Volume 34 Issue 31: 2025 Summer 2025

Vibrations

Powering Sound Ideas

UIA Virtual Collaborations - 11 September & 9 October

Dive into Ultrasonics Innovation!

The Ultrasonic Industry Association (UIA) is proud to present our latest Virtual Collaboration Series — and this time, we're offering a two-part experience packed with practical insights and real-world expertise.

This series features UIA members with hands-on experience in ultrasonic transducers, materials, and applications. Whether you're a seasoned engineer or just exploring the field, these webinars offer valuable knowledge and networking opportunities.

Session Details

Part 1: September 11 at 10 - 11:15 am EDT

Ultrasonic Transducer Materials/RoHS - CTS Denmark

Ultrasonic Transducer Design/Construction - Jay Sheehan, Integra LifeSciences

Ultrasonic Generator Design/Electric - Myra Flitcroft, Moog

Inside this issue:

UIA53 28 - 30 April 2025 in Halifax, Nova Scotia

Monday – Industrial Session

The Monday Industrial session was chaired by **Dr Andrew Feeney** for the morning part, and **Dr Dong Wang** (newly appointed to the Board of Directors) in the afternoon. Following a welcome address by the President of the UIA, **Professor Margaret Lucas**, the Conference Chair, **Dr Andrew Mathieson** introduced delegates to Halifax, giving some cultural and historical contexts with an overview of the symposium for the forthcoming three days.

The first presentation was given by **Dr Charlie Dowling** from CeramTec, with a talk entitled *Manufacturing and Testing Ultrasonic Sensors for Extended Lifetimes and Long Term Repeatability*. In his presentation, Charlie provided an overview of the performance and environ-

UIA Virtual Collaborations - 11 September & 9 October

Part 2: October 9 at 10 - 11:15 am EDT

System Modeling - Rebecca Cleary and Nico Fenu, Nami Surgical

Applications - Kevin Hauser, St. Andrews Systems and Dan Cotter, Integra LifeSciences. Join us for one or both sessions — each is designed to deliver a wealth of information and foster meaningful collaboration across the ultrasonics community.

Can't watch one session live? Register for both and get links to the recordings.

Registration

Unlimited members (Sustaining and Individual) can register at no additional charge. Sustaining members can register up to five individuals at no additional charge. TO PARTICIPATE, please register so that you receive the zoom link.

This edition of Virtual Collaborations will be available to UIA basic members at $50 / students at $25 / nonmembers at $75. Group registration discounts ARE AVAILABLE to those companies who are basic sustaining members or non members who want to have more than one person participate.

REGISTER for BOTH 11 September and 9 October - save time & money!

Registration fees for BOTH parts of our 2025 Fall Collaborations is: basic members (both individual and sustaining) $90 / students $45 / nonmembers $140.

CLICK HERE TO REGISTER NOW.

UIA53 Review: Continued

mental testing challenges for ultrasonic flow metering. First, an introductory overview of ultrasonic flow metering was given, before key testing protocols were discussed, followed by benchmarking and a summary discussion of future challenges. In particular, leak detection was noted to be a significant challenge, where in the UK as an example, around 25% of drinkable water is lost to this. Looking towards long-term success, improving the lifetime of meters, increasing their dynamic range and the accuracy of measurement, and ensuring supply chain stability were noted as key. Matching of material properties to extreme standards and intensive environmental testing processes have led to the development of a new high performance 2 MHz sensor, with automated manufacturing to be introduced later in 2025.

Next was **Mark Norfolk** from EWI, entitled *From Innovation to Industry: The Evolution and Commercialization of Ultrasonic Additive Manufacturing*. Mark provided an overview of ultrasonic additive manufacturing technology, with a detailed timeline towards the commercialization of the technology. It was noted how Dr Dawn White developed the concept of 3D printing foils using ultrasonics, and eventually founded Solidica, with a range of patents including some relevant to ultrasonic welding, and a commercial rapid prototyping product involving ultrasonic consolidation. Principles and the development timeline of CAD/CAM approaches, including simulation,

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UIA Call for Fellow Nominations

The Ultrasonic Industry Association (UIA) is pleased to announce the Call for Nominations for the prestigious grade of Fellow of the UIA. This designation honors individuals who have demonstrated outstanding achievements in the field of ultrasonics or in the management of ultrasonic technologies, and who have made substantial contributions to the advancement of the industry and to the UIA itself.

Qualifications

- To be elected as a Fellow of the UIA, a candidate must:
- Be a current UIA member with at least 10 years of continuous membership
- Be nominated by a current UIA member
- Be sponsored in writing by at least one UIA Board Member
- Have demonstrated a step change in the state of the art in ultrasonics science or engineering and/or made significant contributions to commercial practice
- Have made significant contributions to the UIA

Eligibility Criteria

Nominees should exhibit:

- A record of innovation, leadership, and accomplishment in ultrasonics
- Documented recognition, such as patents, publications, awards, or leadership positions
- Contributions that have had a meaningful impact on society or the profession
- Involvement that goes beyond administrative roles, demonstrating direct influence on outcomes

Nomination Package

- All nominations must be submitted as a single PDF file and include:
- A 1–2 page nomination letter from a current UIA member detailing the nominee's professional contributions and impact
- The nominee's full resume
- Three letters of recommendation (not required to be from UIA members)
- A written sponsorship from at least one UIA Board Member

Deadline and Submission

- Deadline for submission: Last Monday of December

Submit to: uia@ultrasonics.org

Review and Notification

Completed applications will be reviewed by a designated UIA Board sub-committee.

