Volume 30 Issue 3: 2021 **Fall 2021**

ultrasonic industry association UIA powering sound ideas

Vibrations

Powering Sound Ideas

Fundamentals of Langevin Transducer Design – A Tribute to George Bromfield: Virtual Collaborations - November 18

The fifth UIA **Virtual Collaboration** will be held on Thursday, 18 November 2021 at 10 am EST / 3 pm GMT.

Featuring Tony Crandall and Jeff Vaitekunas

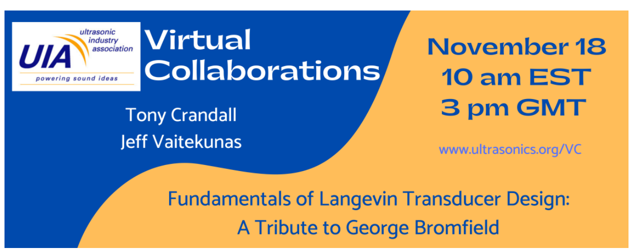
Among George Bromfield's many other accomplishments and contributions, he was a master of design of ultrasonic transducers. This collaboration will focus on the design fundamentals of Langevin-type transducers, and the use of PiezoTran modeling software to quickly and accurately iterate to a design. Many "tricks of the trade" that George taught will be discussed, with particular reference to the use of PiezoTran as well as more general knowledge that George has passed on to all of us to continue his legacy.

Participant interaction and questions will be encouraged.

More about George - Page 2

Group Registrations are available

Register Now



Special Points of Interest

Small group discussions will give participants the opportunity to share ideas with their colleagues and peers about the information presented and specific applications.

UIA50: 25 - 27 April 2022 will be Multi-Access

UIA50 will be held both in person at Warwick University **and** will have live streaming for extended session so that ultrasonic specialists from around the world will be able to join.

Plans are being finalized and the costs for either joining UIA live in Warwick, UK or virtually will be announced shortly.

Call for Papers

Medical Applications

Industrial

Workshop

Posters

presentations due

14 January 2022

CLICK HERE

Our format will include 25 minute presentations on the latest in industrial applications, medical applications to be presented on Monday and Wednesday.

Tuesday will feature workshops on ultrasonic basics, poster sessions, a tour of Warwick University ultrasonic laboratories and dinner at the Warwick Castle.

Accommodations are available at Warwick University - stay tuned for all the details to be finalized shortly.

Continued on next page

Remembering George Bromfield

By Tony Crandall

The ultrasonic industry has recently lost a giant in our field and a wonderful person. George Bromfield passed away on September 17th, 2021. He's the reason I and many others are part of Ultrasonic Industry Association. George's contributions to ultrasonics and to the Association are truly amazing. A review of his patents is exhausting, but worth the time. His patents cover underwater acoustics, ultrasonic fuel injectors, dental devices, surgical devices and methods for making transducers.

I first met George in 1990 when we worked together on sonar transducers at EDO Western in Salt Lake City, Utah. George is renowned in the underwater acoustics field for his work on the Flextensional Transducer. He's listed as the inventor on flextensional patents assigned to the UK Secretary of State for Defence and EDO.

George returned to England and then two years later came back to Salt Lake to work at Zevex International, where he began working on phacoemulsification handpieces for cataract surgery. He convinced me to move to Zevex and work with him on these and other ultrasonic medical devices. He mentored me and taught me much about ultrasonics and more about being a good person. He also introduced me to the UIA and is the reason I'm part of the organization.

We worked together at Zevex, (later Moog Medical) until 2001, then George began consulting, but our friendship and professional collaboration continued. George brought fun, insight, and excitement to every project we did together. George had a small laboratory at his house with an impedance analyzer and a laser vibrometer that he did some of his consulting work in and allowed me to use occasionally.

Like many of George's colleagues, I also had the pleasure of camping and hiking with George in a variety of beautiful places in Utah. George loved the outdoors and loved to share it with other people.

I wouldn't be where and who am I today without George and I'm not alone. What follows are quotes from people in the industry who were touched by George, and I'm sure it's just a small portion of those whom he touched.

My first job in America, was as production worker on the transducer line for Zevex. My responsibilities were to test the ceramics, build a transducer and apply a pre-stress. George spent his time and actually taught me why those steps were needed, and about which properties were important to the transducer and ceramic. I had an English dictionary in one of my pockets and in other a notepad with a pen to write down all he was teaching me. When I moved to R&D side of the business, he continue to teach me and to be my mentor. He shaped my interest and my professional life. He guided me in discovery solution and helped me to gain confidence in myself. George was the wealth of knowledge and support that I had been looking for. He was not only my mentor but also a true friend. I grateful that George was part of my life. I will miss him dearly.

