Volume 29, Issue 2: 2019 Summer 2019

Vibrations

Powering Sound Ideas

Sound Solutions: Glasgow, Scotland 6 October 19

The Ultrasonic Industry Association are holding their Sound Solutions Meeting in Glasgow, UK on **Sunday October 6th 2019**, just prior to the IEEE International Ultrasonics Symposium. SS2019 will be co-chaired by Mark Hodnett (NPL) and Rebecca Cleary (University of Glasgow).

The theme for the half-day meeting is Therapeutic Ultrasound, and the Invited session will include presentations on soft tissue therapies, ultrasound surgery and drug delivery. Our guest speakers will include Kevin Houser (Ethicon, a Johnson and Johnson company), Thomas Stritch (Stryker) and Brad Treeby (University College London).

We will also include a Participation Session, featuring further speakers and extended agenda time for discussion around particular therapeutic ultrasound topics raised by the presenters and by delegates. We will also feature some of the exhibitors from the IEEE IUS for elevator pitches of their latest products.

SS2019 is priced at just $150, and will start at 1pm on 6 October.

Register Now

Special Points of Interest

- Janet Devine newest UIA Honorary Member - page 8
- Ultrasound Improves Colon Cancer Detection - Pages 9-10
- UIA49 Call for Abstracts - Page 12
- Make your reservations for UIA49 - Page 12

UIA 48: Toronto, Canada April 2019

Toronto, ON welcomed the Ultrasonic Industry Association from April 15-17th 2019, for its 48th Symposium. Many of our 60 delegates arrived in town to chilly winds and heavy rain: yet our presentations, posters, visit programme and exhibitors provided a bright, vibrant contrast, showcasing new products, research and opportunities in medical and industrial ultrasonics.

Our Symposium was opened by UIA President

Dominick DeAngelis (Kulicke and Soffa Industries), who welcomed the delegates, and gave an overview of the three-day programme. He introduced Andy Mathieson (Thales UK) as co-chair of the session, who then re-introduced Dominick as the first speaker. Kulicke and Soffa are amongst the worldwide leaders in ultrasonically-enabled wire-bonding, used extensively in PCB manufacture for smartphones and tablets.

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To ensure high bonded chip yields, Dominick's challenge year-on-year is to manufacture the most consistent and reliable ultrasound solution for the task. He presented a detailed study of transducer current gain and electromechanical coupling, correlating experimental results with finite-element analysis, and showing the variations in eight candidate materials as 'drop-in' replacements for standard parts. Making tools and testing appears to be a much more useful approach than relying on catalogue data.

Next up was **Timo Scholehwar** from PI Ceramic. Timo discussed in detail the real world challenges in designing and manufacturing thickness-mode resonators, describing specifically the issues with cross-coupling (electrical and mechanical) and mode-splitting. Solutions include geometric variations (to achieve slight detuning) and damping (adding more glue), and a composite approach, yielding a well-behaved performing device.

The next presentation was given by UIA Board Member Rasmus Lou-Moeller (Meggitt A/S), and he talked about a vitally-important issue for the ultrasonics industry: lead-free

Rasmus Lou-Moeller

piezoelectrics. European legislation is progressively removing lead-based and lead-included products from the marketplace. Since 2002, PZT has been part of an exemption, but this situation will not sustain indefinitely. Meggitt are asked regularly by their customer base to develop lead-free alternatives to PZT, specifically for medical applications, and to show what can be done, Rasmus presented an example of a bismuth-based material, working as an accelerometer in an automotive application. A key message from his talk was that device manufacturers must take a holistic approach, and not consider lead-free materials as a drop-in replacement for existing piezoelectrics: instead, although initially more disruptive, devices should be designed for lead-free materials from the ground up. This will be the subject of further discussion within our UIA community.

Jens Twiefel (Leibniz University, Hannover) then described his work on high-speed, high-magnification optical observation of ultrasonic bonding. The optics chosen gave a 1mm/pixel resolution, allowing close inspection (from beneath) of the deformations occurring during the application of a 60 kHz tool acting

Jens Twiefel

upon aluminium wire. The approach also works well for ultrasonic machining – specifically stone-cutting, where it was used for scratch test observation, showing the different cut widths and profiles achieved with ultrasound assistance.

