Volume 23 Issue 1: 2020 Winter 2020

Vibrations

Powering Sound Ideas

UIA49: Warwick University, England, UK

The Ultrasonic Industry Association is looking forward to UIA49, to be held at the Warwick University in Warwick, England, UK on 22 - 24 April 2020.

Medical Session: Wednesday, 22 April

Robin Cleveland, *University of Oxford,* will present *Shock Wave Induced Drug Delivery* as the keynote speaker for the Medical Sessions.

Thursday, 23 April will feature workshops on ultrasound as well as laboratory tour of the ultrasound facilities at Warwick University.

Our Thursday evening event will be held at Warwick Castle - this event is included as part of the full registration for the symposium.

Register Now

Industrial Session Friday, 24 April

Rob Perkins and **Mike Draper, *Sonic Systems*,** are the keynote speakers for the Industrial Sessions.

The complete schedule of presentations starts on page 3.

Special Points of Interest

IEEE UFFC Lead-Free Piezo Forum

IEEE Ultrasonics, Ferroelectrics and Frequency Control Society

On **Monday, 20 April - Tuesday, 21 April 2020**, the IEEE UFFC will be holding a forum to continue the discussion of lead free piezomaterials and their use in industrial and medical applications. The purpose of the discussion will be to generate input to a paper eligible for peer review publication in TUFFC. The paper will outline the upcoming challenges in going from a lead containing to lead free piezoceramic, from an industrial point of view. This discussion began at UIA48 with a presentation from Rasmus Lou-Moeller, Meggitt, who discussed the upcoming EU regulations and the impact they will have on the ultrasonic industry. UIA48.

This discussion continued at Sound Solutions prior to the IEEE/IUS symposium in Glasgow in October 2019.

If you are interested in representing your company at this forum, please contact Rasmus Lou-Moeller, Director of Engineering and Business Development, at rasmus.lou-moeller@meggitt.com.

Please note, attendance at this workshop is limited..

Call for Posters

The abstract submission website is open for 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 posters by 16 March. If you have any questions, please email uia@ultrasonics.org and we'll get back to you quickly.

Interested in exhibiting at UIA49? Click here to learn more.

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, with taxi services to Warwick University.

Make your reservation at Warwick University prior to 16 March 2020.

Medical Session Schedule: Wednesday, 22 April 2020

8:30 **Registration and Coffee/Tea**

9:15 **Introduction and Welcome to UIA49**

9:30 **An augmented guidance system with multi-modal registration and fast thermal dose computation for thermal ablation of hepatic tumours**
Jinao Zhang and Sunita Chauhan, Monash University

10:00 **An evaluation of 3D Printed Ti-6Al-4V bone penetrating needles**
Rebecca Cleary and Margaret Lucas, University of Glasgow

10:30 **Unconference & Refreshments**

11:15 **Photoacoustics: metrological applications and requirements for quantitative imaging** Anant Shah, Aoife M. Ivory, Srinath Rajagopal, Bajram Zeqiri, National Physical Laboratory

11:45 **Improved segmentation of Intravascular Ultrasound (IVUS) images using fully convolutional networks in the polar domain**
Martin Szarski and Sunita Chauhan, Monash University

12:15 **Luncheon**

13:15 **Exhibitor Presentations**

13:30 **Keynote presentation: Shock wave induced drug delivery**
Robin Cleveland, University of Oxford

14:30 **Unconference & Refreshments**

15:15 **Incorporation of Dynamic Structures in Miniature Ultrasonic Surgical Devices**
Xuan Li and Margaret Lucas, University of Glasgow

15:45 **Numerical modelling of acoustic microbubbles in OpenFOAM** Jacqueline Mifsud, Duncan Lockerby, Yongmann Chung, Gordon Jones, University of Warwick; Waters Corporation

16:45 **Session Concludes**

Wine and Cheese Reception

Following the completion of the day's proceedings, delegates are warmly invited to join us for the customary UIA Wine and Cheese Reception in the early evening, before proceeding to a full evening dinner of your own choosing.

