

Powering Sound Ideas

UIA47: Atlanta GA, USA 30 April - 2 May 2018

Plans are shaping up nicely for the 47th Annual Symposium in Atlanta.

“We already have a very strong line-up of invited speakers and workshops in place,” noted Tony Crandall, UIA47 Chair. “UIA continues its global focus by welcoming Dr. Marc Lethiecq from the University of Tours as our Keynote Speaker for the medical session on Wednesday, 2 May.”

The Symposium will open on Monday, 30 April with



the industrial session, featuring keynote speaker Shashank Priya, Penn State University.

Our Tuesday schedule will feature Dr. Alfredo Vazquez Carazo presenting a 2.5 hour workshop on the

ATILA piezoelectric-based FEA software. (see page 3 for description). You may register for this workshop and receive the book, *FEM and Micromechanics with ATILA software* by Kenji Uchino, a \$125 value.

Continued on next page

Special Points of Interest

- Symposium presentation schedules - Pages 4-5
- Registration and Atlanta Info - Page 9

Tuesday Tour at Georgia Tech

This year’s tour will be at Georgia Tech, located less than 2 miles from our Symposium headquarters.

Professor Jun Ueda has developed compliant, large strain piezoelectric actuators and a robust control method called stochastic broadcast feedback.

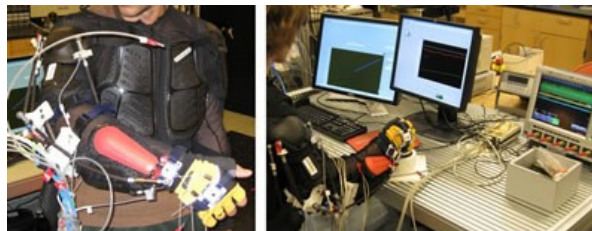
Actuators are a key component for new robotics. A cellular actuator concept inspired by biological muscle structure connects many small actuator units in series or in parallel, and

composes in totality a single actuator. The method of stochastic broadcast control coordinates a vast number of units in this actuator system, which drastically improves wiring and addressing issues. Piezoelectric actuators using nested architecture with exponential strain amplification are developed

for over twenty percent strain that is comparable to natural skeletal muscles.

Due to the available space at the labs, tours will be scheduled for 15 people every 45 minutes.

Participants will be able to sign up for the time slot of their choice.



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UIA47 Preview, continued

Tuesday Evening Event

There is a special evening planned on Tuesday - a great networking opportunity. *Included in full registration*

Exhibit and Sponsorship Opportunities

Once again, UIA is offering a range of exhibit and sponsorship

opportunities to companies who want to target their marketing to key ultrasonic manufacturers and researchers. See page 10 for more information.

Hotel Reservations Information is on page 5. *Please note, the special UIA rate of just \$169 is available until 1 April. Please make your reservations early!*

100% of UIA46 participants said exhibits met or exceeded their expectations.

Piezoelectric aging study - George Bromfeld & Moog Team

Ultrasonic Langevin style transducers with amplification horns attached are used for high power surgical applications including cataract removal and neurological procedures. These ultrasonic handpieces typically use PZT 8 ceramic rings for the motive force.

Lead zirconate titanate ceramic may be made piezoelectric in any chosen direction by a poling treatment which involves exposing it to a strong electric field at a temperature slightly below the Curie point. After polarization some of the dipoles try to revert to random orientation resulting in progressive reduced piezo activity. This aging effect is specified by manufactures for key parameters such as ϵ_{33}^T (dielectric constant), k_p (planar coupling coefficient) and N_{33} (frequency constant). It is approximately logarithmic (% / time decade) . For PZT 8 manufacturers typically specify % / time decade as:

$$\epsilon_{33}^T = -5.0, \quad k_p = -2.0, \quad N_{33} = +1.0.$$

Exposure to a high mechanical stress, a high electric field, or an elevated

temperature at some point along the aging curve results in both permanent and temporary changes as illustrated by Berlincourt in 'Ultrasonic Transducer Materials'.