Next, **Amin Moghaddas,** a PhD student of UIA Honorary Member Karl Graff at EWI, discussed his research into measuring vibration amplitude during ultrasonically-assisted drilling: the clear challenge here is the access to the actual region of interest. Using a 20 kHz vibration, providing amplitudes of vibration up to 25 mm, two amplitude measurement approaches were used: one by inspecting the oscillatory striations on the downhole sidewall, and the other by looking at the collet amplitude.

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Both of these were then applied to systematic drilling tests on brass samples, loaded and unloaded, to examine the amplitude reduction. The next steps will examine alloy steel and titanium.

UIA Board Member **David Grewell** (North Dakota State University) described collaborative research with Branson Ultrasonics, and UIA Titanium Sponsors Dukane Ultrasonics, into welding of PLA. PLA is a biodegradable thermoplastic, derived from renewable biomass, such as corn or sugarcane. It is used extensively in food and FMCG packaging. Welding and joining regions are typically where part integrity is weakest, and David presented a valuable overview of how welding processes work. His research group modelled the weld region (where asperity peaks interact) as a series of cylinders between plates, using ANSYS, and compared the results with simple 'top hat' welds to predict strengths, using the outcomes to ascertain the optimum welding velocity-time profiles for effective unions.

In a change to the Onsite Programme, President Dominick DeAngelis then brought us up to date with all matters UIA, by way of a business meeting. The key points arising were the proposal, seconding and unanimous approval of a motion to accept the proposed slate of the Board of Directors, as prepared by immediate Past President Tony Crandall, including new member Justin Beyers (Bonutti Technologies) and a welcome return for Jeff Vaitekunas (Penn State). As described elsewhere in *Vibrations*, in recognition of her many decades of tireless leadership, advocacy and support for UIA, we are making Janet Devine (Sonobond) an Honorary Member, and our grateful thanks go to her for all the she has done for the Association. Dominick also explained how we are moving to a self-publishing model for our Symposium papers, which will be peer-reviewed by Board Members, hosted on Xenodo and provided with Doi numbers. Our 2020 Symposium will be in Warwick, UK (*see Call for Papers on page 12*), and a promotional video was shown to trailer the beautiful surroundings there.

Following our lunch break, with an excellent range of buffet food, our first afternoon speaker was **Robert Aldaz** from Dukane Corp, who updated delegates on the latest advances in transducer technologies and driver developments. Responding to customer needs, Dukane have added new frequencies to their product range, up to 70 kHz, where they are seeing demand for precision control for joining medical product assemblies. They have also developed custom transducers, incorporating ANSYS Finite Element modelling to look at the performance of custom tip profiles, and have improved the automation capabilities of their generator family.

UIA Secretary Mark Hodnett (NPL) then described some recent research into protocols for controlled ultrasound exposures of nanomaterials, specifically graphite, to generate graphene. This high profile (Nobel Prize-winning) material is being used in photovoltaics, electrical, thermal and mechanical strength applications, and using acoustic cavitation, can be produced with specific size distributions. NPL have tested a range of sonication methods in a multi-frequency reactor, have a publication due in June, and are now talking with exploitation partners.

Closing up the first day was UIA Board Member **Andy Mathieson** (Thales), who described the application of additive layer manufacture in sonar applications, and more broadly in the maritime. Andy leveraged his previous research work at the University of Glasgow, investigating the performance of various conventional and AM titanium rod horn configurations. Measured values for parameters such as density and material moduli showed good agreement between the rod material types. Once some assembly challenges

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were ironed out, the resulting beam profiles and transmit sensitivities also agreed well. Andy sees that the barriers to take up are the present high cost, and overcoming regulation, but the performance is clearly good.

Delegates then enjoyed an excellent Evening Reception, provided by our Titanium Sponsors Dukane, with some very tasty seafood, cheese and a selection of Canadian beers.

Day 2 saw an initial welcome from Symposium Chair **Jay Sheehan**, who then introduced the first of two exposition presentations from the local Toronto research groups. First up was the Sunnybrook Research Institute, with wide-ranging and detailed talks given by Christine DeMore and Meaghan O'Reilly. Sunnybrook are an offshoot from University of Toronto, focusing on new technology developments. They have over 300 scientists, carrying out $100m of research per year, and are the world's first Centre for research in image-guided therapeutics.