Nominees will be notified of the decision by the first Monday in March.

Awardees will be notified by the first Tuesday in March and formally recognized at the UIA Annual Meeting (registration fee waived for the recipient).

We encourage you to recognize the pioneers and leaders among us by submitting a nomination. Help us honor those who are shaping the future of ultrasonics.

Karl Graff Honored as 2025 Fellow

UIA honors Karl Graff as the UIA Fellow for 2025. His nomination was unanimously approved by the UIA Board of Directors in recognition of his life-long devotion to ultrasonics. Karl founded the Edison Welding Institute (EWI) on The Ohio State University campus in Columbus, OH. He worked closely with Sonobond, other UIA members and global experts in ultrasound. He also served for three years as the Executive Director for the UIA while helping to educate the broader industrial community about the benefits of ultrasound.

UIA54: Salt Lake City, UT, USA 20-22 April 2026

Join the Ultrasonic Innovation Wave at UIA54 – Salt Lake City

Get ready to experience the forefront of ultrasonic technology at **UIA54**, hosted in Salt Lake City – a vibrant hub of innovation and discovery. This premier symposium brings together global leaders, pioneering researchers, and forward-thinking manufacturers to explore the latest breakthroughs in ultrasonic applications.

From industrial advancements to medical marvels, UIA54 offers a dynamic program that bridges research and real-world impact. Engage in thought-provoking sessions on the convergence of ultrasonic technologies, and gain practical insights through a hands-on workshop focused on intellectual property strategy and entrepreneurial growth.

Connect with an international network of experts from top-tier universities and industry giants, all passionate about shaping the future of ultrasonics. Whether you're a seasoned professional or a rising innovator, UIA54 is your gateway to inspiration, collaboration, and cutting-edge knowledge.

Don't miss your chance to be part of this transformative event.

Hotel Reservations at the Salt Lake City Hilton

Our Symposium hotel is located In central Salt Lake City, a two-minute walk from Salt Palace Convention Center. City Creek Center mall and Temple Square are both within a half-mile of our door. Cottonwood Canyon is 40 minutes away, offering summer hiking, biking, and climbing, as well as winter skiing. Room rate is $194 per night, plus taxes.

Abstracts submissions

Presentations that focus on industrial applications of ultrasound, ultrasonic medical innovations, and detailed workshops on the engineering behind ultrasonics are now being accepted.

https://app.oxfordabstracts.com/stages/79843/submitter

UIA 54

powering sound ideas

20 - 22 April 2026

Hilton Salt Lake City Center, Utah, USA

Click here to make your hotel resesrvations

UIA53 Review: Continued

were covered, before there were conversations with EWI to progress the technology. From there, system redesign was undertaken at EWI to boost performance, such as to reduce horn size and deliver higher force and power levels. It was then shown how Solidica and EWI then embarked on a joint venture in 2011 called Fabrisonic LLC. Here, ultrasonic consolidation was rebranded as ultrasonic additive manufacturing. A range of Fabrisonic LLC capabilities were then showcased, including the combination of different materials, with production levels reported around 35 million parts for electric vehicle applications in 2023, through ultrasonic additive manufacturing. Future applications were then discussed, including printing in space and enhanced composites.

The third presentation was given in person by **Dr Dominick DeAngelis** from Kulicke & Soffa Industries (K&S), on the topic of *Optimizing the Mechanical Quality Factor of Ultrasonic Transducers*. In this presentation, transducer applications were reported alongside specific examples from the perspective of K&S, global leaders in the manufacture of ultrasonic semiconductor wire bonding equipment. The differences between wedge and ball bonding were outlined, followed by a showcase of Langevin transducers specific to K&S. The aim of optimising mechanical quality factor of a transducer was then discussed, which includes typical approaches for quality factor measurement. The importance of considering mechanical quality factor was shown via infrared camera measurements of two transducers, each with a different tool material quality factor. Through ensuring an optimal mechanical quality factor, stability in resonance can be achieved. Approaches to measurement for transducers incorporating metals with high mechanical quality factor were discussed, including through non-contact instrumentation like laser Doppler vibrometers coupled with ring-down measurement, and processing including high-pass filtering. It was also discussed how mechanical quality factor can be highly dependent on the level of anisotropy for the same alloy. Thus, a robust material testing process is important. Importantly, the ability to predict mechanical quality factor using a measured temperature profile with extracted transverse isotropic properties of a material was demonstrated, important for future developments in power ultrasonics.

After the morning break, *In-Process Quality Monitoring of Ultrasonic Metal Welding* was showcased by **Dr Amin Moghaddas** from EWI. In his presentation, key principles and challenges of ultrasonic metal welding were given, with an overview of how welds can be formed through high-frequency ultrasonic energy transferred to specimens to be joined. The importance of in-process monitoring was emphasised, in part because weld quality using power ultrasonics can be affected by factors including tooling, mate-

UIA53 Review: Continued

rial properties, and the process parameters selected. It was shown how in-process monitoring is desirable to avoid high scrap rates of material and missing any poorly welded specimens, which is typical of destructive methods used at present. Instead, machine learning algorithms can be used in conjunction with acoustic emission sensors and a microphone to provide measurements of sound waves travelling through the anvil. The quality of the returned signal data is assessed, for example through principal component analysis and the KNN algorithm for data classification. This was followed by K-fold cross-validation and regression analysis, and it was demonstrated that all acoustic emission sensors trialled could successfully classify weld quality, which is significant for future manufacturing capabilities.