Olga Jovic

Thanks George – You Will Be Missed

A Tribute by Jeff Vaitekunas

It is not enough to say that George Bromfield taught me everything I know about the design of Langevin stack transducers. Over the last 25 years I have had the pleasure of knowing George along my path that started as a student seeking knowledge and ended as a good friend, sad at his loss. From our first meeting when I was working at Ethicon Endo-Surgery on the Harmonic Scalpel, George had the ability to not only provide solutions, but had the patience, kindness and interest to teach why and how. As my career moved on, I was awed at George's continuing gift to the advancement of science and knowledge of ultrasonic systems. George had a hand in the Olympus Shock-Pulse ultrasonic lithotripter when I worked at Cybersonics and we had many wonderful discussions both technical and personal. I was honored that George gave generously his time and mentoring. I know that George did the same for many of my friends in the Ultrasonic Industry Association, where his handiwork is evident amongst those lucky enough to have crossed his path. Thanks George, I will do my best to carry on your legacy.

George's warmth and enthusiasm will be missed by many. I have a number of great memories of technical discussions with George, but I feel lucky to have been accepted into his group of old sonar friends and will miss our annual evening meal in Bridport with Geoff and Alan.

Andrew Mathieson PhD. MEng. CEng. MIMechE

Ultrasound Applications in the News

Soft skin patch could provide early warning for strokes, heart attacks

Engineers at the University of California San Diego developed a soft and stretchy ultrasound patch that can be worn on the skin to monitor blood flow through major arteries and veins deep inside a person's body.

Knowing how fast and how much blood flows through a patient's blood vessels is important because it can help clinicians diagnose various cardiovascular conditions, including blood clots; heart valve problems; poor circulation in the limbs; or blockages in the arteries that could lead to strokes or heart attacks.

The new ultrasound patch developed at UC San Diego can continuously monitor blood flow -- as well as blood pressure and heart function -- in real time. Wearing such a device could make it easier to identify cardiovascular problems early on.

A team led by Sheng Xu, a professor of nanoengineering at the UC San Diego Jacobs School of Engineering, reported the patch in a paper published July 16 in *Nature Biomedical Engineering*.

The patch can be worn on the neck or chest. What's special about the patch is that it can sense and measure cardiovascular signals as deep as 14 centimeters inside the body in a non-invasive manner. And it can do so with high accuracy.

"This type of wearable device can give you a more comprehensive, more accurate picture of what's going on in deep tissues and critical organs like the heart and the brain, all from the surface of the skin," said Xu.

"Sensing signals at such depths is extremely challenging for wearable electronics. Yet, this is where the body's most critical signals and the central organs are buried," said Chonghe Wang, a former nanoengineering graduate student in Xu's lab and co-first author of the study.

> The new ultrasound patch developed at UC San Diego can continuously monitor blood flow

"We engineered a wearable device that can penetrate such deep tissue depths and sense those vital signals far beneath the skin. This technology can provide new insights for the field of healthcare."

Another innovative feature of the patch is that the ultrasound beam can be tilted at different angles and steered to areas in the body that are not directly underneath the patch.

This is a first in the field of wearables, explained Xu, because existing wearable sensors typically only monitor areas right below them. "If you want to sense signals at a different position, you have to move the sensor to that location. With this patch, we can probe areas that are wider than the device's footprint. This can open up a lot of opportunities."

How it works

The patch is made up of a thin sheet of flexible, stretchable polymer that adheres to the skin. Embedded on the patch is an array of millimeter-sized ultrasound transducers. Each is individually controlled by a computer -- this type of array is known as an ultrasound phased array. It is a key part of the technology because it gives the patch the ability to go deeper and wider.

The phased array offers two main modes of operation. In one mode, all the transducers can be synchronized to transmit ultrasound waves together, which produces a high-intensity ultrasound beam that focuses on one spot as deep as 14 centimeters in the body. In the other mode, the transducers can be programmed to transmit out of sync, which produces ultrasound beams that can be steered to different angles.

"With the phased array technology, we can manipulate the ultrasound beam in the way that we want," said Muyang Lin, a nanoengineering Ph.D. student at UC San Diego who is also a co-first author of the study. "This gives our device multiple capabilities: monitoring central organs as well as blood flow, with high resolution. This would not be possible using just one transducer."