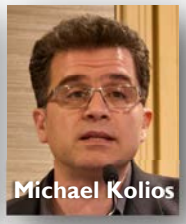
Their first research topic discussed in detail was ultrasound imaging: an initial overview of harmonic and pulse-inversion methods, and then focusing on the contrast and imaging enhancement provided by microbubbles, at frequencies up to 100 MHz. An innovation spun out from this work was Visualsonics, who are amongst the world leaders in pre-clinical imaging systems. This led on to a photoacoustics, which is a rapidly-growing modality exploiting rapid local expansion in tissue which absorbs laser light, generating broadband soundwaves: it specifically can detect oxygen saturation in blood, and so is a versatile imaging method, which is beginning to find clinical traction.

Their next technical topic was on ultrasound therapeutics, particularly the deployment and testing of multi-element hemispherical arrays for brain treatments: accessing the brain is a particular challenge due to the dispersion caused by the skull, which is overcome by applying phase corrections. This enables focused lesion sites to be generated, which is finding treatment applications for conditions such as essential tremor. MR thermometry is used at low power levels to check targeting accuracy. Sunnybrook are also working on the application of ultrasound for drug delivery via opening the blood-brain barrier (this is a topic which UIA have covered previously too), and for focused treatments to the spine.

The final speaker from Sunnybrook was Raphael Ronen, who is their Senior Commercialisation Manager. He has overseen the spin-out of several successful tech companies arising from Sunnybrook innovations, spanning diagnostic to therapeutic applications and products. His goal is to embed an entrepreneurial culture amongst scientists, encouraging them to think commercially from early stage research: to support this, Sunnybrook have facilities for device manufacture and testing. He also described a fascinating program named Medventions, which is aiming to train the next generation of Medtech entrepreneurs to close the development gap between innovation and commercialisation.

Following coffee, our attentions turned to the research programmes under way at Ryerson University. Michael Kolios and Jahan Tavvakoli were our guides, taking us through a broad range of


Jahan Tavakoli


Michael Kolios

topics, again spanning the diagnostic and therapeutic fields of ultrasound. Like Sunnybrook, a particularly high profile area of study for Ryerson is photoacoustics, in which they carry out multi-spectral tomography and molecular imaging. They have active ongoing research collaborations with hospitals (including Sunnybrook, and the Princess Margaret and St. Michael's Hospital), and offer Batchelor's and Master's degrees in Medical and BioMedical Physics respectively. Their partnership with St. Michael's Hospital forms the Institute for Biomedical Engineering, Science and Technology (iBEST), with laboratories in central Toronto.

Their therapy research spans high and low power applications, investigating tumour treatments primarily, but also noninvasive procedures for neurosurgery and orthopaedics, all under ultrasound image guidance. Jahan described a neat technique for synthetic aperture focusing at high frequencies, and signal-processing approaches specific to HIFU lesion imaging, examining tissue properties such as nonlinearity and stiffness. They also have an interesting project looking at the possible use of HIFU for providing extracorporeal nerve blocking (usually carried out via a needle under ultrasound guidance), which has shown promising results during tests on earthworms, lobsters and swine. Amongst the most fascinating current examples was a study of traumatic brain injury (TBI), using a zebrafish model: zebrafish are surprisingly quite genetically similar to humans. A HIFU system was used to generate a TBI in the zebrafish, with protein markers used to indicated apoptosis. Their future work streams include incorporating cannabidiol with HIFU for

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targeted drug delivery, using gold nanoparticles as vehicles, and a low intensity device for local pain relief.

Overall, the morning session was well-received by delegates, with detailed discussions following on, and future collaboration ideas conceptualised.

Lunch was accompanied by our Poster Session, featuring work from both Sunnybrook and Ryerson, alongside new research from the University of Glasgow examining piezo material development and characterisation. Concurrently, delegates took the opportunity to network with our exhibitors *(Fran – include list here)*, renewing relationships and building new ideas together.

Delegates then made their own way (many on foot, helping to burn off the delicious lunch) to the Li Ka Shing Knowledge Institute for the Ryerson Laboratory tours at iBEST. Here, our delegates were guided around a range of interesting exhibits, with the presentations from the morning session brought to life by the bright and engaging student and researcher cohort. We saw projects investigating HIFU lesion assessment, high frequency materials characterisation, nonlinear ultrasound thermometry and some excellent work on photoacoustics, using both animal models and mimicking materials.

Our tour concluded in good time for delegates to enjoy some downtime, and then for us all to make our way to the Mill Street Brewery for our Symposium Dinner. Located in the heart of the Historic Distillery District, delegates enjoyed a private space at the back of the venue, and sampled the varied delights from the on-site microbrewery, with a range of flights on offer. The food menu was also excellent, with the butternut squash ravioli and apple pie being particular highlights.