A recorded presentation was then given by **Professor Mae Seto** from Dalhousie University, on *Undersea Robot Communications: Challenges and Solutions using Acoustics Underwater*. An overview of 'what needs to be measured?' was given, for underwater sensors. Both acoustic and non-acoustic requirements were discussed, including temperature, depth, methane, and particle concentration. Autonomous maritime robots were then discussed, including uncrewed underwater vehicles (UUVs), and their surface equivalents (USVs). A major challenge identified is sensing in harsh environments, something that these platforms support. The requirements of undersea robot communications were reported, considered here in terms of underwater nodes (that could include the UUVs or USVs). It was demonstrated that acoustics is desirable for underwater communications due to the low absorption, though challenges include spatial-temporal fluctuations in the channel due to the environment. Furthermore, sound speed is relatively low (especially compared to electromagnetic), and the physical separation between transmitters and receivers can cause problems for the quality of channel state information received, and time delays. A range of solutions were explored, including Code Division Multiple Access (CDMA) and inserting preamble and pilots into signals. The presentation concluded with examples of case studies, including using CDMA verification.

The first presentation after the lunch break was given by **Professor Sandy Cochran** from the University of Glasgow. The topic of the talk was *Piezoelectric Material Characterisation for the Design of Industrial Ultrasonic Transducers*, primarily showcasing recent developments from the Ultrasound Materials and Devices group. The research that was discussed spans multiple projects, including robotic surgery, underwater sonar, speech and language therapy, and conformable arrays. The primary goal of this work is to accelerate the uptake of new bulk piezoelectric materials into ultrasound devices and systems in industry, through a combination of virtual prototyping via finite element analysis and using a complete electropiezodielectric (EPD) matrix, and highly accurate measurement of piezoelectric material properties. The status of characterisation was demonstrated, including improved optimisation through AI across all parameters, making use of miniature single samples, and undertaking single measurements through impedance spectroscopy. It was shown that although the multisample IEEE approach is still the standard, it is likely that single sample approaches will replace it in future.

UIA53 Review: Continued

A talk by **Anna Alexandrou** from the University of Glasgow followed this, on the *Characterisation of Textured Piezoceramics and Performance Evaluation in Single Element Transducers*. The presentation first showed some classifications of piezoelectric materials, from those which are hard or soft (or lead free) ceramics, to those which are crystals and polymers like PVDF. It was demonstrated that the crystal form of piezoelectric materials, such as PMN-based, typically exhibit favourable performance in medical applications but are often expensive and require complicated fabrication processes. Textured ceramics were then introduced, which can display improved levels of piezoelectric performance when compared to polycrystalline ceramics, with a less complex fabrication process at lower cost (if compared to single crystals). The characterisation of such textured ceramics was then introduced, through extraction of the EPD matrix using the relevant IEEE standard with impedance spectroscopy and a piezoelectric analysis program. Validation of the EPD matrix was then undertaken using COMSOL Multiphysics finite element software, before the fabrication of a single element transducer was shown. Promising performance levels were demonstrated for the transducer, for example with a higher SNR shown compared to an equivalent transducer fabricated using PZT5A.

The next presentation was given by **Rasmus Lou-Møller**, Director of Engineering and Business Development from CTS Corporation. Rasmus provided a detailed account of *RoHS Status and Future*, showing how the European Union's directive on Restriction of Hazardous Substances (RoHS) is currently impacting research and development of electric and electronic equipment, and the power ultrasonic technologies relevant to the expertise showcased at the symposium. It was shown how the maximum concentration value for lead, by weight, tolerated is 0.1%. This value is higher for lead zirconate titanate in piezoelectric transducers. The exemption status for various areas was discussed, some of which have included security, space, and medical devices, and which affect the field of power ultrasonics. The status of the consultation period and feedback timeline for responses to the directive and the potential for extension was then covered.

A productive discussion in the form of an Open Forum followed, focused on the *Current Status of Piezoelectric Materials & Security of Supply*.

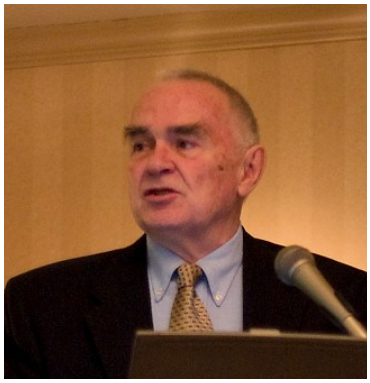
Olubunmi Onanuga from the University of Glasgow, presented *Incorporation of Lead-free Piezoceramic Material in a Power Ultrasonic Transducer*. In her research, the challenges around the incorporation of lead-free piezoelectric ceramics into trans-

UIA53 Review: Continued

ducers was discussed, thereby avoiding the toxicity and adverse health effects of lead in the manufacturing process. Bolted Langevin transducers were used in the study to compare performance between a configuration incorporating sodium bismuth titanate, and the other fabricated using lead zirconate titanate. In the process, the effects of pre-stressing and aging on transducer response were both considered, with coupling coefficients and mechanical quality factors measured, prior to harmonic analysis with temperature monitoring. It was found that the transducer with lead-free piezoelectric ceramics showed a weaker nonlinear softening response compared to that for transducers incorporating lead-based piezoelectric ceramics. This was partly due to the lower levels of displacement amplitude. The mechanical coupling factor and coupling coefficients of the lead-free transducer were also lower, but with lower heat loss measured. Future research will focus on further understanding the electromechanical responses of the transducers.