Workshops - Posters - Lab Tour Tuesday, 23 April 2020

9:00 **Registration and Coffee/Tea**

9:30 Workshops

Programme to be confirmed, will include an update on the ongoing topic of lead-free ultrasonic products

11:30 Refreshments & Poster Session

A case study in piezoelectric single crystal use for high power applications

Nicola Fenu, Nathan Giles-Donovan, Sandy Cochran, University of Glasgow

A miniature transducer for focussed ultrasound surgery

Jack Stevenson, Margaret Lucas, University of Glasgow

A Predictive Algorithm for Simulating the Dynamics of Flexural Ultrasonic Transducers

William E. Somerset, Lei Kang, Andrew Feeney, and Steve Dixon, University of Warwick

Electromagnetic Acoustic Transducers (EMATs) for driving guided waves on composite aerospace structures

S. Amato, D.A. Hutchins, S. Dixon, University of Warwick

Suitability of Electromagnetic Acoustic Transducers for Inspection of Titanium Laser Welds

Christian Peyton, Rachel Edwards and Ben Dutton, University of Warwick

In Situ Non-Contact Pressure Measurement of Sealed Units Using Acoustic Methods

Elizabeth Sharp and Steve Dixon, University of Warwick

12:15 Luncheon

13:45 Laboratory Tours

The opportunity to see first-hand the work carried out by the Centre for Industrial Ultrasonics, under the leadership of Professor Steve Dixon, the Centre Director. There are a range of exhibits, covering the Centre's diverse portfolio of projects, including flow system characterization and Non-Destructive Testing.

16:00 Evening Banquet

We will return from the laboratory tours in good time for you to rest, relax and refresh, before we travel by coach for the Symposium Banquet, to be held in the Undercroft at the historic medieval Warwick Castle, complete with between-course entertainment. Take time to enjoy the scenic setting alongside the banks of the River Avon!

Industrial Session Schedule: Friday, 22 April 2020

9:15 **Registration and Coffee/Tea**

9:30 **Air-coupled Ultrasonic Transducers Operating through Electromagnetic-Mechanical Coupling Mechanism**
Lei Kang, Andrew Feeney, William Somerset, and Steve Dixon, University of Warwick

10:00 **Flexural Ultrasonic Transducers for Hostile Environments: Resilience to Elevated Pressures**
Andrew Feeney, Lei Kang, William Somerset, Steve Dixon, University of Warwick

10:30 **Unconference & Refreshments**

11:15 **Optimizing Joint Interface Flatness for Piezoelectric Stacks of Ultrasonic Transducers** Dominick A. DeAngelis, Gary W. Schulze, Kulicke and Soffa Industries

11:45 **Unconference and UIA Business Matters**
This time is set aside for discussion about ideas and issues identified by participants, and to update delegates on matters of UIA Business

12:15 **Luncheon**

13:15 **Exhibitor Presentations**

13:30 **Keynote presentation: Real world applications of High Power Ultrasonics**
Mike Draper and Rob Perkins, Sonic Systems Ltd

14:00 **Unconference & Refreshments**

14:30 **Parallel and Series Resonance Operation of High-Power Ultrasonic Systems**
Jens Twiefel

15:15 **Latest Developments in Dukane's Technologies** Leo Klinstein, Dukane Corporation

15:45 **UIA49 Concludes**

Ultrasound Applications in the News

Micromotors push around single cells and particles

A new type of micromotor -- powered by ultrasound and steered by magnets -- can move around individual cells and microscopic particles in crowded environments without damaging them. The technology could open up new possibilities for targeted drug delivery, nanomedicine, tissue engineering, regenerative medicine and other biomedical applications.

The micromotors are hollow, half capsule-shaped polymer structures coated with gold. They contain a small piece of magnetic nickel in their bodies, which allows them to be steered with magnets. The inner surface is chemically treated to repel water so that when it is submerged in water, an air bubble spontaneously forms inside the micromotor.

This trapped bubble allows the micromotor to respond to ultrasound. When ultrasound waves hit, the bubble oscillates inside the micromotor, creating forces that propel its initial movement. To keep the micromotor moving, researchers apply an external magnetic field. By changing the direction of the magnetic field, researchers can steer the micromotor in different directions and alter its speed.