Day 3 was our Medical Sessions, with co-chair Justin Beyers running the

morning for us. Our first speaker was **Jason Winder** (Acoustic Sciences Associates (ASA)), who described a project that he and UIA Board Member Robert Muratore have collaborated on, investigating proof-of-concept of a new bi-modal LIPUS (low-intensity pulsed ultrasound) device for promoting bone healing (the existing state of the art in this space is EXOGEN, which is based on innovations dating back a quarter-century). Using a rabbit fibula model, this first study showed improvements of 25% in bone strength when compared to the current market device, positioning ASA for provisional patent disclosure.

Justin Byers

Robert himself was up next, with an intriguing insight into how the potential benefits of ultrasound neuromodulation might be determined, alongside other forms of energetic stimulation. Taking a mechatronics systems model (itself a close parallel of the human nervous system) illustrates pathways and injection points for receptor stimulation: ultrasound is a strong candidate for doing so in a precise manner due to its excellent spatial and temporal control. Future studies will involve collaboration with artists, to explore such new artificial senses.

Following refreshments, UIA Board Member **Kevin Houser** (Johnson and Johnson) gave us a great refresher in the timeline of medical ultrasound intellectual property ('a brief history of time' – perhaps a protracted phase shift?!), taking us from Langevin's SONAR transducers, through Cavitron, CUSA in the 1970's, and so on. He focused on the diverse areas of surgical/ cutting device patents, and then onto HIFU, with its progression towards tumour destruction using cavitation, and cell barrier transference. before describing in more detail the need for inventors within companies to develop strategies for their innovation portfolio. Interestingly, the patent landscape now seems to incorporate increasing number of disclosures around software and algorithms, which potentially provide a quicker return on investment.

Taking us up to lunch, Symposium

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Chair Jay Sheehan facilitated a new idea for the UIA – "Questions in Ultrasonics." The aim of the hour-long session was to open the floor to all delegates to ask their burning questions: some of these related specifically to the earlier talks, and offered the opportunity for more detailed discussions where research experiences and ideas were exchanged. Other broader issues were talked about, including medium-term and in-service piezoceramic performance under elevated temperatures, and, perhaps most interestingly, a more in-depth discussion on the lead-free ultrasound devices challenge which was raised initially during the Industrial Session. Several users and manufacturers put their views forward, and this will be taken forward as an agenda item for UIA Board Meetings and future Symposia.

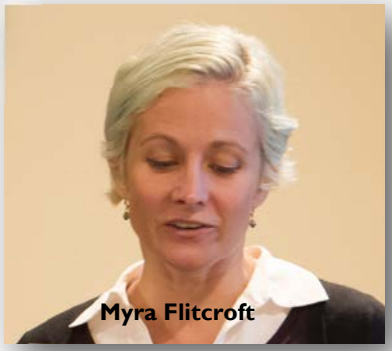
Following another delicious luncheon, our closing session of the Symposium was looked after by co-chair Myra Flitcroft (Moog SLC Ultrasonics).

The first speaker was **Graham Ferrier** from Ryerson, who talked in more detail about the TBI studies described by Jahan earlier in the day. Harnessing the controllability and specificity of pulsed HIFU, Graham described validation methods for ultrasound exposimetry, and 3D simulations to carry out parallel investigations of controlled mechanical injury of zebrafish brain *in vivo*, and mouse brain endothelial cells in culture, over a wide range of focal pressures. Following exposure the zebrafish locomotor behavioural function was studied, showing anxiety symptoms; the mouse cell lines showed nuclei shape deformation. Future studies will include higher ultrasound frequencies.

Our second speaker was **Christine Demore**, speaking about her work on micro-ultrasound technologies, in particular harnessing the technology advancements of the Visualsonics system to support regional anaesthesia, using frequencies up to 40 MHz on a porcine model. The high resolution provided by the scanner allows precise visualisation, such that it can evaluate the risks of damage via direct nerve injection. Future work will evolve towards Thiel cadavers.

Christine Demore

Myra herself then presented a detailed systematic study on ceramic ageing, a topic which was touched upon in the morning 'Questions…' session. A particular driver for the work, which is an issue facing all device manufacturers, is batch-to-batch consistency. Using a simple dumbbell configuration, PZT-8 rings were sourced from four manufacturers, and their performance scrutinised, examining capacitance, coupling coefficient, stroke. Across suppliers, results were generally comparable at low powers, but at high powers, the differences in performance were greater, particular when examining dry- vs epoxy- stacks. The significant number of questions and discussion points raised by delegates following the talk demonstrated the importance of this topic in real-world products.



