Conversation with a Colleague: Andy Piacsek

Andrew Piacsek
Conversation with a Colleague Editor: Micheal L. Dent

Meet Andrew Piacsek

Andrew (Andy) Piacsek is the next acoustician in our "Sound Perspectives" series "Conversation with a Colleague." Andy is a professor of physics at Central Washington University (CWU), Ellensburg, having completed his BA in physics at Johns Hopkins University, Baltimore, Maryland, and a MA and PhD in acoustics at The Pennsylvania State University, State College. Andy is a Fellow of the Acoustical Society of America (ASA) and has served numerous roles in the Society over the years, including chairing the Committee on Public Relations, the Virtual Technology Task Force, and the Technical Committee on Musical Acoustics. We asked Andy to give us his elevator pitch and then to elaborate on his inspirations, contributions, and hopes for the future.

Give your "elevator speech" about the thrust(s) of your scholarly work over your career.

My career has been a fusion of undergraduate physics education, acoustics research, and fostering public understanding of science. The focus of my research has evolved and diversified over three decades, driven by the interests and constraints of the undergraduate physics students who work in my laboratory.

My early career was centered on modeling the propagation of sonic booms and other weak shock waves, but when our department moved to a new building with a bespoke acoustics laboratory, including an anechoic chamber and a laser-scanning vibrometer, I shifted my focus to experimental projects, particularly in architectural, structural, and musical acoustics.

In one set of studies, I have been working with students to explore the possibility of noninvasively monitoring changes in intracranial pressure by measuring skull resonances. In other studies, we are developing tools for quantifying uncertainty in the violin frequency-response measurements and investigating the popular belief that new violins improve their sound after being played for some time.

In fact, I find that there is a fruitful synergy between what I learn in the laboratory and what I teach in the classroom. My research background helped me create new courses at CWU in the areas of acoustics and computational physics, which, in turn, have attracted students who bring new ideas to my laboratory and motivate me to expand the tools I use in my research. Underlying both my classroom teaching and mentoring of student research is the goal of fostering the habits of scientific inquiry, with which students are comfortable applying broad physical concepts to specific problems using mathematics, analyzing data, and asking questions.

What inspired you to work in this area of scholarship?

There are three people who exerted a strong influence on the direction of my career. The first was Bill Kuperman at the Naval Research Laboratory in Washington, DC, who arranged for me to work for a year in his group after I graduated from college, uncertain about what to do with my physics degree. I spent that year mainly writing code to graphically display the results of underwater sound propagation models but also sitting in on many animated discussions of acoustics between Bill and his colleagues and attending my first ASA meeting. This experience

https://doi.org/10.1121/AT.2023.19.4.56

fostered an appreciation for acoustics as a diverse and fascinating area of applied physics, so I pored over the ASA guide to graduate schools and successfully applied to the program at Penn State.

As I was wrapping up a master's thesis involving cavitation noise, I asked Allan Pierce if he would take me on as a PhD student. Not only did Allan lead me into the fascinating world of sonic booms and nonlinear acoustics, but he also taught me how to approach problems with rigor and persistence, in other words, to think like a scientist. By coincidence, the computer program I wrote for my doctoral dissertation was based on a theoretical approach developed by Bill Kuperman and Ed McDonald, who also provided the connection to my third important mentor, John White.

John hired me as a postdoc at the Lawrence Livermore National Laboratory in Livermore, California, to model the underwater propagation of weak shock waves arising from clandestine nuclear tests. John was an expert in shock physics, but he was also passionate about science education, and he was developing a course called Physics Appreciation that he taught at San Jose State University in nearby San Jose, California. John recruited me to review the textbook he was writing for the class and this spurred my interest in the philosophy of science and how scientific thinking should be a skill that is taught to everyone, not just scientists. I am also grateful to John for indulging my passion for cycling while I worked for him; we learned to avoid scheduling morning meetings because I was often late when I rode to work, which involved going over a sizable mountain pass between my apartment in Tracy, California, and Livermore.