The operational environment is unique in that most surgical ultrasonic handpieces must be steam sterilized in an autoclave before each use. Autoclave temperatures can be as high as 137 ° C, with an exposure time of up to 20 minutes, and can include pre-vacuum cycling. Furthermore, some doctors prefer to use a handpiece straight from the autoclave with rapid cool down by circulating chilled water through the center of the piezo ceramic stack. Other doctors may use handpieces that have been stored at room temperature in a sterile pack for an indeterminate time. The purpose of this study is to evaluate performance under these extreme operational environments. It is assumed that the handpieces are driven by a constant current voltage-limited control algorithm.

Handpieces for this application typically operate between 20 kHz and 60 kHz. For simplicity and comparison the piezo ceramic drive stacks are configured as half-wave Langevin style dumbbells. They are comprised of a stack of ceramic rings with end masses and a bias bolt passing through the center. In a practical design these dumbbells are coupled to a half-wave horn with the same resonant frequency. The minor diameter includes a distal application specific end effector. For this study we assembled dumbbells with 6 rings that have an OD = .375", ID = .193", and thickness = .080".

The dumbbells were analyzed using PiezoTran transmission line software with the dumbbell input data option iterated to obtain a good fit with measured data. Voltage-limited reserve power is calculated as the primary performance indicator.

UIA47 Preview: ATILA Workshop Tuesday 1 May

Ultrasonic Transducer Modeling in ATILA FEA software - Dr. Alfredo Vazquez Carazo

ATILA is a finite element software package developed specifically for the analysis of two or three dimensional structures that contain piezoelectric and magnetostrictive materials. Its FEM solver is organized around strong electrical-to-mechanical coupling and fluid-to-structure coupling formulations. As a result, this software has been extensively used in a variety of ultrasonic power transducers and underwater sonars. During this workshop, a typical analysis of various piezoelectric and magnetostrictive devices will be shown. An example analysis of an ultrasonic transducer will be implemented with special focus on its modal, harmonic and transient response.

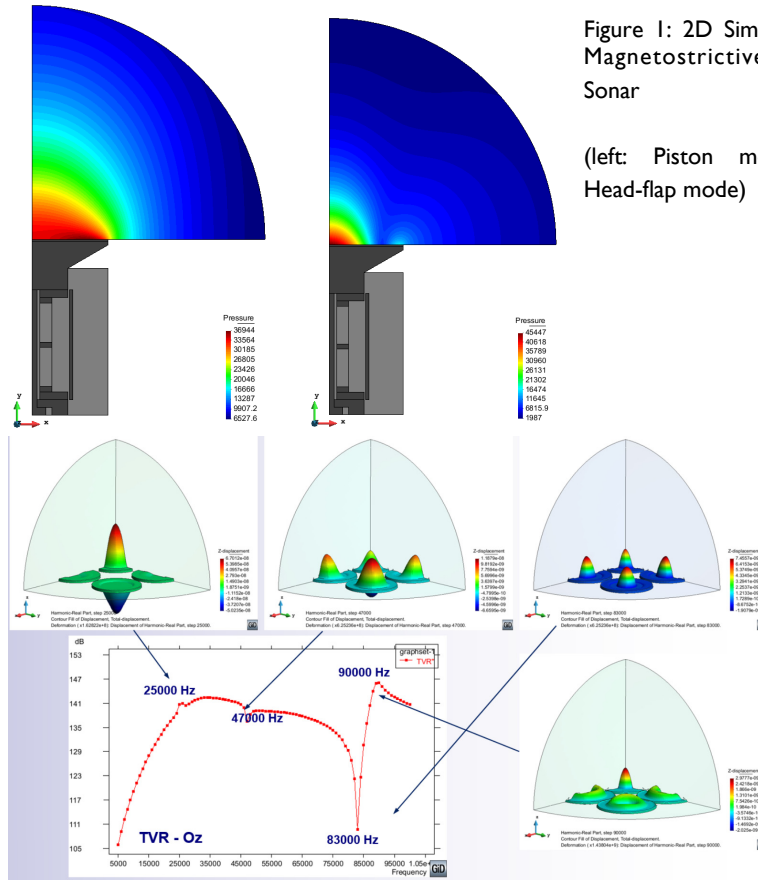
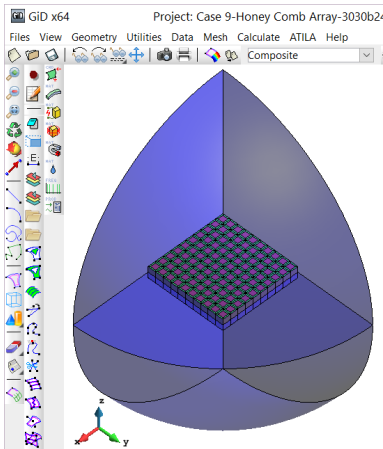


Figure 1: 2D Simulation of a Magnetostrictive Tonpilz Sonar

(left: Piston mode; right: Head-flap mode)

TVR and deformed shape of an underwater Cymbal Array.