Myra Flitcroft

Our penultimate presentation was from returning UIA Board Member **Jeff Vaitekunas** (Penn State). Revisiting some of his work from OmniSonics Medical Technologies, Jeff spoke in detail about the anatomical challenges of delivering ultrasound to the correct region, particularly when carrying out procedures such as peripheral thrombectomy. He discussed the reflection and mode conversion issues in a proximal waveguide, using a model system of wires over feed wheels, with ultrasound vibrations detected using a laser vibrometer. A particular focus was on double-bend transmission, explored over a range of bend diameters at high and low power regions. As expected, additional bends compound the challenge of delivering effective ultrasound excitation at the distal tip, which has significant implications for system control and feedback.

Our final speaker was **Rebecca Cleary** (University of Glasgow), who described her research on ultrasonic surgery. Their standard approach to applicator design is based on a combination of finite-element and experimental modal analysis, with tests carried out on bone mimics formed from polyurethane foams. Rebecca is looking in particular at the petrous apex, which is difficult to access due to its medial location in the skull base, hence requiring long surgeries with greater risk of morbidity. Taking

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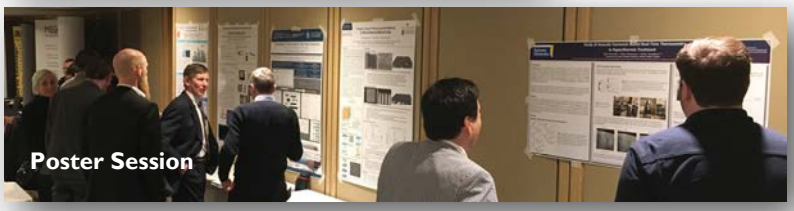
advice from surgeons, and initially using a combined longitudinal-torsional needle design, penetrating through the mastoid in a commercial model system was initially successful: however moving to animal bone showed high temperatures were created near the needle tip, resulting in thermal necrosis. The next step is to look at variations to the needle design (longitudinal-only, more piezo rings, higher frequencies, lower mass, hollow vs solid drill bit) to improve future clinical performance.

The breadth of topics covered, and the detailed depth within them made Toronto one of our most diverse meetings yet, showing that there is still valuable engineering and science research to be done in ultrasonics. UIA President Dominick DeAngelis then closed the Symposium, with a rallying call for delegates to join us in Europe for UIA #49. See you all in Warwick in April 2020!

Scenes From UIA48

All photos by Mark Hodnett



Janet Devine Awards Honorary Membership by UIA Board

In April 2019 the UIA Board of Directors received and reluctantly accepted the resignation of a Board Member and dear friend, **Janet Devine.** For those who may not know, Janet is a long time member of the organization and served as President of the UIA from 1997 to 1999. She has also held the position of Vice President and was Board Secretary for many years. She has played a large role in building the UIA from its roots as a loose alliance of domestic industrial high power ultrasonic manufacturers into a strong multinational technical association spanning research and applications, as well as manufacturing of medical, scientific and commercial ultrasound devices.

Janet's impact on the Ultrasound Industry goes far beyond her efforts for the UIA. She was born and educated in England and graduated from the prestigious Imperial College of the University of London, with a B.Sc. Degree in Mathematics and Physics. After immigrating to the US in 1959, she joined the predecessor company to Sonobond Inc., which was working on the then nascent concept of using ultrasound energy for metal welding. Ms. Devine has been an active participant in the development of many of the most significant commercial and industrial systems and applications for ultrasonic metal welding and forming, many of which are employed to this day. She served as the company's Vice President and Technical Director.

In 1990, she was named President of Sonobond Inc., a position she still holds as of this writing, when it was rare for a women to head an important technology company.

Ms. Devine has been awarded multiple patents. She has also authored numerous papers in the field of ultrasonic metal welding, textile bonding, and ultrasonic processing (e.g., extrusion and wire drawing). Several of the papers were presented at UIA Symposia over the years.

In 1991, she was a member of the committee that authored the chapter on Ultrasonic Welding for Volume 2, Eighth Edition of the American Welding Society's *Welding Handbook*. She also authored the chapter on "Ultrasonic Welding" for the ASM International Handbook, *Volume 6A - Welding Fundamentals and Processes,* November 2011.