Industrial Session Co-Chair, **Dr Dong Wang** from the University of Exeter presented *A High-Performance Piezo Stack Energy Harvester for Railway Applications* demonstrated the development of piezoelectric energy harvesters to address the challenges of railway infrastructure monitoring, including for relatively harsh weather conditions. It was shown how traditional power-monitoring devices either rely on expensive wired electricity or batteries that are difficult to replace across widespread field networks. It was also demonstrated how existing energy harvesting methods lack sufficient power output and scalability. To address this, Dong's research team have developed remote monitoring devices using piezoelectric stack transducers combined with frequency up-conversion, allowing efficient energy harvesting from low-frequency railway vibrations. Key innovations were noted, including a dual-frequency response which effectively widened the bandwidth of operation, with an optimised harvester structure with power generation into the tens of milliwatts, exceeding the previous state of the art. The improved system achieves milliwatt-level power output, significantly surpassing previous designs that generated only hundreds of microwatts.

Finally, the Industrial Session was rounded off by a highly entertaining and nostalgic review of the remarkable career of **Dr Karl Graff**, across the last 60 years of his significant contributions to the field of ultrasonics. Although Dr Graff was not able to travel to Halifax for the symposium, he recorded *An Account of Time Served…in Ultrasonics*, encompassing his achievements and perspectives on the field of



power ultrasonics from 1965 to the present day. Karl covered various themes, from early work in which he was involved such as comminution, the people and mentors who shaped his career, notably Robert McMaster at the Ohio State University. Some further key contributions to the field were recounted, including the ultrasonic drilling of geological materials and impact coupling, before an overview of his literary contributions to the history of ultrasonics was given. Karl's significant contributions to

UIA53 Review: Continued

ultrasonic metal welding were then showcased, with accounts of the many technical achievements of the efforts at EWI through the decades. The links Karl forged with many leading researchers around the world were also noted, demonstrating the impact of his technical research on the field of power ultrasonics. There was an especially nice touch given at the end where he recognised the colleagues who he considered to be particularly important to him through his career, who he termed his 'ultrasonifriends'.

Tuesday's Workshop: Concept to IP

Tuesday's workshop focussed on a topic which was new for our mid-symposium workshop. Themed *Concept to IP* the workshop explored the journey of building an idea from an initial technical concept through to a commercial product. Professor **Jeremy Brown** of Dalhousie University kicked us off with his invited talk entitled ***Miniature Ultrasound technology for Precision Imaging and Therapy***, during which he discussed his professional career, one as a university professor and another of an entrepreneur and co-founder of two tech companies; Dasonics, a design and fabrication house provide technical expertise and engineering support for emerging applications in advanced ultrasound technologies, specifically high-frequency imagining, and **Soundblade**, a novel compact ultrasonic technology that combines real-time imagining with tissue ablation on a single platform.

UIA's Vice President, **Kevin Houser**, followed up with an informative session on the key "don't's", "dos" and "most definitely think about" aspects of IP identification, protection and exploitation. Many of Kevin's messaged followed the "keep it simple" methodology, ensure clarity, but fundamentally, how far are you wishing to go to protect your invention.

Tuesday's morning session finished with a panel discussion on the theme of Concept to IP and included business and engineering leaders from Atlantic Canada. We welcomed **Melanie Nadeau, CEO COVE, Jeff Leadbetter, CEO Daxsonics,\ Nemana, Director, Ceramics Business Unit Sensor Technology and Adam Gray, Chief Engineer R&D Ultra Maritime** with our President Professor Margaret Lucas hosting the panel. Delegates were treated to a detailed and in-depth discussion, and although the amicable atmosphere, each panellist offered slightly different thoughts due to the size of business or technological focus.

After a short ferry trip across Halifax Harbour, we enjoyed a tour of the maritime incubator COVE (Centre of Ocean Ventures and Enterprise). The breadth of the industries based at COVE and their clarity of mission stood out, as did their **Stella Maris** testing solution, a subsea platform that facilitates product development, verification, and commercialisation.

Beer tasting with Andy Mathieson, Andrew Feeney & Dominick DeAngelis

UIA53 Review: Medical Sessions

The first presentation of the session was given by **Dr Martin Hoffman** from the University of Bern, on *Integrated Sensor System to Quantify the Forces Applied During Ultrasonic Periodontal Debridement*. Dr Hoffman introduced the challenges in controlling applied force during ultrasonic debridement procedures. He explored several force measurement techniques, identifying Hall sensors as particularly effective for monitoring, being highly considerate of how the sensor interaction impacts blade resonance and mass. The findings are promising, with in vitro trials planned next to validate performance under surgical-like conditions.