The phased array consists of a 12 by 12 grid of ultrasound transducers. When electricity flows through the transducers, they vibrate and emit ultrasound waves that travel through the skin and deep into the body. When the ultrasound waves penetrate through a major blood

Continued on next page

Ultrasound Applications in the News *continued*

vessel, they encounter movement from red blood cells flowing inside. This movement changes or shifts how the ultrasound waves echo back to the patch -- an effect known as Doppler frequency shift. This shift in the reflected signals gets picked up by the patch and is used to create a visual recording of the blood flow. This same mechanism can also be used to create moving images of the heart's walls.

A potential game changer in the clinic

For many people, blood flow is not something that is measured during a regular visit to the physician. It is usually assessed after a patient shows some signs of cardiovascular problems, or if a patient is at high risk.

The standard blood flow exam itself can be time consuming and labor intensive. A trained technician presses a handheld ultrasound probe against a patient's skin and moves it from one area to another until it's directly above a major blood vessel. This may sound straightforward, but results can vary between tests and technicians.

Since the patch is simple to use, it could solve these problems, said Sai Zhou, a materials science and engineering Ph.D. student at UC San Diego and co-author of the study. "Just stick it on the skin, then read the signals. It's not operator dependent, and it poses no extra work or burden to the technicians, clinicians or patients," he said. "In the future, patients could wear something like this to do point of care or continuous at-home monitoring."

In tests, the patch performed as well as a commercial ultrasound probe used in the clinic. It accurately recorded blood flow in major blood vessels such as the carotid artery, which is an artery in the neck that supplies blood to the brain. Having the ability to monitor changes in this flow could, for example, help identify if a person is at risk for stroke well before the onset of symptoms.

The researchers point out that the patch still has a long way to go before it is ready for the clinic. Currently, it needs to be connected to a power source and benchtop machine in order to work. Xu's team is working on integrating all the electronics on the patch to make it wireless.

https://www.sciencedaily.com/releass/2021/07/210722145217.htm

---

Researchers developing new cancer treatments with high-intensity focused ultrasound

Researchers are bringing the use of acoustic waves to target and destroy cancerous tumours closer to reality.

While doctors have used low-intensity ultrasound as a medical imaging tool since the 1950s, experts at the University of Waterloo are using and extending models that helpcapture how high-intensity focused ultrasound (HIFU) can work on a cellular level.

Led by Siv Sivaloganathan, an applied mathematician and researcher with the Centre for Math Medicine at the Fields Institute, the study found by running mathematical models in computer simulations that fundamental problems in the technology can be solved without any risk to actual patients.

Sivaloganathan, together with his graduate students June Murley, Kevin Jiang and postdoctoral fellow Maryam Ghasemi, creates the mathematical models used by engineers and doctors to put HIFU into practice. He said his colleagues in other fields are interested in the same problems, "but we're coming at this from different directions."

> *Running mathematical models in computer simulations can solve fundamental problems in the technology without any risk to actual patients.*

"My side of it is to use mathematics and computer simulations to develop a solid model that others can take and use in labs or clinical settings. And although the models are not nearly as complex as human organs and tissue, the simulations give a huge head start for clinical trials."

One of the obstacles that Sivaloganathan is currently working to overcome is that in targeting cancers, HIFU also poses risks to healthy tissue. When HIFU is being used to destroy tumours or cancerous lesions, the hope is that good tissue won't be destroyed. The same applies when focusing the intense acoustic waves on a tumour on the bone where lots of heat energy gets released. Sivaloganathan and his colleagues are working to understand how the heat dissipates and if it damages the bone marrow.

Continued on next page

Ultrasound Applications in the News *continued*

Other researchers working with Sivaloganathan include engineers, who are building the physical technology, and medical doctors, in particular, James Drake, chief surgeon at Hospital for Sick Children, looking at the practical application of HIFU in clinical settings.

Sivaloganathan believes HIFU will make significant changes in cancer treatments and other medical procedures and treatments. HIFU is already finding practical application in the treatment of some prostate cancers.

"It's an area that I think is going to take center stage in clinical medicine," he said. "It doesn't have the negative side effects of radiation therapy or chemotherapy. There are no side effects other than the effect of heat, which we are working on right now. It also has applications as a new way to break up blood clots and even to administer drugs."

www.sciencedaily.com/releaes/2021/08/210824083437.htm

Silicon chips combine light and ultrasound for better signal processing

The continued growth of wireless and cellular data traffic relies heavily on light waves. Microwave photonics is the field of technology that is dedicated to the distribution and processing of electrical information signals using optical means. Compared with traditional solutions based on electronics alone, microwave photonic systems can handle massive amounts of data. Therefore, microwave photonics has become increasingly important as part of 5G cellular networks and beyond. A primary task of microwave photonics is the realization of narrowband filters: the selection of specific data, at specific frequencies, out of immense volumes that are carried over light.