As much as, if not more so than these accomplishments and accolades, Janet has had a lasting impact on the technical community through her willingness to give others of her knowledge and insights into the world of ultrasound. She has always been quick to answer questions and provide information to technologists in the field, even if it outside of her normal business scope. In this way, she has encouraged the expansion of the application of ultrasound energy in science, medicine and commerce.

In recognition of her long time service to the UIA and her significant contributions to the Ultrasound Industry, we are proudly awarding a Lifetime Honorary Membership in the UIA to Janet Devine

The entire UIA Board thanks Janet, wishes her well in the years to come and looks forward to our crossing paths again.

Janet Devine accepts the glass plaque commemorating her honorary membership from Dominick DeAngelis at the Sonobond Ultrasonics office.

Ultrasound Applications in the News

A miniature robot that could check colons for early signs of disease

Engineers have shown it is technically possible to guide a tiny robotic capsule inside the colon to take micro-ultrasound images.

Known as a Sonopill, the device could one day replace the need for patients to undergo an endoscopic examination, where a semi-rigid scope is passed into the bowel -- an invasive procedure that can be painful.

Micro-ultrasound images also have the advantage of being better able to identify some types of cell change associated with cancer.

The Sonopill is the culmination of a decade of research by an international consortium of engineers and scientists. The results of their feasibility study are published today (June 19th) in the journal Science Robotics.

The consortium has developed a technique called intelligent magnetic manipulation. Based on the principle that magnets can attract and repel one another, a series of magnets on a robotic arm that passes over the patient interacts with a magnet inside the capsule, gently maneuvering it through the colon.

The magnetic forces used are harmless and can pass through human tissue, doing away with the need for a physical connection between the robotic arm and the capsule.

An artificial intelligence system (AI) ensures the smooth capsule can position itself correctly against the gut wall to get the best quality micro-ultrasound images. The feasibility study also showed should the capsule get dislodged, the AI system can navigate it back to the required location.

Professor Pietro Valdastri, who holds the Chair in Robotics and Autonomous Systems at the University of Leeds and was senior author of the paper, said: "The technology has the potential to change the way doctors conduct examinations of the gastrointestinal tract.

"Previous studies showed that micro-ultrasound was able to capture high-resolution images and visualise small lesions in the superficial layers of the gut, providing valuable information about the early signs of disease.

"With this study, we show that intelligent magnetic manipulation is an effective technique to guide a micro-ultrasound capsule to perform targeted imaging deep inside the human body.

"The platform is able to localise the position of the Sonopill at any time and adjust the external driving magnet to perform a diagnostic scan while maintaining a high quality ultrasound signal. This discovery has the potential to enable painless diagnosis via a micro-ultrasound pill in the entire gastrointestinal tract."

Sandy Cochran, Professor of Ultrasound Materials and Systems at the University of Glasgow and lead researcher, said: "We're really excited by the results of this feasibility study. With an increasing demand for endoscopies, it is more important than ever to be able to deliver a precise, targeted, and cost-effective treatment that is comfortable for patients.

"Today, we are one step closer to delivering that.

"We hope that in the near future, the Sonopill will be available to all patients as part of regular medical check-ups, effectively catching serious diseases at an early stage and monitoring the health of everyone's digestive system."

The Sonopill is a small capsule -- with a diameter of 21mm and length of 39mm, which the engineers say can be scaled down. The capsule houses a micro ultrasound transducer, an LED light, camera and magnet.

A very small flexible cable is tethered to the capsule which also passes into the body via the rectum and sends ultrasound images back to a computer in the examination room.

The feasibility tests were conducted on laboratory models and in animal studies involving pigs.

Diseases of the gastrointestinal tract account for approximately 8 million deaths a year across the world, including some bowel cancers which are linked with high mortality.

Source: www.sciencedaily.com/releases/2019/06/190619142523.htm

Ultrasound-assisted optical imaging to replace endoscopy in breakthrough discovery

Carnegie Mellon University's Assistant Professor of Electrical and Computer Engineering (ECE) Maysam Chamanzar and ECE Ph.D. student Matteo Giuseppe Scopelliti today published research that introduces a novel technique which uses ultrasound to noninvasively take optical images through a turbid medium such as biological tissue to image body's organs. This new method has the potential to eliminate the need for invasive visual exams using endoscopic cameras.