"We have a lot of control over the motion, unlike a chemically fueled micromotor that relies on random motion to reach its target," said Fernando Soto, a nanoengineering Ph.D. student at UC San Diego. "Also, ultrasound and magnets are biocompatible, making this micromotor system attractive for use in biological applications."

Future improvements to the micromotors include making them more biocompatible, such as building them from biodegradable polymers and replacing nickel with a less toxic magnetic material such as iron oxide, researchers said.

YouTube video: Micromotors push single cells and particles

Source: Materials provided by **University of California - San Diego**. Original written by Liezel Labios.

Novel MRI-guided ultrasound treatment destroys prostate cancer

A novel MRI-guided procedure that uses therapeutic ultrasound effectively treats prostate cancer with minimal side effects, according to a new study presented today at the annual meeting of the Radiological Society of North America (RSNA). Researchers said the incision-free technique could also be used to treat benign enlargement of the prostate gland. Prostate cancer is the second-leading cause of cancer death in men after lung cancer. Treating disease in the small gland that surrounds the urethra just outside the bladder is challenging. Surgery and radiation are not always effective and can result in incontinence, impotence and bowel dysfunction. Other currently available techniques lack sophisticated imaging guidance and temperature monitoring.

In recent years, a minimally invasive method called MRI-guided transurethral ultrasound ablation (TULSA) has emerged as a promising treatment option. TULSA works by delivering precise doses of sound waves to diseased prostate tissue while sparing the healthy nerve tissue surrounding the prostate.

TULSA relies on a rod-shaped device that is inserted into the urethra. The novel device has 10 ultrasound-generating elements that can cover the entire prostate gland. One or more of the elements are used to send out sound waves that heat and destroy the target prostate tissue. The elements are controlled automatically by a software algorithm that can adjust the shape, direction and strength of the therapeutic ultrasound beam. The entire procedure takes place in an MRI scanner so that doctors can closely monitor treatment and assess the degree and location of heating.

"Unlike with other ultrasound systems on the market, you can monitor the ultrasound ablation process in real time and get immediate MRI feedback of the thermal dose and efficacy," said study co-author Steven S. Raman, M.D., professor of

Continued on next page

Ultrasound Applications in the News, continued

radiology and urology, and director of Prostate MR Imaging and Interventions and Prostate MR Imaging Research at the University of California at Los Angeles (UCLA). "It's an outpatient procedure with minimal recovery time."

In the new multicenter study, researchers reported on the 12-month outcomes from the TULSA-PRO® ablation clinical trial (TACT). The trial enrolled 115 men, median age 65, with localized low or intermediate risk, gland-confined prostate cancer. Clinicians delivered TULSA treatment to the entire gland. Treatment time averaged 51 minutes.

Prostate volume in the study group decreased on average from 39 cubic centimeters pre-treatment to 3.8 cubic centimeters a year after treatment. Overall, clinically significant cancer was eliminated in 80% of the study participants. Seventy-two out of 111 men, or 65%, had no evidence of any cancer at biopsy after one year. Blood levels of prostate-specific antigen (PSA), a marker of prostate cancer, fell by a median of 95%. There were low rates of severe toxicity and no bowel complications.

"We saw very good results in the patients, with a dramatic reduction of over 90 percent in prostate volume and low rates of impotence with almost no incontinence," Dr. Raman said.

Approved for clinical use in Europe, TULSA has just received FDA 510(k) clearance for prostate tissue ablation in the United States. Assuming follow-up studies support the preliminary results, the technique could develop into an important tool for treating both prostate cancer and benign prostatic hyperplasia, or enlargement of the prostate.

"There are two very unique things about this system," Dr. Raman said. "First, you can control with much more finesse where you're going to treat, preserving continence and sexual function. Second, you can do this for both diffuse and localized prostate cancer and benign diseases, including benign hyperplasia."

TULSA also has the benefit of allowing further treatment if needed, Dr. Raman said. If it fails, then the procedure can be repeated, and more aggressive invasive approaches like surgery and radiation therapy can still be used. Alternatively, TULSA may enable noninvasive treatment for localized radiation failure.