> We've learned how to convert the information of interest from the form of light waves to ultrasonic, surface acoustic waves, and then back to optics.

Many microwave photonic systems are built of discrete, separate components and long optical fiber paths. However, the cost, size, power consumption and production volume requirements of advanced networks call for a new generation of microwave photonic systems that are realized on a chip. Integrated microwave photonic filters, particularly in silicon, are highly sought after. There is, however, a fundamental challenge: Narrowband filters require that signals are delayed for comparatively long durations as part of their processing.

"Since the speed of light is so fast," says Prof. Avi Zadok from Bar-Ilan University, Israel, "we run out of chip space before the necessary delays are accommodated. The required delays may reach over 100 nanoseconds. Such delays may appear to be short considering daily experience, however the optical paths that support them are over ten meters long! We cannot possibly fit such long paths as part of a silicon chip. Even if we could somehow fold over that many meters in a certain layout, the extent of optical power losses to go along with it would be prohibitive."

These long delays require a different type of wave, one that travels much more slowly. In a study recently published in the journal *Optica*, Zadok and his team from the Faculty of Engineering and Institute of Nanotechnology and Advanced Materials at Bar-Ilan University, and collaborators from the Hebrew University of Jerusalem and Tower Semiconductors, suggest a solution. They brought together light and ultrasonic waves to realize ultra-narrow filters of microwave signals, in silicon integrated circuits. The concept allows large freedom for filters design.

Bar-Ilan University doctoral student Moshe Katzman explains: "We've learned how to convert the information of interest from the form of light waves to ultrasonic, surface acoustic waves, and then back to optics. The surface acoustic waves travel at a speed that is 100,000 slower. We can accommodate the delays that we need as part of our silicon chip, within less than a millimeter, and with losses that are very reasonable."

Acoustic waves have served for the processing of information for sixty years, however their chip-level integration alongside light waves has proven tricky. Moshe Katzman continues: "Over the last decade we have seen landmark demonstrations of how light and ultrasound waves can be brought together on a chip device, to make up excellent microwave photonic filters. However, the platforms used were more special-

Continued on next page

Ultrasound Applications in the News, *continued*

ized. Part of the appeal of the solution is in its simplicity. The fabrication of devices is based on routine protocols of silicon waveguides. We are not doing anything fancy here." The realized filters are very narrowband: the spectral width of the filters passbands is only 5 MHz.

In order to realize narrowband filters, the information-carrying surface acoustic waves is imprinted upon the output light wave multiple times. Doctoral student Maayan Priel elaborates: "The acoustic signal crosses the light path up to 12 times, depending on choice of layout. Each such event imprints a replica of our signal of interest on the optical wave. Due to the slow acoustic speed, these events are separated by long delays. Their overall summation is what makes the filters work." As part of their research, the team reports complete control over each replica, towards the realization of arbitrary filter responses. Maayan Priel concludes: "The freedom to design the response of the filters is making the most out of the integrated, microwave-photonic platform."

https://www.sciencedaily.com/releaes/2021/05/210520133938.htm

---

Noninvasive imaging strategy detects dangerous blood clots in the body

Atrial fibrillation -- an irregular and often rapid heart rate -- is a common condition that can cause clots to form in the heart that may then dislodge and flow to the brain, potentially leading to a stroke. The standard way to detect these clots requires patients to be sedated and to have a fairly large tube inserted down the throat and esophagus for a transesophageal ultrasound. Investigators at Massachusetts General Hospital (MGH) have now developed and tested a targeted contrast agent to detect and image these clots noninvasively. They verified the potential of this strategy in a study published in *JACC: Cardiovascular Imaging*.

The agent has a strong affinity for fibrin, a component of blood clots, and is detected with a radioactive copper tag. "The idea behind the technology is that the agent will find and bind to blood clots anywhere in the body -- not just in the heart -- and make the clots detectable like a bright star in the night sky," says senior author David Sosnovik, MD, FACC, director of the Program in Cardiovascular Imaging within MGH's Martinos Center for Biomedical Imaging and an associate professor of Medicine at Harvard Medical School. "In some ways this is analogous to doing a smart search with a search engine such as Google, where the search terms one uses guide the search. We inject the agent into a small peripheral vein and it circulates throughout the human body on its search for clots." If it doesn't find any clots, then it's rapidly excreted from the body; however, if it finds a clot and binds to it, clinicians can detect it with an imaging technique known as positron emission tomography.