In other words: one day, scopes may no longer need to be inserted into the body, such as down the throat or under the skin, to reach the stomach, brain, or any other organs for examination.

Endoscopic imaging, or using cameras inserted directly inside the body's organs to investigate symptoms, is an invasive procedure used to examine and diagnose symptoms of deep tissue disease. Endoscopic imagers, or cameras on the end of catheter tubes or wires, are usually implanted through a medical procedure or surgery in order to reach the body's deep tissues, but Chamanzar's new technique provides a completely non-surgical and noninvasive alternative.

Ultrasound Applications in the News, continued

The lab's paper published in Light: Science and Applications, a journal published by Springer Nature, shows that they can use ultrasound to create a virtual "lens" within the body, rather than implanting a physical lens. By using ultrasonic wave patterns, the researchers can effectively "focus" light within the tissue, which allows them to take images never before accessible through noninvasive means.

Biological tissue is able to block most light, especially light in the visible range of the optical spectrum. Therefore, current optical imaging methods cannot use light to access deep tissue from the surface. Chamanzar's lab, however, has used noninvasive ultrasound to induce more transparency to enable more penetration of light through turbid media, such as biological tissue.

"Being able to relay images from organs such as the brain without the need to insert physical optical components will provide an important alternative to implanting invasive endoscopes in the body," says Chamanzar. "We used ultrasound waves to sculpt a virtual optical relay lens within a given target medium, which for example, can be biological tissue. Therefore, the tissue is turned into a lens that helps us capture and relay the images of deeper structures. This method can revolutionize the field of biomedical imaging."

Ultrasound waves are able to compress and rarefy, or thin, whatever medium they are flowing through. In compressed regions, light travels more slowly compared to rarefied regions. In this paper, the team shows that this compression and rarefication effect can be used to sculpt a virtual lens in the target medium for optical imaging. This virtual lens can be moved around without disturbing the medium simply by reconfiguring the ultrasound waves from outside. This enables imaging different target regions, all noninvasively.

The published method is a platform technology that can be applied in many different applications. In future, it can be implemented in the form of a handheld device or wearable surface patch, depending on the organ being imaged. By placing the device or patch on the skin, the clinician would be able to easily receive optical information from within the tissue to create images of what's inside without endoscopy's many discomforts and side effects.

The closest current applications for this technology would be endoscopic imaging of brain tissue or imaging under the skin, but this technique can also be used in other parts of the body for imaging. Beyond biomedical applications, this technique can be used for optical imaging in machine vision, metrology, and other industrial applications to enable nondestructive and steerable imaging of objects and structures at the micron scale.

The researchers showed that the properties of the virtual "lens" can be tuned by changing the parameters of the ultrasonic waves, allowing users to "focus" images taken using the method at different depths through the medium. While the LSA paper is focused on the method's efficacy for closer-to-the-surface applications, the team has yet to find the limit to how deep within the body's tissue this ultrasonically-assisted optical imaging method can reach.

"What distinguishes our work from conventional acousto-optic methods is that we are using the target medium itself, which can be biological tissue, to affect light as it propagates through the medium," explains Chamanzar. "This in situ interaction provides opportunities to counterbalance the non-idealities that disturb the trajectory of light."

This technique has many potential clinical applications, such as diagnosing skin disease, monitoring brain activity, and diagnosis and photodynamic therapy for identifying and targeting malignant tumors.

In addition to the direct implications this research has on clinical medicine, it will also have indirect clinical applications. By using this acousto-optic technology to view mouse models of brain disorders in action and selectively stimulate different neural pathways, researchers would be able to study the mechanisms involved in disease conditions such as Parkinson's, informing the design of next generation clinical therapeutic interventions to treat these diseases in humans.

"Turbid media have always been considered obstacles for optical imaging," says Scopelliti. "But we have shown that such media can be converted to allies to help light reach the desired target. When we activate ultrasound with the proper pattern, the turbid medium becomes immediately transparent. It is exciting to think about the potential impact of this method on a wide range of fields, from biomedical applications to computer vision."

The researchers project that this new imaging technology could be applied in biomedical and clinical contexts within the next five years.