Underwater Simulation of a honeycomb Composite ultrasonic Transducer

FEM and Micromechatronics with ATILA software by Kenji Uchino, a \$125 value, is being offered to conference attendees at the subsidized cost of only \$50 (must register for this workshop to receive discount). As a special bonus, the full-featured ATILA light version of the latest ATILA++ software will also be offered to all participants for free when it is published in 2018; the only thing "light" about this software compared to ATILA++ is the limit in model size.

Dr. Alfredo Vazquez Carazo is the CEO and CTO of Micromechatronics, Inc, State College, Pennsylvania, USA. Dr. Vazquez Carazo received his Ph.D. in Electrical Engineering (2000) and MS in Industrial Engineering (1996) degrees from Polytechnic University of Catalonia, Barcelona, Spain. Before joining Micromechatronics Inc., he worked in several world-leading institutions in the fields of smart-material and nano-engineering, including the University of Southampton, England (1997), the Ecole Polytechnique Federale de Lausanne, Switzerland (1998), Murata Manufacturing Co. Ltd., Japan (1999), and the International Center for Actuators and Transducers (ICAT) of the Penn State University (2000). He has been the Principal Investigator of several Phase I and II SBIR projects for NASA, Darpa, Army and NIH developing multiple innovative piezoelectric-devices for space, military and medical applications. He is the inventor of several commercialized patents, author or co-author of more than 50 papers and 2 books, and has participated in more than 30 international conferences.

UIA47 Industrial Session: Monday, 30 April

- 8:30 - 9:00 **Analysis of Flexural Ultrasonic Transducers for High Frequency Applications**, Andrew Feeney, Lei Kang, and Steve Dixon, *University of Warwick, UK*
- 9:00 - 9:30 **Ultrasonic Assisted Conversion of Switchgrass using a Specific Designed Ionic Liquid**, Curtis Covelli, David Grewell, George Kraus, *Iowa State University, USA*
- 9:30 - 10:00 **Latest Innovations in Ultrasonic Power Generators**, Leo Klinstein *Dukane*
- 10:00 - 10:30 **Networking in the Ultrasonic Solutions Center**
- 10:30 - 11:00 **Ice Detection on Aircraft Using SAW Based Sensor**, Rasmus Lou-Moeller, *Meggitt Sensing Systems*
- 11:00 - 12:00 **Unconference**
- 12:00 - 1:00 **Lunch**
- 1:00 - 2:00 **Textured Piezoelectric Ceramics**, S. Priya, *Center for Energy Harvesting Materials and Systems (CEHMS)*
- 2:00 - 2:30 **Using Perforated Electrodes to Avoid Adhesive Delamination in Piezoceramic Stacks of Ultrasonic Transducers**, Dominick A. DeAngelis, Gary W. Schulze, *K & S*
- 2:30 - 3:00 **Development of Molecular Diffusion Models for Ultrasonic Welding of PLA**, Leo Klinstein, Jeff Frantz, Karla Lebron, David Grewell, *Iowa State University*
- 3:00 - 3:30 **Networking in the Ultrasonic Solutions Center**
- 3:30 - 4:00 **Full-field Approach to Characterizing Acoustoplasticity**, Colin Souza, Margaret Lucas, *University of Glasgow*
- 4:00 - 4:10 **Daily Wrap-up**
- 5:00 - 6:30 **Wine & Cheese Reception**



The Unconference sessions allow participants to delve more deeply into the topics and ideas presented by speakers. This feature sets UIA47 apart, as it affords the global participants the opportunity to discuss ideas with other colleagues and peers separate from refreshment breaks, rather than just listen to presentations or opportunity to synthesize the information provided.