The next presentation was given by **Alicia Gardiner** from the University of Glasgow, on *FEA Simulation of Ultrasonic Bone Surgery*. Alicia presented a robust 2D ex vivo simulation approach to explore ultrasonic bone tool dynamics. She examined variables such as mesh density, frequency, and thermal output. Her findings demonstrated the significant impact of vibration and speed on bone integrity, supporting the importance of modelling to predict risks like thermal damage and stress accumulation.

The next presentation was given by **Dr Olga Yevlashevskaya** from the University of Birmingham, on *A Novel Approach to Evaluating Ultrasound Effects on the Osteogenic Differentiation of Human Mesenchymal Stromal Cells Attached on Titanium Surfaces In Vitro*. Dr Yevlashevskaya addressed conflicting evidence in literature regarding ultrasound and bone integration. Her in vitro study tested how ultrasound at 20kHz and 40kHz affected human mesenchymal cells on titanium. The results revealed that osteogenic expression varied with ultrasound exposure, suggesting that careful frequency targeting could improve outcomes in physiotherapeutic applications.

The next presentation was given by **Prof Mark Schafer** from Drexel University, on *Ultrasonic Surgical Devices: New Requirements for Characterisation*. Prof Schafer provided an update on revisions to the IEC 61847 standard, which originally focused on phacoemulsification tools. The updated standard now incorporates newer ultrasonic surgical technologies. His session outlined the two-year development process and emphasized the need for evolving regulations that keep pace with emerging innovations in surgical ultrasonics.

Professor Kullervo Hynynen from Sunnybrook Health Sciences Centre, University of Toronto, presented *Ultrasound Phased Arrays for Therapy*. Prof Hynynen discussed the limitations of delivering ultrasound through the skull, including signifi-

UIA53 Review: Continued

cant absorption and signal defocusing. He introduced the use of hemispherical phased arrays—ranging from 64 to 500 elements—for improved beam control. A highlight a study which included over 20,000 was MRI-guided focused ultrasound (MRIgFUS) thalamotomies and an investigation on blood-brain barrier (BBB) permeability for drug delivery. He also shared promising results in Alzheimer's models and described developments in conformal phased arrays for non-invasive brain therapies.

The next presentation was given by **Ehsan Malekipour** from the University of Glasgow, on *Incorporating Lattice Scaffolds in Langevin Transducers: Ultrasonic Fatigue and Stress Analysis*. Ehsan examined how TPMS (triply periodic minimal surface) lattice structures influence transducer fatigue resistance and stress behaviour. His finite element and experimental work revealed early cracking at 20kHz excitation, highlighting the need for post-processing, material tuning, and surface treatment strategies to improve transducer longevity in demanding conditions.

The next presentation was given by **Alexandr Kiyashko** from Nami Surgical, on *Complex Material Property Characterization and Modelling of Piezoelectric Ceramics for High-Power Ultrasonic Applications*. Alexandr introduced Nami's miniature high-power ultrasonic scalpel, emphasizing its role in efficient tissue dissection and sealing. He described the modelling of piezoceramic behaviours using Comsol and noted the challenges of quantifying thermal loss and self -heating.

Oskar Okaya from the University of Bern, presented *Comparison of Synthetic, Animal, and Human In Vitro Bone Models for Intraosseous Temperature and Cutting Force Measurements in Ultrasonic Osteotomy*. Oskar investigated how different bone models—including polyurethane sawbones, bovine ribs, and human samples—respond to ultrasonic osteotomy. Findings showed that slower cutting speeds causing increases to intraosseous temperature, contributing to thermal risks like foaming, which could compromise surgical precision.

The next presentation was given by **Dr Weihuan Kong** from the University of Glasgow, on *Vibrational Characteristics of Langevin Transducers Assembled with TPMS Lattice Front Masses*. Dr Kong explored the application of powder bed fusion additive manufacturing in Langevin transducer design. His FEA and electromechanical analysis aligned well, but harmonic excitation exposed cracking vulnerabilities. He highlighted the ongoing challenge of balancing structural durability and acoustic performance in lattice-based front masses.

The session concluded with closing remarks by UIA President **Professor Margaret Lucas**, who reflected on the technical richness and innovation demonstrated throughout the

UIA53 Review: Concluded

Margaret Lucas

day's programme and the collective contribution to advancing ultrasonic applications across the meetings programme. She also extended her thanks to **Dr Andrew Mathieson** for his instrumental support in the organisation of the meeting and associated activities in Halifax, recognising his pivotal role in bringing the event together so successfully.

Andrew Mathieson

2025 - 26 UIA Board of Directors in Halifax

The UIA Board of Directors met in Halifax to plan for the upcoming year. Pictured above are (left to right)

Andrew Feeney, Andrew Mathieson, Dominick DeAngelis, Myra Flitcroft, Brian Julius, Rebecca Cleary, Ron Staut, Margaret Lucas, and Wang Dong.

