Ocean Acoustics
ACS 597	Marine Bioacoustics
ACS 597	Advanced Transducers and Acoustic System Modeling
AERSP 511	Aerodynamically Induced Noise

AE, Architectural Engineering; EMCH, Engineering Mechanics; AERSP, Aerospace Engineering.

more full-time faculty members as soon as possible. With the limited funding available at the time, a search was conducted for a distance education coordinator whose primary responsibilities would entail teaching acoustics courses and simultaneously running the extensive distance education program. Dr. Daniel Russell was hired and came back to Penn State in the summer of 2011 after receiving his PhD from Penn State Acoustics in 1995. He is now running the distance education program as well as teaching courses in acoustics fundamentals, noise control engineering, and the physics of musical instruments.

One “hole” in faculty expertise was also apparent around the same time, that in the technical area of architectural acoustics. None of the faculty members were actively doing research in that area. Considering how many acoustics students get jobs on graduation with acoustical consulting firms, an additional faculty member was needed. Furthermore, the Penn State Department of Architectural Engineering has two courses that are required for its graduates in the area of architectural acoustics. After the retirements of Dr. Howard Kingsbury who taught those classes years ago and of Dr. Courtney Burroughs in more recent years, a string of graduate students were brought in to teach the courses, with mixed results. Architectural Engineering approached the Acoustics Program about finding a more stable and authoritative instructor for these classes. Due to the strong need for someone to step in and teach those courses right

away, a special confluence of forces led to the hiring of Dr. Michelle Vigeant. Dr. Vigeant is a 2008 PhD graduate of the University of Nebraska under the mentorship of Penn State Acoustics alum Dr. Lily Wang.

### Snapshots of Ongoing Research

With a 50-year history of innovation and discovery, there are too many research accomplishments to list in a short article on Penn State Acoustics. This list describes a few of the 40 current faculty members and their areas of emphasis, showing the broad range of interests across the ASA’s technical committees.

Dr. Timothy Brungart of Acoustics and the Applied Research Laboratory is looking at pulsating ventilated supercavities as high-output, low-frequency underwater sound projectors. A ventilated supercavity is generated by injecting gas into the separated flow region behind a cavitator. The ventilated supercavity can become unstable and pulsate as an intense monopole source under certain conditions. An upcoming research effort will assess the feasibility of using such pulsating ventilated supercavities as high-output, low-frequency underwater sound projectors.

Dr. Steve Garrett of Acoustics is well known in the area of thermoacoustics from his research group’s work building acoustic refrigerators and freezers without ozone-depleting chlorofluorocarbons (CFCs) or their hydrofluorocarbon (HFC) replacements, both of which are powerful global warming gasses. Motivated by the loss of sensor signals during the Fukushima disaster, his group’s recent research has been focused on using thermoacoustic standing-wave engines as self-powered, acoustically telemetered sensors in nuclear reactors, work sponsored by the Idaho National Laboratory and Westinghouse. Using the heat from fission or gamma absorption, it will be possible to know the coolant temperature from the frequency of the sound and the energetic particle flux from the sound amplitude.

Dr. Amanda Hanford of Acoustics and the Applied Research Laboratory is performing work on computational methods in acoustics with applications in particle methods such as the direct simulation Monte Carlo, outdoor sound propagation, and nonlinear propagation using compressible Navier Stokes solvers. Additional recent work involves simulating the multiscale acoustic structure interaction in acoustic metamaterials.

Dr. Michael Krane of Acoustics and the Applied Research Laboratory is involved in research in fluid structure inter-

action, focusing on the human voice as an aeroacoustic-aeroelastic problem. Using both computer simulations and model experiments, voice aeroacoustics is studied, both for characterizing the energy flow in vocal fold vibration and for defining energy efficiencies for clinical use.

Dr. Clifford Lissenden is with Acoustics and the Department of Engineering Science and Mechanics, and his research program in guided wave ultrasonics for structural health monitoring (SHM) and nondestructive inspection (NDI) has applications to pipelines, vessels, aircraft, machinery, and bridges. His group is looking at multisensor and robotic systems for dry storage casks as well as using nonlinear ultrasonic guided waves for early damage detection.