Tuesday Schedule: 1 May

- 8:45 - 9:00 **Welcome**, *Dominic DeAngelis*
- 9:00 - 12:00 **ATILA Workshop**, *Alfredo Vazquez Carazo, Penn State University*
- 10:30 - 11:00 **Networking in the Ultrasonic Solutions Center**
- 12:00 - 1:00 **Lunch**
- 1:00 **Travel to Georgia Tech**
- 2:00 - 4:00 **Georgia Tech Ultrasonic Laboratory Tours**

Wednesday Medical Sessions: Schedule: 2 May

- 9:00 - 9:30 **Update on the Applications of Cavitation in Dental Ultrasonic Cleaning**, N. Vyas, Q. X. Wang, A. D. Walmsley, *University of Birmingham, UK*
- 9:30 - 10:00 **Defining a Critical Bend Diameter for Thin Flexible Ultrasonic Waveguides**, Jeffrey Vaitekunas, Jessie Jones IV, Kurt Guggenberger, David Constantine, James Sheehan, Steve Forcucci, *Penn State Behrend*
- 10:00 - 10:30 **Networking in the Ultrasound Solutions Center**
- 10:30 - 11:00 **Review of tools for sound field simulations**, Klaus-V. Jenderka, Konrad Mehle, *Physics, Sensor and Ultrasound Technology University of Applied Sciences*
- 11:00 - 12:00 **Unconference**
- 12:00 - 1:00 **Lunch**
- 1:00 - 2:00 **Ultrasonic Transducers for High Frequency Biomedical Imaging: Materials, Technologies and Applications**, Marc Lethiecq, Franck Levassort, Jean-Marc Gregoire, Frédéric Ossant and Dominique Certon, *University of Tours*
- 2:00 - 2:30 **Failure Mechanisms in Piezoceramic Actuators**, Dr.-Ing. Timo Scholehwar, *PI Ceramic GmbH*
- 2:30 - 3:00 **Piezoelectric Aging Study**, George Bromfield and Moog Team, *Moog*
- 3:00 - 3:30 **Networking in the Ultrasound Solutions Center**
- 3:30 - 4:00 **Frequency Tunable Actuator Design for Elasticity Imaging of Human Intervertebral Disk**, Waiman Meinhold, Efe Ozkaya, Jun Ueda, and Mehmet Kurt, *Georgia Institute of Technology, Woodruff School of Mechanical Engineering*
- 4:10 **Symposium Concludes**

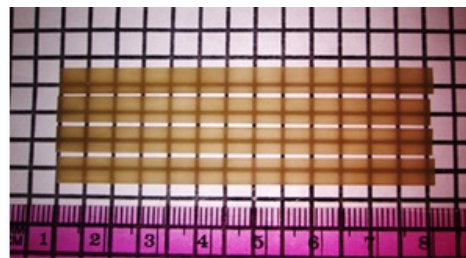
Priya Shashank: Industrial Keynote Monday 30 April



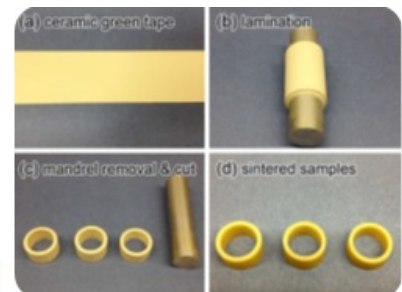
Shashank Priya is currently Associate VP for Research at Penn State and an adjunct faculty in the department of mechanical engineering and Associate Director of Research and Scholarship at Institute for Critical Technology and Applied Science (ICTAS). In past he has served as program director at National Science Foundation, and Director of Center for Energy Harvesting Materials and Systems (CEHMS). His research is focused in the areas related to multifunctional materials and sensors, energy harvesting and bio-inspired systems. He has published over 350 peer-reviewed journal papers and more than 60 conference proceedings covering these topics. Additionally, he has published more than five US patents, and edited five books. He has worked on research projects related to ceramics, magnetic nanomaterials, and smart material systems with various federal agencies including NSF, ARO, AFOSR, DARPA and ONR. He has expertise in designing high performance ceramic materials as bulk, thin films and nanostructures. His laboratory has developed new processing techniques and material compositions in order to provide functional characteristics