Of all your contributions during your career, which are you most proud of and why?

This is a difficult question for me because my professional work has multiple components that are all important to me. My compromise would be to highlight one contribution from each of the three areas I mentioned in the "elevator speech": research, teaching, and public outreach.

A brief summary of my rather nonlinear academic career will provide some context. In 1994, as I was finishing my doctoral dissertation, I followed my then fiancée, Lisa Ely, to CWU, where she had been hired as an assistant professor in the Geology Department. A year later, I left for Livermore to start my postdoc. Shortly after Lisa and I married in 1996, I was hired as a lecturer, with full-time teaching responsibilities in the Physics Department at CWU (see cwu.edu/physics). I held that position for 10 years, during which time I took on a variety of administrative roles, such as supervising a National Science Foundation (NSF)-funded Science Honors Program that supported undergraduate research. In 2007, I was hired to a tenure-track position, which enabled me to devote more time to doing research. However, when I became Department Chair six years later, the bulk of my responsibilities were again outside the laboratory. The latest chapter of my career began when I completed my term as Chair and initiated a variety of research projects utilizing the facilities in our new building.

My ongoing research projects in musical, structural, and architectural acoustics are very exciting and may end up being quite impactful down the road, but I take great pride in my early and midcareer work on focusing sonic booms. When I began this work as a PhD student in 1990, there were competing hypotheses to explain how atmospheric turbulence produced the observed variability in sonic boom signatures recorded on the ground. I created a numerical model, based on McDonald and Kuperman's time-domain formulation of the parabolic equation (known as the NPE), to test Pierce's idea that turbulence led to focusing and defocusing of sonic boom wave fronts and that focusing could produce "folded" wave fronts with multiple peaks. My simulations showed that mesoscale turbulence can lead to alternating regions of rounded and spiky (folded) wave fronts, qualitatively like observed sonic boom signatures. I also identified and explored the parameter space of nonlinearity and diffraction that determines whether a focusing weak shock folds or straightens out.

This work led to an invitation to participate in a NASA-funded project, the Superboom Caustic Analysis and Measurement Program (see ntrs.nasa.gov/citations/20150019419), to evaluate the capability of models to predict the detailed signature of sonic booms that focus near the ground, becoming extra loud due to the acceleration or other maneuvers of supersonic aircraft. This was part of NASA's ongoing effort to develop and evaluate commercial supersonic aircraft designs that produce "quiet" sonic booms. Working with sonic boom expert Ken Plotkin (who passed away in 2015) to adapt my code to the particular geometry and physics of this problem was one of the intellectual highlights of my career.

In the field of physics education, I am most proud of a course that I developed, called Physics of Musical Sound, and that I have been continuously refining. This is a General Education course that satisfies a science requirement for students in non-STEM majors. Beyond getting students to recognize the essential features of sound and vibration, to use simple tools to analyze sound, to appreciate the mathematical basis of musical scales, and to describe the rudiments of speech and hearing mechanisms, I see the class as a vehicle for teaching powerful physical concepts, such as the conservation of energy, instilling an appreciation for the usefulness of math, and developing habits of scientific inquiry. These are lofty goals (and I often don't succeed in all of them), but I leverage the students' natural curiosity about sound and music to get them to do something that doesn't come naturally to most people: think quantitatively. Over the 25 years of teaching this course, I have developed a variety of pedagogical tools and strategies, which I've shared at ASA meetings; likewise, I have utilized ideas picked up at those meetings to improve my teaching.

My path in following in John White's footsteps to spread "science appreciation" far and wide has taken me in multiple directions, from teaching interdisciplinary courses on pseudoscience and conspiracy theories to giving public lectures about the applications of acoustics and how science works. But I am proudest of the work I have done serving on the ASA Public Relations Committee (PRC), which I chaired from 2009 to 2018. With the committee's support, and the involvement of Student Council, I began a tradition of organizing interdisciplinary special sessions aimed at helping ASA members improve their media relations skills. Offered every two or three years, these sessions typically include a mix of media professionals sharing tried and true strategies for effectively communicating science to the public and ASA members sharing their own experiences (positive and negative).