Source: https://www.sciencedaily.com/releases/2019/07/190717090342.htm

From the President

Dominick DeAngelis

UIA President

I would like to thank everyone who attended our 2019 Symposium in Toronto this year, for making it one of the best and most successful in UIA's history! I hate to be one of those "I told you so," types, but I told you "this is the one that will definitely exceed your expectations." I just knew we had the right location and organizing team in-place with their abundance of energy and passion, so my hat goes-off to our symposium chair Jay Sheehan, executive director Fran Rickenbach, medical session chairs Justin Byers and Myra Flitcroft, industrial chairs Andrew Mathieson and Andrew Feeney (i.e., Andrew^2), and poster chair Mark Hodnett, for pulling-this-off in flying colors! I would also like to extend a special thanks to our UIA director Robert Muratore who suggested Toronto as our destination, and for volunteering to be the editor of the UIA 2019 Toronto proceedings.

Even with all the accolades to our organizing team, we still had lots of outside help: the city of Toronto really attracted a diverse array of presenters that is the epitome of what every UIA Symposium could be. With the great support from Toronto's vast ultrasonic community, Tuesday's session provided a broad swatch of the amazing medical research being done at Toronto's Ryerson University, Sunnybrook Research Institute, and the Li Ka Shing Knowledge Institute. If you did not learn something from these groups, then you are not working in ultrasonics for sure! We also tried a few new things this year, such as a question and answer session and lead-free piezoceramic forum, that I hope will help the UIA continue to evolve in the future.

For those who missed the UIA symposium this year, don't worry since our new 2020 Symposium chair Mark Hodnett never disappoints! Also, if you liked what you saw this year, consider becoming a UIA member and getting involved with our organization, or just check-out our website. I hope to see you all next year at University of Warwick in the United Kingdom!

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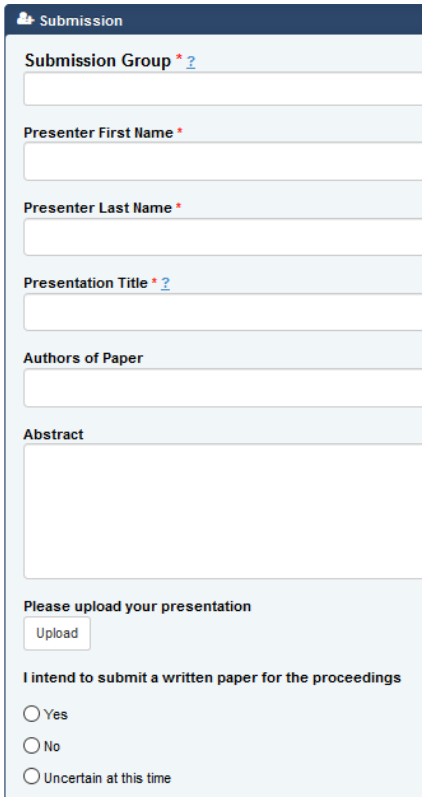
Call for Papers

The abstract submission website is now open for UIA49. This symposium will feature both medical and industrial applications for ultrasound, results of research, workshops that investigate different aspects of ultrasound and posters from graduate students.



To submit your abstract:

1. Go to https://tinyurl.com/UIA49Abstract
2. Create your account (email, name, country)
3. Click on **Submissions** from the menu at the top of the page
4. Click on **Add New**
5. Complete the information. You can upload a document with your abstract or cut and paste into the text box.
6. You will receive two emails - one confirming your profile creation and another one confirming your abstract submission with a link to your information.

Please submit your abstracts by 31 October. If you have any questions, please email uia@ultrasonics.org and we'll get back to you quickly.

Planning your trip to UIA49

This year's symposium will begin at 8:30 am on **Wednesday, 22 April** and conclude by 5:00 pm on **Friday, 24 April 2020.**

The symposium will be held at the **Conference Center at Warwick University.** There is a 4★hotel-style B&B for Symposium participants at the rate of £88 + VAT single / £108 + VAT double (includes breakfast). You can make your reservations **here**.

Traveling to Warwick

Birmingham International Airport is roughly 20 minutes away. The **Coventry**, **Warwick** and **Leamington Spa** stations are all close by, with regular trains, seven days a week.

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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

6 October 2019: Sound Solutions, Glasgow Event Center (prior to IEEE IUS) Register at **https://tinyurl.com/UIA19SS**

7 October 2019: Registration open for UIA49

31 October 2019: UIA49 Abstract Submission Deadline https://tinyurl.com/UIA49Abstract

17 March 2020: Last day to make hotel reservations at Warwick University

22 - 24 April 2020: UIA49 Warwick University Conference Center, Warwick, England, UK