Textured Piezoelectric Ceramics

This presentation will provide review of the textured piezoelectric ceramics, both lead-based and lead-free, covering various methodologies such as templated grain growth and reactive templated grain growth techniques. $\text{Pb}(\text{Zr,Ti})\text{O}_3$ (PZT) based compositions have been challenging to texture or grow in a single crystal form due to the incongruent melting point of ZrO_2 . We have been successful in achieving >95% textured PZT-based ceramics and further show that it can provide the highest known energy density in piezoelectric materials through enhancement of piezoelectric charge and voltage coefficients (d and g). Our method provides $\sim 3 - 5$ times increase in the ratio $d(\text{textured})/d(\text{random})$. The electromechanical properties of textured $0.4\text{Pb}(\text{Mg}_{1/3}\text{Nb}_{2/3})\text{O}_3-0.25\text{PbZrO}_3-0.35\text{PbTiO}_3$ (PMN-PZT) composition which has relatively high rhombohedral to tetragonal (R-T) transition temperature (TR-T of 160°C) and Curie temperature (TC of 234°C) were doped with Mn to improve mechanical quality factor. MnO_2 doped PMN-PZT ceramics textured with 3 vol% BT and subsequently poled at 140°C (T-3BT140) exhibited very stable and high k_{31} (> 0.53) in a wide temperature range from room temperature to 130°C through reduction in the interface region volume. Further, the T-3BT140 ceramic exhibited excellent hard and soft combinatory piezoelectric properties of $d_{33} = 720\text{ pC/N}$, $k_{31} = 0.53$, $Q_m = 403$, $\tan \delta = 0.3\%$ which are very promising for high power and magnetoelectric applications. In lead-free materials, the presentation will cover the texturing of sodium bismuth titanate – barium titanate and sodium potassium niobate systems. Combined, the results will demonstrate that texturing process is cost-effective and reliable way to improve the performance of existing compositions. Texturing process is fully compatible with current industrial manufacturing of polycrystalline ceramics.



[001]-Textured PMN-PZT



Marc Lethiecq: Medical Keynote 2 May



Marc Lethiecq is Professor at the University of Tours, France, where he has been working on ultrasonic transducers & piezoelectric material characterisation and modelling since 1990. He is head of GREMAN, a laboratory of 120+ staff on materials, micro-electronics, acoustics and nanotechnology. From 1987 to 1989 he worked as a research engineer on ultrasonic devices for Vermon and CNTS companies and between 1984 and 1987 he was assistant professor at Institut National des Sciences Appliquées (INSA) in Lyon, France, from which he had graduated (M. Eng. in Electronics & Electrical Engineering 1984, MSc 1984 and PhD 1988 in Acoustics). He has been teaching electronics, feedback control and courses related to his research activities since 1984 in several universities and engineering schools, currently at INSA Centre Val de Loire, Blois, France.

Ultrasonic Transducers for High Frequency Biomedical Imaging: Materials, Technologies and Applications

Marc Lethiecq, Franck Levassort, Jean-Marc Gregoire, Frédéric Ossant and Dominique Certon

The need for very high-resolution biomedical imaging systems has been increasing during the past 20 years in application fields such as dermatology, ophthalmology, intravascular examinations and small animal exploration, among others. This requires transducers that operate typically in the 20 to 100 MHz frequency range for which classical technologies (bulk piezoelectric materials) are not adapted. After an introduction on pioneering work on high-frequency transducers, the talk will review recent work on technologies compatible with large-scale industrial production. Transducer performance as well as images obtained for several applications will be presented; finally the pros and cons of the different technologies will be highlighted.



Make Your Hotel Reservations Now

Our hotel, **Atlanta Marriott Suites Midtown**, offers a central location and the appropriate size for our meeting and exhibition space that encourages in-depth discussions about all things ultrasonic.

Room rates are just \$169 single/double, with this rate available from Friday, 27 April through Friday, 4 May for those who wish to spend longer time in Atlanta. **Reservations must be made by 1 April to ensure you receive this special UIA rate.**



UIA has negotiated a flat rate of \$15 for overnight self-parking during the Symposium..

Make your hotel online reservation now: **[UIA47 Hotel Reservations](https://tinyurl.com/HotelReservationsUIA47)** or **<https://tinyurl.com/HotelReservationsUIA47>**

From the President...