Dr. Jennifer Miksis-Olds of Acoustics and the Applied Research Laboratory uses acoustics to study biology in the ocean. Some of the projects she has been directly involved with include a Bearing Sea ecosystem study, a global ocean noise study, and a large-scale density estimation of blue and fin whales. She also serves as a technical advisor to the Exploration & Production (E&P) Sound and Marine Life Joint Industry Program. Some of the issues being addressed are climate change, how animals are impacted by humans, how animals communicate and live in their natural environment, and how acoustics is used to study the marine life.

Dr. Karl Reichard of Acoustics and the Applied Research Laboratory has been working on problems related to prognostic health management for machinery, embedded sensing and processing systems, and acoustic applications in robotics and unmanned systems. Dr. Reichard’s group has been active in developing sensing techniques and prognostic algorithms that can detect early indicators of machine damage and predict the remaining useful life of machines. In the robotics area, Dr. Reichard’s group has been focused on improved sensing for navigation and improving operator situational awareness.

Dr. Daniel Russell of Acoustics is well known nationally and internationally for his development of animations and other teaching tools for acoustics education. His website has won many awards and can be seen at <http://www.acs.psu.edu/drussell/demos.html>. Dr. Russell also has a strong research interest in the vibration and modal response of sports equipment. How a baseball bat, golf club, hockey stick, or tennis racket feels and sounds is a very important part of the sports experience, and Dr. Russell is looking at ways of improving performance and safety for all players.

Dr. Vic Sparrow of Acoustics has a broad range of research interests including acoustics education, history, physical acoustics, and computational acoustics. In the last few years, he has primarily been working on problems related to aircraft noise for both current subsonic and future supersonic aircraft. His recent contributions have focused on aircraft flight path optimization to minimize noise on the ground, accounting for meteorological conditions in outdoor sound calculations, and quantifying the sonic booms of low-boom supersonic aircraft, how they are heard in and around homes and how they might be characterized in an aircraft certification procedure.

Dr. Michelle Vigeant of Acoustics and the Department of Architectural Engineering studies sound perception with a strong emphasis on room acoustics. One major project underway is to understand overall room impression and listener envelopment, which is being accomplished via subjective studies being conducted in a new multichannel auralization facility. The stimuli consist of reproductions of both simulated and measured impulse responses of various venues. Another major project is to understand the emotional response to acoustic stimuli, which is being evaluated objectively using the functional magnetic resonance imaging (fMRI) facilities on the Penn State campus.

Dr. Steve Thompson of Acoustics has been working on a low-frequency SONAR projector based on the design of a musical instrument, the clarinet, underwater. Recent experimental results have shown that the new underwater sound source “plays” as it should. In shallow water, the “instrument” may cavitate near the metal reed, but the proper design can reduce this tendency to cavitate. This new sound source produces a reasonably stable waveform. The effort is funded by the Office of Naval Research.

These are just snapshots of some of the ongoing work. Additional descriptions and projects can be found at the website for the Penn State Center for Acoustics and Vibration ([www.cav.psu.edu](http://www.cav.psu.edu)).

### Accomplishments of Graduates

An important bellwether for any educational institution is its graduates. Penn State Acoustics has been very fortunate in that a number of its over 600 graduates have made their mark in the broad acoustics community. A sampling of a few of the graduates and their areas and accomplishments include



Figure 5. Graduate Program in Acoustics 50th Anniversary Reception and Dinner, Pittsburgh, PA, May 20, 2015.