Sosnovik and his colleagues first examined how the agent reacts (specifically, its metabolism and pharmacokinetics) in eight healthy volunteers. After injection, the agent was initially stable within the body and then was cleared from tissues within several hours, suggesting that it was safe. Next, the team administered the agent to patients with atrial fibrillation, some with clots in the heart and some without. Imaging tests of the heart revealed bright signals within the clots that were not seen in patients without clots.

"Obviously much more work and many more studies will need to be done before this changes routine clinical practice, but this first-in-human study is an important step," says Sosnovik. "Importantly, this smart or molecularly targeted agent can be used to detect clots anywhere in the body."

Sosnovik stressed that the multidisciplinary nature of this project was critical to its success, with vital roles played by diverse scientists, including Peter Caravan, PhD, who invented and developed the study's agent and is the co-director of MGH's Institute for Innovation in Imaging. "This probe was invented and optimized in my laboratory by a dedicated team of chemists and biologists through the support of the National Heart Lung and Blood Institute of the National Institutes of Health," says Caravan. "It is extremely gratifying to see these years of effort come to fruition with a fibrin-specific PET probe with the potential to make a real impact on human health."

Others playing a major role in the study. "Not only did we use a novel molecular imaging probe in humans for the first time, but also, this is one of the first studies to fully explore the synergies and advantages of integrated PET-MRI scanners," says Izquierdo-Garcia.

For more information, please go to https://www.sciencedaily.com/releaes/2021/11/211101105402.htm

From the President

Dominick DeAngelis

UIA President

The final decision has now been made to host the next UIA50 symposium as a "hybrid" event in 2022. We are all excited to bring back the in-person "flavor" of our regular annular event that we all miss so much, while still allowing the UIA to expand our reaches to the broader ultrasonics community "virtually" for those who don't have the means or opportunity to attend in person. The planning for an in-person UIA50 "hybrid" at Warrick University is already underway, starting with the "Call-for-Papers" now, and we all expect to see lots of progress on the great research that was presented there virtually in 2021 (no pressure). ☺ Also, you may remember last year that we promised to continue the virtual collaboration series if there was demand, so I am proud to say that the demand has exceeded expectations, and the series will continue for the indefinite future; please continue to support the cause if you would like these events to continue, and also think about being a contributor for the next one too. My final words of thought go out to the memory of George Bromfield, who like most others in the UIA community also had a big impact on me for the past +10 years of our friendship, not only for his vast knowledge on ultrasonics that he so eagerly shared, but mostly for his kindness and enthusiasm that inspired so many!

UIA Board

Ultrasonic Industry Association
11 W Monument Ave, Ste 510
Dayton OH USA

Phone: +1.937.586.3725
uia@ultrasonics.org

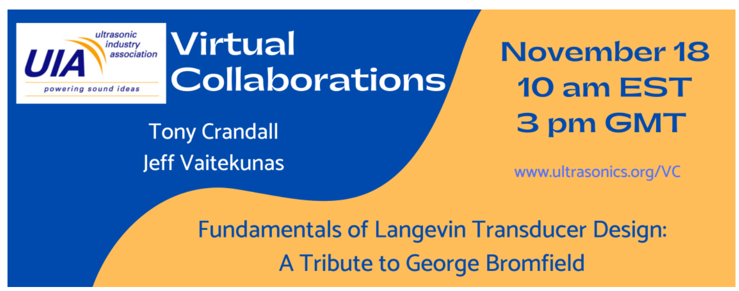
VISIT US AT ULTRASONICS.ORG

How can ultrasonics enhance the value of your business?

UIA is the international business forum for users, manufacturers, and researchers of ultrasonics. Our members use acoustic vibrations to improve materials, industrial processes, and medical technology. We call this *powering sound ideas.*

Let's work together to power your sound ideas. Contact a member consultant or company through our online Referral Network, learn about ultrasonics with our online primer, or meet industry leaders at our next symposium.

Important Dates



18 November 2021: Virtual Collaborations - Fundamentals of Langevin Transducer Design – A Tribute to George Bromfield: Virtual Collaborations

14 January 2022: Call for Papers/Posters Submission Deadline

February 2022: Virtual Collaborations

25 - 27 April 2022: UIA50, Warwick University, UK

June 2022: Virtual Collaborations

September 2022: Virtual Collaborations Mini Symposium

November 2022: Virtual Collaborations