Tony Crandall, UIA President

This year's UIA 47 symposium in Atlanta should be a great meeting, as the articles in this issue of Vibrations illustrate. Our keynote speakers, Marc Lethiecq from the University of Tours, France and Priya Shashank from Penn State are both slated to give great presentations. Our industrial session and workshop chair, Dominick DeAngelis, has put together a great workshop on ATILA Finite Element Analysis for Tuesday. We'll also tour some really interesting labs at Georgia Tech that day. Tuesday evening we'll all get together for a great dinner.

If you haven't already made plans to be attend, consider the benefits to you and to your company. As an ultrasonic engineer or researcher, there is much to be gained. UIA is the only forum worldwide where the participants, with their decades of collective experience in ultrasonics, share their insight and knowledge so freely. As a supplier, you are not likely to find another event where the people who use and specify ultrasonic equipment or materials are as accessible and engaged.

We, the UIA, look forward to seeing you in Atlanta.

UIA47: Share Your Insights

*UIA is the only
global forum
where the
participants
share their
insight and
knowledge as
freely*

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Register NOW!

Registration is now open! Go to <https://tinyurl.com/UIA47Reg> to complete your registration.

The registration fee for members is \$950 USD

The registration fee for non-members is \$1,050

A few hints:

- ◇ Our Tuesday evening event is **included** in full member and non-member registration. You may purchase a ticket for your companion
- ◇ The Tuesday workshop is **NOT** included in your registration. Please choose this on your registration. The \$50 fee covers the ATILA book (a \$125 value) and free ATILA light software available after the symposium.
- ◇ If you plan to attend the Tuesday evening event, **please be sure to check this box on the registration form.**
- ◇ You may register for one or two days if you do not want to stay the entire 3 days. To do this, select the daily registration for the days you wish to attend
- ◇ The daily registration for Tuesday **does** include the ATILA workshop and book, but **does not** include the Tuesday evening event. You may purchase a ticket to join us at this event.
- ◇ Questions? Feel free to call the UIA office at +1.937.586.3725

Important Links:

Registration:

<https://tinyurl.com/UIA47Reg>

Hotel Reservations:

<https://tinyurl.com/HotelReservationsUIA47>

Paper/Poster Abstract:



Centennial Park courtesy of <http://travelinnate.com>

Atlanta, Georgia

Recently, Atlanta Georgia is becoming the new 'it' place and attracting more and more visitors. It is becoming the next international destination that you must put on your list to visit.

Take your taste buds on a fiery adventure with authentic world-class cuisines at fancy restaurants. Take yourself to hip nightclubs and make memories of a lifetime.

Modernism hasn't taken over the city though, because the city has carefully preserved its' history. Atlanta Georgia History Center and Martin Luther King Jr. Historical Site are all part of the main tourist attractions in this upcoming city.



Here's how YOUR company can reach key ultrasonics users



UIA offers companies access to key influencers in the international ultrasonic community through four key avenues: new website, *Vibrations* newsletter, Sound Solutions one-day meeting and UIA47 International Symposium.

UIA47 Annual Symposium

The three day annual symposium will be held in Atlanta, Georgia, USA 30 April - 2 May 2018. Sponsorships include table top exhibits.

Website Banners

There are two positions available that will appear on every page of the site that will click through to the URL of your choice. See page two for more information about sizes, location, and costs.

Vibrations Newsletter

Display ads are available in this newsletter that is distributed electronically every quarter. Ads include a link to the URL of your choice.

Sponsorship Packages

Each package is for 12 months from date of payment. Go to page 2 to see details and pricing.

Titanium Includes two ad positions on website, full page ad in *Vibrations* newsletter and sponsor recognition/tabletop exhibit at Sound Solutions midyear meeting and Annual Symposium and more.

Gold Includes masthead banner ad position on ultrasonics.org, half page ad in *Vibrations* newsletter and sponsor recognition/exhibit at Sound Solutions and Symposium.

Silver Includes vertical ad position on ultrasonics.org, 1/3 page ad in quarterly *Vibrations* newsletter and tabletop exhibit at Sound Solutions and Annual Symposium.

Bronze Includes 1/2 column page ad in quarterly *Vibrations* newsletter and tabletop exhibit at Symposium.