- Megan Ballard, PhD 2009: underwater acoustics and currently Chair of the ASA Committee on Underwater Acoustics;
- Gary Elko, PhD 1984: transducers and signal processing, formerly with Bell Laboratories and currently president of Mh Acoustics, and recipient of the ASA Silver Medal in Engineering Acoustics;
- Mark Hamilton, PhD 1983: nonlinear acoustics and medical acoustics at the University of Texas at Austin, former ASA President, and recipient of the Rayleigh-Helmholtz Interdisciplinary Silver Medal in Physical Acoustics, Biomedical Acoustics, and Engineering Acoustics;
- Ed Liszka, MS 1986: Director of the Penn State Applied Research Laboratory, retired;
- Scott Porter, PhD 2011: transducers, one of the developers of the audio system for the iPhone 5 and later iPhones, Apple;
- Scott Sommerfeldt, PhD 1989: noise and active control, Dean of the College of Mathematical and Physical Sciences at Brigham Young University, recent member of the ASA Executive Council;
- Peter Stephanishen, PhD 1969: transient vibration and acoustic radiation, retired, and recipient of the ASA Trent-Crede Medal;
- Lily Wang, PhD 1999: architectural acoustics, and currently ASA Vice President, University of Nebraska, and recipient of the ASA's R. Bruce Lindsay Award;
- Earl Williams, PhD 1979: Naval Research Laboratory, retired, and author of the book *Fourier Acoustics* (Academic Press, 1989); and
- D. Keith Wilson, PhD 1992: outdoor sound propagation, US Army Engineer Research and Development Center, and recipient of the ASA's R. Bruce Lindsay Award.

Many of the alumni of the Graduate Program in Acoustics gathered for a special 50th Anniversary Reception and Dinner that was held in Pittsburgh, PA, on May 20, 2015 in conjunction with the Acoustical Society's 169th meeting (Figure 5). The speakers at the Reception and Dinner included the authors and several of the alumni just mentioned.

### The Future

What is next for the Graduate Program in Acoustics? In future years, the program needs to hire expert faculty in the areas of medical ultrasound and transducers. Medical ultrasound is clearly an important area of interest for both the faculty and students, and transducers will always be important in acoustics, linking the electrical and mechanical domains. There are always new technologies and new innovations that make acoustics an exciting, interdisciplinary, and ever-changing area. The Graduate Program in Acoustics at Penn State has had tremendous success over the last 50 years, and it looks forward to continuing as a national leader in acoustics education, research, and service.

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### Biosketches



**Vic Sparrow** has been a faculty member at Penn State since 1990. He has provided leadership for the Acoustics Program since 2010. He served as a US Research Focal Point for the International Civil Aviation Organization (ICAO) Committee on Aviation Environmental Protection's Noise Working Group since 2005. His usual duties include research and teaching graduate-level courses such as The Acoustics of Fluid Media, Nonlinear Acoustics, Computational Acoustics, Spatial Sound and 3D Audio, and Outdoor Sound Propagation. He served the Society as a member of the Executive Council and as Vice President, is an ASA Fellow, and currently chairs the ASA Committee on Archives and History.



**Jiri Tichy** is Professor Emeritus of Acoustics at the Pennsylvania State University. His interest and teaching is in architectural acoustics, active noise control, theoretical acoustics and intensity technique. For 25 years, he was chairman of the Graduate Program in

Acoustics at Penn State. He is a Fellow of the Acoustical Society of America. Also, he served as cochairman, chairman, and member of many committees and was awarded the Gold Medal for his service to the Society. He was also President of the Institute of the Noise Control Engineering Society. Under his leadership, the first joint conference with the European Acoustical Association was organized in Berlin, Germany, so that personal contacts of the two worlds were initiated.



**Anthony Atchley** is Professor of Acoustics and Senior Associate Dean in Penn State's College of Engineering. He is a Fellow and Past President of the ASA and a recipient of the R. Bruce Lindsay Award. Dr. Atchley earned a PhD in Physics from the University of Mississippi and pursued postdoctoral research at

Yale University, supported by an ASA F. V. Hunt Postdoctoral Research Fellowship. He has conducted research in shock formation in very high amplitude noise, measurements of noise from commercial aircraft and sub- and supersonic military jets, acoustic propagation modeling, optical imaging of sound fields, ultrasonics, oscillatory boundary layer processes, and acoustic heat transport.



**Sabih I. Hayek** is Distinguished Professor Emeritus of Engineering Mechanics, Department of Engineering Science and Mechanics, Penn State University, University Park, PA. He is a Fellow of the ASA and American Society of Mechanical Engineers (ASME) and a recipient of the Trent-Crede Silver Medal. He is a member of the Technical Committee on Structural Acoustics and Vibration.