

Ask an Acoustician: Subha Maruvada

Subha Maruvada and Micheal L. Dent

Meet Subha Maruvada

In this issue, “Ask an Acoustician” features Subha Maruvada. Dr. Maruvada is the lead for the Therapeutic Ultrasound Program in the Division of Applied Mechanics, which is a part of the Office of Science and Engineering Laboratories of the US Food and Drug Administration (FDA). Dr. Maruvada is active in both scientific and standards organizations. She serves as working group convener, primary liaison, and technical expert on several working groups within the International Electrotechnical Commission (IEC) Technical Committee (TC) 87, Ultrasonics, and led the development of an international standard for the field specifications and methods of measurements for low-frequency ultrasound physiotherapy devices within the IEC/TC 87. Dr. Maruvada led the completion of an FDA guidance document establishing guidelines to report ultrasound physiotherapy device characterization in support of safety evaluation of medical devices. Until this May, she was the chair of the Biomedical Ultrasound Technical Committee of the Acoustical Society of America.

A Conversation with Subha Maruvada, in Her Words

Tell us about your work.

I work in the Office of Science and Engineering Laboratories, Center for Devices and Radiological Health, FDA, as an ultrasound engineer who primarily does research on developing acoustic metrology (scientific study of measurement) for therapeutic medical ultrasound devices. My focus is to develop preclinical testing methods for ultrasound devices that will help in our regulatory review of these devices. Developing standardized testing methods helps both the FDA and manufacturers to efficiently evaluate and ensure device safety and efficacy. For medical ultrasound devices, acoustic output characterization that includes understanding the acoustic field that will



eventually be transmitted into a patient is critical. I primarily develop methods to measure acoustic power and the pressure field and use tissue-mimicking material to further develop test beds that can be used to measure temperature rise due to therapeutic ultrasound.

With a background in electrical and acoustical engineering and in acoustics, I have worked in the area of acoustics measurements and modeling for over 20 years. My current areas of research are preclinical characterization of high-intensity therapeutic ultrasound (HITU) devices, characterization of tissue-mimicking materials for HITU applications, HITU-induced bioeffects, and comparison of acoustics measurements to modeling results. Some of my specific studies are (1) to evaluate and improve existing techniques for characterizing the acoustic fields produced by these devices, including radiation force, piezoelectric hydrophone, thermal, and acousto-optic techniques; (2) to evaluate computational models for mapping the temperature fields associated with high-intensity forced ultrasound (HIFU); and (3) to perform experimental investigations comparing the modeled temperature patterns with lesions produced in tissue mimicking materials and tissue samples. I am active in providing physics and engineering consults to the FDA regulatory staff for HITU, lithotripsy, physiotherapy, and diagnostic ultrasound devices.

Describe your career path.

Growing up, I was convinced I would become a jockey. I loved horses, and all I wanted was to be around them

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as much as possible. When I reached 5 feet 1 inch in height, my dad informed me that I was now too tall to be a jockey. I then thought I would be a veterinarian because I loved animals and wanted to be around them as much as possible. I had the opportunity to spend the day with a veterinarian and decided that I would have pets but not be their doctor as the idea of putting an animal down at the end of its life (I was 17) was unappealing. Loving high-school math and physics and not loving biology led me to electrical engineering at the Pennsylvania State University (University Park). I am a Penn Stater through and through. I did my bachelor's and master's in electrical engineering (EE) and finally a PhD in acoustics there. I enjoyed EE but realized that I wanted a career doing something medically related without becoming a doctor. A friend and mentor directed me to the Graduate Program in Acoustics, and when I looked into the program and professors, I found that I could do my degree in acoustics and specialize in medical ultrasound. Some of the influential mentors who helped shaped my path were my MS and PhD thesis advisors, Russell Philbrick and Kirk Shung, as well as many acoustics professors including Anthony Atchley and Doug Mast. I can't praise the Acoustics Program at Penn State enough. The professors all love acoustics and really motivate students to appreciate not just the science and math but the amazing breadth and importance of the field. The subject of my PhD dissertation was measuring the backscatter of biological tissues at high frequencies (>10 MHz). I then did a postdoctoral fellowship at Brigham & Women's Hospital/Harvard Medical School (Boston, MA) in the Radiology Department. My postdoctoral supervisor was Kullervo Hynynen, who was also an influential mentor who helped me forge my career path to the FDA. The subject of my postdoctoral work was investigating HIFU-induced bioeffects in biological media. I injected glass catfish (they are small fish with nearly transparent bodies and a visible vascular structure) with ultrasound microbubbles and monitored vessel destruction at HIFU output levels. After my postdoc, I joined the FDA and have been there since.

What is a typical day for you?

A typical day involves some administrative work (emails and such), either lab work or data processing, and some regulatory consult work. I usually start my day around 8 a.m. and earlier if I'm doing experiments. Over time, I've tried to become better about keeping my workday

organized and have found that a day planner really helps. I try to document what I do during the day, and I find that it really helps me manage my time more efficiently.