More recently, under the leadership of PRC chairs who have followed me, these sessions have evolved into media training workshops that provide interactive activities in which participants practice specific skills and strategies for describing their scientific work to a journalist. The value of this work is the increase in science literacy among the public that comes from broadening the number of researchers and practitioners who are comfortable telling the stories of what they've learned, how they learned it, and why it's important. This kind of communication is essential for fostering public trust in science and scientists, which is increasingly at risk.

What are some of the other areas in which you feel you made substantive contributions over your career?

I was chair of the Physics Department at CWU during a crucial period in which the number of students and faculty positions doubled. The groundwork for this "inflationary period" of our department had been laid by my predecessor, but it fell on me to manage it, most importantly by overseeing the hiring of five new tenure-track faculty (as well as several interim lecturers to tide us through the enrollment jump). As many readers will likely know, the process of hiring new faculty is fraught with difficult choices. This is especially true in a small department where collegiality is prized; we were looking not just for talented educators and researchers, but future colleagues with whom we could work collaboratively for decades. I am very proud, then, of the incredible group of young faculty that we recruited and brought on board, three of whom are women. They have collectively transformed the department, as I had hoped, bringing not just new expertise but also a new attitude and a different kind of energy. It is no coincidence that the camaraderie and work ethic displayed by the faculty is also evident among the physics students. As the horizon of my career approaches (still distant, but now visible), I am grateful that the department I helped to shape is thriving and poised to become even better.

What do you think are the most pressing open questions that you would like to focus on over the next 5-10 years?

As an educator, a scientist, and a citizen, the most pressing question for me is how to make a significant impact on public scientific literacy. This is not just about improving standardized test scores or ensuring that everyone graduates high school with an understanding of Newton's laws, redox reactions, and the Krebs cycle, but actually demystifying the process of science for the vast majority of people who are not professional scientists. I am convinced that a lack of understanding of what science is and how it is done underlies the susceptibility of the public to letting a political or cultural affiliation override their trust in science; as the Covid epidemic showed, the consequences of this lack of trust can be dire. One of my goals for the next few years is to develop high-school level educational materials centered on musical acoustics that will not only improve students' quantitative and reasoning skills but will also help them default to using those skills when confronted with new information or unfamiliar problems. The goal is to reach students who might otherwise avoid science and math classes by leveraging their natural curiosity and interest in music and sound.

Bibliography

Page, J., Plotkin, K., Salamone, J., Piacsek, A., Sparrow, V., Elmer, K., Cowart, R., and Maglieri, D. (2015). *Superboom Caustic Analysis and Measurement Program (SCAMP) Final Report*. Report No. NASA/CR-2015-218871, National Aeronautics and Space Administration, Washington, DC.

Piacsek, A. (2002). Atmospheric turbulence conditions leading to focused and folded sonic boom wave fronts. *The Journal of the Acoustical Society of America* 111, 520-529.

Piacsek, A. (2020). Communicating your research to journalists (and your relatives). *Acoustics Today* 16(3), 80-83.

Piacsek, A., Taylor, R., and Abdul-Wahid, S. (2012). Resonance frequencies of a spherical aluminum shell subject to static internal pressure. *The Journal of the Acoustical Society of America* 131(6), EL506-EL511.

Rajendran, V., Piacsek, A., and Mendez, T. (2022). Design of broadband Helmholtz resonator arrays using the radiation impedance method. *The Journal of the Acoustical Society of America* 151, 457-466. https://doi.org/10.1121/10.0009317.

Contact Information

Andrew A. Piacsek andy.piacsek@cwu.edu

Department of Physics
Central Washington University
Ellensburg, Washington 98926-7422, USA