Other board members not included above are: Sunita Chauhan, Dan Cotter, Tony Crandall, David Grewell, Kevin Hauser, Mark Hodnett, Rasmus Lou-Moeller, Ron Manna, Mark Schaefer, Jay Sheehan, and Dan Voic,

Mark Schafer joins Rockefeller Neuroscience Institute

Mark Schafer, PhD, Fellow of the Ultrasound Industry Association, recently joined the Rockefeller Neuroscience Institute at West Virginia University as Director of Ultrasound Engineering for Neuromodulation. In this role, he joins an outstanding clinical team that is pioneering the optimization of brain health through focused ultrasound neuromodulation. Their groundbreaking work using ultrasound to treat neurological conditions has been featured in numerous media outlets, including The Washington Post, BBC, CNN, PBS, and most notably, 60 Minutes. Dr. Schafer will leader a group developing breakthrough brain neuromodulation therapies that will help millions of people with neurological disorders such as addiction and Alzheimer's using low intensity focused ultrasound stimulation. His responsibilities include transducer and system design, project management, regulatory affairs and IP development.

Dr. Schafer currently is on the Board of the Ultrasound Industry Association (UIA). He is also a past President of the UIA, as well as past President of the IEEE Ultrasonics, Ferroelectrics, and Frequency Control Society (UFFC). He is an internationally recognized expert in medical ultrasound, including design, development, intellectual property, regulatory, and applications. A serial entrepreneur, he is a named inventor on over 40 patents. Dr. Schafer is also a Fellow of the American Institute of Ultrasound in Medicine, the Acoustical Society of America, and the American Institute of Medical and Biological Engineering.

Ultrasound in the News

3D PRINTING IN VIVO USING SOUND

Imagine if doctors could precisely print miniature capsules capable of delivering cells needed for tissue repair exactly where they are needed *inside* a beating heart. A team of scientists led by Caltech has taken a significant step toward that ultimate goal, having developed a method for 3D printing polymers at specific locations deep within living animals. The technique relies on sound for localization and has already been used to print polymer capsules for selective drug delivery as well as glue-like polymers to seal internal wounds.

Previously, scientists have used infrared light to trigger polymerization, the linking of the basic units, or monomers, of polymers within living animals. "But infrared penetration is very limited. It only reaches right below the skin," says Wei Gao, professor of medical engineering at Caltech and a Heritage Medical Research Institute Investigator. "Our new technique reaches the deep tissue and can print a variety of materials for a broad range of applications, all while maintaining excellent biocompatibility."

Gao and his colleagues report their new in vivo 3D-printing technique in the journal Science. Along with bioadhesive gels and polymers for drug and cell delivery, the paper also describes the use of the technique for printing bioelectric hydrogels, which are polymers with embedded conductive materials for use in the internal monitoring of physiological vital signs as in electrocardiograms (ECGs). The lead author of the study is Elham Davoodi, an assistant professor of mechanical engineering at the University of Utah, who completed the work while a postdoctoral scholar at Caltech.

The Origin of a Novel Idea

Wanting to figure out a way to realize deep tissue in vivo printing, Gao and his colleagues turned to ultrasound, a platform that is widely used in biomedicine for deep tissue penetration. But they needed a way to trigger crosslinking, or binding of monomers, at a specific location and only when desired.

They came up with a novel approach: Combine ultrasound with low-temperature-sensitive liposomes.

Continued on the next page

Ultrasound in the News, continued

Such liposomes, spherical cell-like vesicles with protective fat layers, are often used for drug delivery. In the new work, the scientists loaded the liposomes with a crosslinking agent and embedded them in a polymer solution containing the monomers of the polymer they wanted to print, an imaging contrast agent that would reveal when the crosslinking had occurred, and the cargo they hoped to deliver -- a therapeutic drug, for example. Additional components can be included, such as cells and conductive materials like carbon nanotubes or silver. The composite bioink was then injected directly into the body.

Raise the Temperature Just a Touch to Trigger Printing

The liposome particles are low-temperature sensitive, which means that by using focused ultrasound to raise the temperature of a small targeted region by about 5 degrees Celsius, the scientists can trigger the release of their payload and initiate the printing of polymers.

"Increasing the temperature by a few degrees Celsius is enough for the liposome particle to release our crosslinking agents," says Gao. "Where the agents are released, that's where localized polymerization or printing will happen."

The team uses gas vesicles derived from bacteria as an imaging contrast agent. The vesicles, air-filled capsules of protein, show up strongly in ultrasound imaging and are sensitive to chemical changes that take place when the liquid monomer solution crosslinks to form a gel network. The vesicles actually change contrast, detected by ultrasound imaging, when the transformation takes place, allowing scientists to easily identify when and precisely where polymerization crosslinking has occurred, enabling them to customize the patterns printed in live animals.

The team calls the new technique the deep tissue in vivo sound printing (DISP) platform.

When the team used the DISP platform to print polymers loaded with doxorubicin, a chemotherapeutic drug, near a bladder tumor in mice, they found substantially more tumor cell death for several days as compared to animals that received the drug through direct injection of drug solutions.

> They came up with a novel approach: Combine ultrasound with low-temperature-sensitive liposomes.

"We have already shown in a small animal that we can print drug-loaded hydrogels for tumor treatment," Gao says. "Our next stage is to try to print in a larger animal model, and hopefully, in the near future, we can evaluate this in humans."

The team also believes that machine learning can enhance the DISP platform's ability to precisely locate and apply focused ultrasound. "In the future, with the help of AI, we would like to be able to autonomously trigger high-precision printing within a moving organ such as a beating heart," Gao says.

