fellow SPOTLIGHT:

PETER A. LEWIN, MSC, PHD

Fellow since 2019

By Jon Goff, Director of Development

Tell us a bit about your education and career, including your current position at Drexel.

I was always attracted to learning about things that were not obvious, which ultimately got me interested in a variety of sensors or transducers—relatively small devices that could measure physical properties of nature by converting physical signals, such as sound, into electrical ones that could be quantified and visualized (on screens, for example). This interest in sensors and transducers led me to study Electrical Engineering (EE) and to realize that any progress in the development of portable or wearable sensors required a combination of knowledge from many areas other than just electronics. My M.Sc. degree in EE landed me a job in the sound and vibration industry and taught me the importance of careful product development, interpersonal skills, and rigorous time management. Ten years later, all these skills proved to be of immense value when I decided to move from industry to academia and to enhance my electrical engineering background with mechanics, material science, chemistry, physiology, and the interaction of live tissue with ultrasound. Combined with a few crash courses in physiology and biology (especially cell and molecular cell biology) this

background turned out to be very helpful when I got involved in the development of early ultrasound imaging systems and discovered the unmet need for ultrasound metrology. My early post-doctoral research was focused on the development of high quality, calibrated acousto-optic and piezoelectric sensors that paved the way for International Safety Standards adapted by the Food and Drug Administration (biomedical instrumentation cannot be used without FDA approval).

At present, as the R.B. Beard Distinguished University Professor of Electrical, Computer and Biomedical Engineering at Drexel University in Philadelphia, I am leading the Ultrasound Research and Education Center in The School of Bioengineering, Bioscience and Health Systems. My current interests are primarily in the field of biomedical ultrasonics, including the design and testing of piezoelectric transducers and sensors, power ultrasonics for tissue therapy, ultrasonic exposimetry, tissue characterization using nonlinear acoustics, biological effects of ultrasound, applications of shock waves in medicine, and image reconstruction and processing. My current Ph.D. students are all involved in NIH-sponsored research of ultrasonically-assisted chronic wound healing, the details of which are featured on the NIH website.

In addition to my teaching and research duties, I serve as Editor-in-Chief of the journal *IEEE Transactions on Ultrasonics, Ferroelectrics and Frequency Control*. I was also elected as a resource member of the Franklin Institute Science and Awards Committee, and most recently I was tapped by the Secretary of Health to serve on the NIH Advisory Council.

What interested you about becoming a Fellow of the College?

I was and am impressed by the mission of the College and its contributions to the betterment of healthcare through the advancement of medical science, as well as its well-thought out and implemented community outreach.

I always look for opportunities to broaden my horizons and learn something new. I also believe that there is a need for a constructive exchange of ideas and cross-fertilization between different communities of professionals. As a scholar and engineer I realize that without input from the individuals who have direct contact with patients, medical technology contributions designed purely by engineering teams are optimized neither for clinical applications, nor for desirable personalized treatment applications. Conversely, such goals cannot be achieved by physicians alone—my personal experience has taught me that the advancement of public health is a complicated, multifaceted task that necessitates close collaboration of medical doctors, engineers, nurses and, yes, liberal arts-trained individuals. Becoming a Fellow of the College offered an opportunity to meet kindred souls who are also interested in addressing all of these issues.

Apart from that, I visited the Museum quite a few times in the past and liked the exhibits, the friendly and knowledgeable staff, and the exquisite site. I am also impressed by the outreach programs and have occasionally attended lectures organized by the Medical History, the Medicine and the Arts, and the Public Health and Preventive Medicine sections.

At what point in your career did you begin to focus on the biomedical applications of electrical engineering? How have the healing properties of technologies like ultrasound caused you to look at your field differently?

That clearly crystalized during my Ph.D. research. As mentioned earlier, the quantitative measurements of ultrasound field parameters—such as pressure amplitude, its frequency, rate of delivery, and spatial distribution of the wave traveling through the medium (tissue)—were not only critical to manufacturers for obtaining FDA approval to sell their machines, but also to the then-budding industry of therapeutic applications of ultrasound. The realization of the potential role that ultrasound might play as a therapeutic tool led immediately to the question about the mechanism of action and whether this mechanism was dependent on the specific values of the acoustic field parameters. Raising this question identified the need for the development of calibrated ultrasound metrology sensors.

The next eye-opening finding was the realization that only a very few published papers were able to link the quantified value of ultrasound stimulus with a biological end-point outcome. Further research indicated that the topic of healing properties of ultrasound is promising but requires a truly holistic approach. As elaborated below, our diversified research team has developed such a holistic—dubbed

theranostic—approach for chronic wound healing. Briefly, the ultrasound applicator acts as a (**thera**peutic) source of healing energy and the progress of healing is constantly monitored by the optic (diag**nostic**) probe. This approach permits the attending physician to nimbly change the standard care, if needed.

Can you talk a bit about your current research into chronic wound therapy.

My current research is sponsored by a National Institute of Health/National Institute of Nursing Research grant, and our carefully assembled interdisciplinary team, including engineering, medical, nursing, and statistical expertise, is conducting the first random, double-blind clinical trial. The aim of the trial is to verify the results of our earlier limited clinical pilot study, which indicated that our ultrasound applicator can significantly accelerate healing of chronic wounds, such as venous and diabetic ulcers. I realize that the natural follow-up question is, "OK, so how does it work?" This question is the focus of our current research efforts. Our studies to identify the possible mechanism(s) of action strengthened my conviction that such important clinical research—with the goal of improving quality of life for underprivileged patients—requires the involvement of a truly interdisciplinary team. Without such a team and the cross-pollination of ideas, I do not think that launching this project would have been possible. I would like to give explicit credit to my co-investigators Dr. Rose Ann DiMaria-Ghalili (College of Nursing, Drexel U.), Michael S. Weingarten, M.D. (College of Medicine, Drexel U.), Dr. Michael Neidrauer (School of Biomed, Drexel U.), Dr. Leonid Zubkov (School of Biomed, Drexel U.), and Dr. David Margolis (College of Medicine, U. Penn,). In this context, it is also worth noting that this clinical study has strong potential to contribute to personalized healthcare by enhancing the efficacy of wound management. The holistic approach devised by our team is helping in the identification of social, biological, and environmental parameters that can be adjusted or altered to optimize wound healing and/or health-related quality of life (HRQOL) for treated patients.

Tell us about one of your favorite items in the College Library or the Mütter Museum.

That is a hard question—there are probably a few favorite items. First of all, I was impressed with the depth of the introduction provided by Beth Lander, College Librarian, who clearly reveres the Collection. It was fascinating to learn that I had the privilege of visiting one of the world's preeminent and oldest library research collections in the history of medicine. Being able to glance inside such rare books as **William Harvey's *De motu cordis*** published (incredibly!) in 1628 describing the circulation of the blood, and one written even earlier, in 1543, by the then 29 year-old Andreas Vesalius on human anatomy was enthralling. But I have to admit that I was also thrilled by the 19th century volumes bound in human skin (perhaps a possible inspiration for a scary, Friday the 13th–type movie script?).

Other indelible memories...? Hmm, perhaps the collection of human toenails? Well, that one is definitely not for the faint of heart or the squeamish, so I'd better stop there. ■