How do you feel when experiments/projects do not work out the way you expected them to?

That depends on whether the outcome was positive or not. If positive, it's delightful because that means the work turned out better than expected. Otherwise, disappointed, but then I try to figure out a better way to tackle the problem. There's always another way to approach a problem. The solution can be either to improve the experimental setup (which is often the case) or to reevaluate my current methodology. Sometimes it is as simple as changing the material used to hold an absorbing target that will allow for more stability during experiments. It always helps to talk to colleagues about a problem. Many problems are identified when talking things through with another person. This is as true in personal life as it is in professional life. Asking for help sometimes is the answer.

Do you feel like you have solved the work-life balance problem? Was it always this way?

I have studied a style of Indian classical dance called Kuchipudi since I was a child. I continued dancing as an adult in a semiprofessional capacity, performing solo and with my teacher's dance troupe in the United States, India, and Canada. I now run a dance school and teach mostly on weekends but some weekday evenings as well. I do sometimes think that I work all the time, but honestly, I love both my day job and side hustle so much that I can't imagine my life any other way. However, even when you love what you do, you still need to take care of yourself. I think I do that better now by checking in with myself every day rather than just autopilot through all the things I have to do. I take breaks when I need and am better at maintaining a reasonable schedule of work time, dance time, and me time.

What makes you a good acoustician?

I hope I'm a good acoustician. I certainly strive to be a good acoustician and researcher. I love acoustics. I'm in awe of how much acoustics encompasses. I respect the field and the people who work in this area. I feel like I still have so much to learn and enjoy doing that. I love finding acoustics in things other than my work. I enjoy Indian classical dance, yoga, Sanskrit, and meditation, and there

is acoustics to be found in each of these interests. I've been learning to read and write Sanskrit in preparation for studying the language in depth. I would like to be able to read the ancient Indian texts such as the Vedas and original yoga texts. So much of yoga and meditation uses sound healing as part of the practice. Ancient Indian texts acknowledge the importance of acoustics. For example, Sanskrit is a vibrational language in that the way you pronounce a word is of utmost importance in conveying its meaning. Also, the alphabet order comes from how the sounds are formed in the vocal tract, from back to front. I'm fascinated by how ancient cultures understood acoustics and would love to study that more.

How do you handle rejection?

I try to figure out why the rejection was good for me: what did I need to learn and how do I need to improve? It may take some time to get over the initial hurt, but then it is truly a great learning experience. In the past, I have interviewed poorly. I realized that just because I knew what was needed for the position, I may not have communicated that properly or may not have completely understood what was expected of me. What helped me was taking classes on communication, finding my natural talents, and understanding where I needed to improve professionally. Most workplaces have good professional development support. I think that continuous training in professional development is necessary to enjoy your career.

What are you proudest of in your career?

What drove me to be an acoustician was the desire to do something medically related without becoming a physician. I wasn't crazy about biology but wanted to be in a healing profession. I loved *Star Trek*, especially when I was younger, and the idea that you could run a small device over a body and immediately know what was wrong was magical and inspiring to me. Ultrasound is that magic. It's amazing how many applications ultrasound is used for, both diagnostically and therapeutically. A career in ultrasound within the Department of Health and Human Services has allowed me to fulfill that desire and so much more. I'm proud that I work toward promoting and protecting public health.

What is the biggest mistake you've ever made?

I don't think I've made serious mistakes, but I do regret times during my career when I have let myself feel stag-

nant. I feel like I wasted time by not finding ways to be more motivated. Once I realized that it was a fear of failure or a lack of confidence that was hindering me, I started to look for training opportunities to help me develop further my skills in leadership, writing, and communicating more effectively, to name a few.

What advice do you have for budding acousticians?

Do what you love. It's not a cliché. Take some time to find the right advisor and the right educational program. There are so many great options for both mentors and acoustics programs. Come to meetings of the Acoustical Society of America (ASA) and talk to people. The ASA is a wonderful organization for budding acousticians because many professionals there started coming to the ASA as students or young professionals themselves and truly understand what budding acousticians need and how to help them.

Have you ever experienced imposter syndrome? How did you deal with that if so?

I've experienced a lack of confidence that has made me feel like an imposter. There have been a few times during my academic and professional career when I have let underconfidence get in the way of my professional development. What I have done to overcome those moments or times was to either work harder or find techniques to help, from meditation to professional development classes.

What do you want to accomplish within the next 10 years or before retirement?

I want to inspire as many budding acousticians as I can. At the FDA, we try to create opportunities in ultrasound research for student fellows and volunteers. I also want to share my love of acoustics with my dance students. They are mostly girls, and I love engaging with them about their future career aspirations. I want to continue to learn and apply that knowledge in the field of medical ultrasound and public health. I would also like to continue studying acoustics in other areas of my life such as the study of Sanskrit and meditation.

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