The work was supported by funding from the National Institutes of Health, the American Cancer Society, the Heritage Medical Research Institute, and the Challenge Initiative at UCLA. Fluorescence microscopy was performed at the Advanced Light Microscopy/Spectroscopy Laboratory and Leica Center of Excellence at the California NanoSystems Institute at UCLA.

https://www.sciencedaily.com/releases/2025/05/250508172457.htm

Focused ultrasound halts growth of debilitating brain lesions

A new, incision-free technique developed at UVA Health to treat debilitating brain lesions called cerebral cavernous malformations, or cavernomas, has shown great promise in early testing, halting the growth of the lesions almost entirely.

The new approach could represent a paradigm shift in how the malformations, commonly called CCMs, are treated, the researchers say. The technique uses tiny, gas-filled "microbubbles" propelled by focused sound waves to open the brain's protective barrier and stunt the growth of the malformations.

"This is a clear example of serendipity in science. We were looking for something else --

Continued on the next page

Ultrasound in the News, continued

performing long-term safety studies of focused ultrasound as a tool for drug and gene delivery to CCMs -- when we noticed that CCMs exposed to just focused ultrasound with microbubbles were being stabilized. After the initial observations, we spent years doing experiments to confirm the effect was real and reproducible," said researcher Richard J. Price, PhD, co-director of UVA Health's Focused Ultrasound Cancer Immunotherapy Center. "Because the focused ultrasound treatment is relatively simple and non-invasive and the necessary clinical devices are becoming more common, if proven safe in clinical trials, I am hopeful it could eventually become a real treatment option."

About Cavernomas

Cavernomas are clusters of overgrown blood vessels that can sprout like weeds in the brain, spinal cord or other parts of the body. Most cases cause no symptoms, but they can, in some instances, cause headaches, seizures, muscle weakness and even death. Treatment options for patients include brain surgery, often used when the CCM is at risk of causing a dangerous brain bleed, or stereotactic radiosurgery, which uses radiation to destroy CCMs that are difficult or impossible for a surgeon to reach.

UVA's new approach could offer an alternative that avoids unwanted side effects associated with brain surgery and stereotactic radiosurgery, Price says. For example, traditional brain surgery comes with the risks of the surgery itself and also the possibility that the removed cavernomas could regrow.

Price and his collaborators were shocked at how well their microbubble treatment performed in lab tests. One month after treatment, the approach had halted the growth of 94% of CCMs in lab mice. During this same time, untreated CCMs grew seven-fold.

> ***This is a clear example of serendipity in science.***

"One thing that really stands out is the magnitude of the effect. The mouse models of CCM are much more severe than human CCMs. Mouse CCMs grow exponentially. Yet despite their aggressive nature, CCMs in mice still respond completely to treatment," said Price, of UVA's Department of Biomedical Engineering. "In some studies, we even saw that brain tissue exposed to focused ultrasound with microbubbles was less inclined to harbor new CCMs in the future. If translated to humans, this prophylactic effect could open the door to treatments for so-called 'familial' patients who are genetically predisposed to acquiring multiple new CCMs throughout their lifespan."

Further, simulated treatment plans for patients with CCMs (patients who have received stereotactic radiosurgery) revealed that the approach is already viable with existing technology, though clinical trials will be needed before the federal Food and Drug Administration would consider making it available for patients.

One notable aspect of the approach is that it doesn't involve the use of any drugs. Scientists at UVA and elsewhere have been exploring the potential of focused ultrasound to briefly breach the blood-brain barrier -- the brain's natural defenses -- to allow the targeted delivery of medications for Alzheimer's and other conditions. But in both Alzheimer's and now cavernomas, the use of the sound-propelled microbubbles appears to have dramatic benefits even without drugs -- benefits scientists can't fully explain.

The promising Alzheimer's results have already led to the launch of several clinical trials testing the approach in patients. Price hopes UVA's pioneering research will prompt the launch of similar trials soon for CCMs.

"We are very interested in understanding what is in the 'black box' that somehow connects focused ultrasound to the cessation of mutant cell expansion in the CCMs. We are also returning to our original ideas about drug and gene delivery to CCMs. Since the baseline effect stabilizes the lesions, perhaps we can now think of eradicating them entirely with additional therapies," Price said. "This type of discovery is largely an outcome of the investments UVA has

Continued on the next page

Ultrasound in the News, continued

made in focused ultrasound technology over the years. There are few other institutions in the world with the critical mass of expertise and infrastructure to allow new discoveries like this."

https://www.sciencedaily.com/releases/2025/05/250515131836.htm

Using sound to 'see' unexploded munitions on the seafloor

More than 400 underwater sites in the United States are potentially contaminated with unexploded ordnance (UXO) -- weapons that did not explode upon deployment, which continue to pose a safety concern.

Connor Hodges, a doctoral student at the University of Texas at Austin, studies the changes in the acoustic characteristics of these UXOs after they have been subject to corrosion and biofouling to help detect them underwater.

"Many of these sites are in shallow water, potentially posing a threat to human safety, and date back several decades," said Hodges. "This long exposure to the environment leads to corrosion as well as encrustation in the form of barnacles or algal growth."

Corrosion and growth make UXOs difficult to observe with standard sonar imaging techniques, as the objects begin to lose resemblance to their original appearance and blend into their environment over time. These changes also alter how acoustic signals scatter from the objects, and the changes can become more severe over time as corrosion or organic growth gets worse.