The study also supports the use of MRI for post-treatment monitoring of patients who undergo TULSA. MRI at one year after treatment had a negative predictive value of 93 to 96% for detecting residual cancer, meaning it was very accurate for ruling out disease recurrence in patients.

Source: Materials provided by Radiological Society of North America

Researchers produce first laser ultrasound images of humans

For most people, getting an ultrasound is a relatively easy procedure: As a technician gently presses a probe against a patient's skin, sound waves generated by the probe travel through the skin, bouncing off muscle, fat, and other soft tissues before reflecting back to the probe, which detects and translates the waves into an image of what lies beneath.

Now, MIT engineers have come up with an alternative to conventional ultrasound that doesn't require contact with the body to see inside a patient. The new laser ultrasound technique leverages an eye- and skin-safe laser system to remotely image the inside of a person. When trained on a patient's skin, one laser remotely generates sound waves that bounce through the body. A second laser remotely detects the reflected waves, which researchers then translate into an image similar to conventional ultrasound..

In a paper published today by Nature in the journal Light: Science and Applications, the team reports generating the first laser ultrasound images in humans. The researchers scanned the forearms of several volunteers and observed common tissue features such as muscle, fat, and bone,

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From the President

Dominick DeAngelis
UIA President

Our symposium chair, and two-term past president, Mark Hodnett has "delivered -the-goods" for this year's symposium at Warwick University; like there was really any doubt that he wouldn't, especially on his own UK turf! For those working in the European ultrasonic community, this is great opportunity to come join our "tight-knit" UIA family right in your own backyard, and see for yourself why the UIA has a great following of world-class ultrasonic researchers from around the globe. This year's setting in Coventry, England is amazingly quaint and picturesque in every way possible, and who doesn't like castles?

The medical session day will focus on diverse topics such as thermal ablation of tumors, bone penetrating needles, photoacoustics, intravascular ultrasound, miniature ultrasonic surgical devices, modeling of acoustic microbubbles, and shock wave induced drug delivery presented by our world-renowned, keynote speaker Robin Cleveland from the University of Oxford.

Our workshop session day will focus on lead-free piezoceramics, followed by an extensive poster session on wide-ranging topics such as single crystal piezos for high power, focused ultrasound surgery, flexural transducers, electromagnetic acoustic transducers (EMATs) and acoustic pressure measurement, followed by laboratory tour at the Centre for Industrial Ultrasonics (headed by Centre Director Professor Steve Dixon) featuring cutting-edge research

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UIA Board

Ultrasound Applications, continued

down to about 6 centimeters below the skin. These images, comparable to conventional ultrasound, were produced using remote lasers focused on a volunteer from half a meter away.

"We're at the beginning of what we could do with laser ultrasound," says Brian W. Anthony, a principal research scientist in MIT's Department of Mechanical Engineering and Institute for Medical Engineering and Science (IMES), a senior author on the paper. "Imagine we get to a point where we can do everything ultrasound can do now, but at a distance. This gives you a whole new way of seeing organs inside the body and determining properties of deep tissue, without making contact with the patient."

Source: Materials provided by Massachusetts Institute of Technology. Original written by Jennifer Chu.

President's Message, continued

projects such as flow system characterization and non-destructive testing.

Our symposium banquet dinner will be held in the evening at the "Undercroft" of the historic medieval Warwick Castle, which will give you an immersive experience back into the Middle Ages with their period entertainment featuring knights in armor, and copious amounts of food and spirits.

Register Now

Our industrial session day will feature topics such as air-coupled transducers, flexural transducers, optimizing joint interface flatness, parallel and series resonance operation, and finally our amazingly brilliant keynote speakers Mike Draper and Rob Perkins from Sonic Systems will talk about real-world applications of high power ultrasonic transducers from their many decades of transducer design experience.

Hopefully, I have made "my case" and I will see you at Warwick!

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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

16 March 2020: UIA49 Poster Submission Deadline https://tinyurl.com/UIA49Abstract

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

20 - 21 April 2020 IEEE-UFFC Lead Free Piezo Forum *(See page 1 for more details)*

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