Select the level of exposure best for your company. Go to www.Ultrasonics.org/UIA47Reg



11 W Monument Ave., Suite 510 | Dayton, OH 45402 USA
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	Titanium	Gold	Silver	Bronze
	\$5,000	\$4,000	\$3,000	\$1,500

Website

Masthead banner with URL link	X	X		
Vertical banner with URL link	X		X	
Career Center Ad	unlimited	4 per year	3 per year	1 per year

Vibrations

Ad in 4 quarterly issues with URL Link	Full	1/2 page	1/3 page	1/2 column
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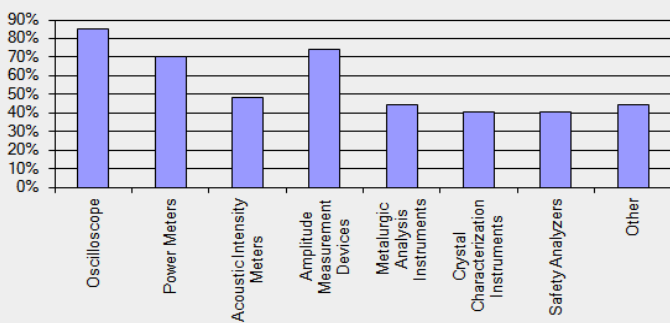
Sound Solutions

Sponsor Recognition	X	X		
Tabletop exhibit	X	X	X	X
Complimentary Registration	2	2	1	1

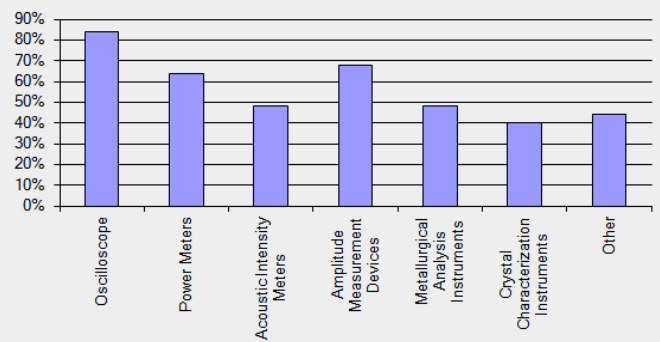
UIA46 Symposium

Sponsor Recognition	X	X		
Tabletop exhibit	X	X	X	X
Complimentary Registration	3	2	1	
Proceedings Sponsorship	X	X		
Sponsor Badge Ribbon Recognition	X			
Onsite Program Recognition	X	X	X	X
Exhibitor Badge Ribbon Recognition	X	X	X	X

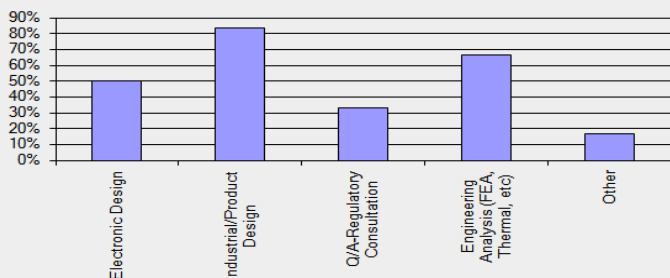
Instruments used in R&D and Production



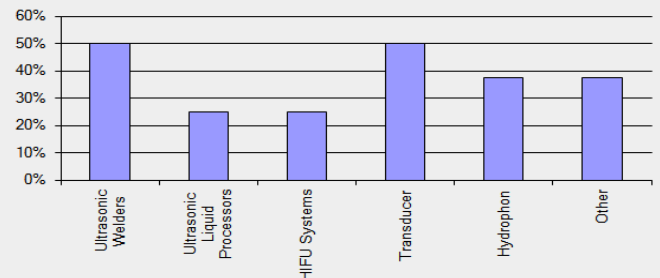
Instruments used for products and services



Types of Design Service Companies used by UIA members



Types of Ultrasound Companies used by UIA members



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Dayton OH USA

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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

1 April 2018: Last day to make your reservations at the Marriott Suites Hotel Midtown [UIA47 Hotel Reservations](#)

30 April - 2 May 2018: UIA47 in Atlanta, GA, USA

15 - 17 April 2019: UIA48 in Toronto, ON, Canada