Hodges and his collaborators tested a collection of AN-Mk 23 practice bombs -- miniature bombs used for dive-bombing practice -- in various stages of corrosion, which had been buried in a brackish pond on Martha's Vineyard for about 80 years. They compared the acoustics of these samples to those of pristine AN-Mk 23, monitoring the scattering response at different directions and angles.

> "Acoustic scattering techniques give an insight into the internal structure of the object imaged, as well as a method to 'see' into the seafloor,"

The researchers found the change in size, shape, and material makeup of a bomb as it corrodes changes its acoustic resonance and leads to a different, weaker scattered acoustic signal than pristine bombs. The changed acoustic signature could result in the object being misclassified or undetected.

"Acoustic scattering techniques give an insight into the internal structure of the object imaged, as well as a method to 'see' into the seafloor," said Hodges, noting that using sonar to map the seafloor and detect munitions is also faster and cheaper than other techniques.

Many former military sites used for practice bombs are shifting toward public use, making UXO identification a timely endeavor.

"There is a risk of detonation if they are stepped on or otherwise disturbed," Hodges said. "This poses a larger risk to human safety in shallow waters, and UXO identification and recovery becomes vital as old sites are transitioned away from military use."

He hopes the work can help provide better predictive tools for finding UXOs in civilian environmental demining efforts and plans to study other types of munitions as well as other types of corrosion and biofouling phenomena.

"Underwater UXO can be tricky to find and recover, so it is important that this can be done safely and effectively," said Hodges. "We hope this work will ultimately help save lives."

https://www.sciencedaily.com/releases/2025/05/250519132024.htm

Remotely moving objects underwater using sound

Sound can do more than just provide a nice beat. Sound waves have been used for everything from mapping the seafloor to breaking apart kidney stones. Thanks to a unique material structure, researchers can now move and position objects underwater without ever touching them directly.

Continued on the next page

Ultrasound in the News, continued

Dajun Zhang, a doctoral student at the University of Wisconsin-Madison, will present his work on developing a metamaterial for underwater acoustic manipulation Tuesday, May 20, as part of the joint 188th Meeting of the Acoustical Society of America and 25th International Congress on Acoustics, running May 18-23.

A metamaterial is a composite material that exhibits unique properties due to its structure. Zhang's metamaterial features a small sawtooth pattern on its surface, which allows adjacent speakers to exert different forces on the material based on how the sound waves reflect off it. By carefully targeting the floating or submerged metamaterial with precise sound waves, Zhang can push and rotate any object attached to it exactly as much as he wants.

Manipulating objects in water without touching them could make a lot of underwater work easier. It could also be used inside the human body, which is mostly water, for applications like remote surgery or drug delivery.

"Our metamaterial offers a method to apply different acoustic radiation forces on objects in liquid media, such as underwater robots and vehicles, parts for assembly, or medical devices and drugs," said Zhang.

However, manufacturing underwater metamaterials with the correct properties for object manipulation is difficult, especially with conventional methods.

"Current fabrication methods for underwater metamaterials do not provide the resolution or material properties required and are usually very expensive," said Zhang. "To solve this issue, I developed a new fabrication method. This method is not only low cost and easy to implement but also achieves high fabrication resolution and large acoustic impedance contrast with water, which are keys to underwater metamaterials."

Manipulating objects in water without touching them could make a lot of underwater work easier.

In tests, Zhang used his metamaterial to manipulate floating objects, such as wood, wax, and plastic foam, along with objects completely submerged underwater. He attached his metamaterial to each object and used acoustic waves to push, pull, and rotate them. With submerged objects, this technique gave him the ability to manipulate them in three dimensions.

Zhang plans to continue his work, developing a metamaterial patch that is smaller and more flexible. He hopes his work will lead to new uses in medicine and underwater robotics.

https://www.sciencedaily.com/releases/2025/05/250520224428.htm

From the President

Margaret Lucas

UIA President

This year's Symposium was a huge success in the beautiful city of Halifax in Nova Scotia. Thanks to Andrew Mathieson for hosting us there. There were many highlights, all detailed in this edition of Vibrations. Our middle day focus on 'concept to IP' was a new feature and was really interesting. We had plenty of inspiration from local academic and industry participants, including a fascinating and insightful invited talk by Jeremy Brown of Dalhousie University on mixing an academic and entrepreneurial career. More research advances in ultrasonics in Canada were showcased by our invited speakers, Kullervo Hynynen from Synnybrook in Toronto on ultrasound therapy and Mae Seto from Dalhousie in Halifax on underwater acoustics. We honoured Karl Graff as Fellow of UIA for his career-long major contributions to power ultrasonics, many of which he highlighted in his fascinating talk about his 60 years of work in ultrasonics research and innovation. As always at the UIA symposia, the networking and socialising were as important as the talks – you learn a huge amount of new information in a short few days and have a great time meeting new fiends and catching up with old ones. In April 2026 we are off to Salt Lake City – please come and join us!

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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.

UIA 54
powering sound ideas
20 - 22 April 2026
Hilton Salt Lake City Center, Utah, USA

Important Dates

11 September 2025: Virtual Collaborations Part 1 10 am EDT

9 October 2025: Virtual Collaborations Part 2 10 am EDT

2 February 2026: Abstracts due for UIA54

23 March 2026: Deadline to make hotel reservations for UIA54

20 - 22 April 2026: UIA54, Hilton Salt Lake City Center, Utah, USA