Volume 22, Issue 3 Summer 2012

Vibrations

Ultrasonic Industry Association

UIA Symposia: 2012 and 2013

It was a great pleasure to welcome so many delegates to our April Symposium in San Francisco, and I thank everyone for sharing their stimulating research and insightful thoughts on the cutting edge applications discussed. Our thoughts now begin to turn to our 42nd Symposium, to be held in Orlando, FL, USA on the Disney campus, with a new date of 22-24 April 2013. Elsewhere in Vibrations you will find a Call for Papers, and I encourage you to make your travel plans early, and perhaps stay for an extra week with your families, as I shall be doing.

I am delighted to announce the honorary lifetime UIA Membership of Alan Broadwin. I first met Alan at an International Electrotechnical Commission meeting in London in 2000, and was immediately struck by his immense technical knowledge and astute manner in translating this into usable standards for manufacturers. His contributions to UIA have been numerous over a period of many years, and I am very pleased that we can recognise him in this way. Starting on page 8 is a biography, detailing Alan's many pioneering achievements in high power ultrasound.

We are discussing some exciting ideas for the fall, centered around increasing the value of our offering to the membership, which we hope will provide new ways of presenting cutting edge power ultrasonics work from around the world. With some intriguing new applications coming to the marketplace, I look forward to sharing these with you soon.

Mark Hodnett, UIA President, welcomed the Ultrasonic Industry to the 41st Annual Symposium and looks forward to the year ahead.

2013 Symposium: 22 - 24 April in Orlando, FL, USA

Robert Muratore, Quantum Now, LLC is the chair of the 42nd Annual UIA Symposium. Dominick DeAngelis has agreed to chair the Industrial Session and Jay Sheehan will chair the Medical Session.

Robert Muratore

The format will be similar to past successful symposia, including one day devoted to Medical sessions, one day to ultrasonic workshops and one day to Industrial sessions. The Call for Papers is on page **14**.

The symposium will be held at the Hilton Orlando Lake Buena Vista hotel in the Walt Disney World Resort. Ideally situated next to the Downtown Disney® Marketplace and Downtown Disney® West Side and Cirque de Soleil, symposium participants will benefit from complimentary transportation to and from Disney theme parkas and enjoy Disney's exclusive Extra Magic Hours benefit — providing longer fun and shorter queues.

Inside this issue:

Orlando offers ROI: Return on Ideas

42nd UIA Symposium 22-24 April 2013

Birds flock to Greater Orlando's more than 2,000 named lakes, rivers and springs.

Orlando is known for its creative outlets… Walt Disney World, Universal Studios, SeaWorld and much, much more. So, it stands to reason that attending the 42nd UIA Symposium in Orlando will provide you with great ROI: Return on Ideas.

To start planning for your trip, Visit Orlando has a series of apps for both iPhone and the Android:

- Official Guides to Walt Disney World, Universal Orlando and Sea World
- Wait times for Walt Disney World and Universal Orlando
- Live updates for Orlando International Airport and Orlando traffic
- Orlando Dining Guide

You can access all these apps by going to http://www.visitorlando.com/plan-your-trip/orlando-app-store/

For your convenience, we have assembled information to help you plan your WALT DISNEY WORLD® Resort vacation:

Downtown Disney® Area Map

Printable Downtown Disney® Brochure (PDF)

WALT DISNEY WORLD® Resort Information

Downtown Disney

Hilton Orlando Lake Buena Vista hotel is located in the western corner of the Downtown Disney® Area. This area, know as Downtown Disney® West Side, is home to some of the most unique entertainment venues, shops, and restaurants at the Walt Disney World® Resort.

Discover the biggest shopping extravaganza on the planet, Downtown Disney® Marketplace. Sample dozens of unique and imaginative chain and specialty stores loaded with must-have merchandise.

Downtown Disney® Area entertainment, shopping, and dining options:

- Entertainment
- Shopping
- Dining

UIA Rates at the Hilton Orlando Lake Buena Vista Hotel are $189 plus tax, single/double. To make your reservations, call **1.800.782.4414** and reference the code **UAA**.

To make your reservation on line, go to http://tinyurl.com/UIA2013

"La Nouba" is the first Cirque du Soleil show presented in a custom-built freestanding theater. Nearly 5 million spectators have watched "La Nouba's" cast perform daring feats and physical acrobatics. Located at Downtown Disney.

Photos courtesy of Visit Orlando

2012 UIA Symposium Report - San Francisco

The 41st UIA Symposium drew 68 delegates from 7 countries, re-affirming UIA's strong position in bringing together world-wide users, manufacturers and academics in the diverse field of power ultrasound. The prestigious Mark Hopkins hotel, atop Nob Hill, provided a strong metropolitan focus for the attendees, plus daily opportunities for improving cardio-vascular fitness!

Symposium Chair Dan Cotter, in collaboration with session co-chairs Robert Muratore, Damien Walmsley, Tony Crandall, Margaret Lucas, Dominick DeAngelis, Patrick Harkness and Leo Klinstein, assembled a cutting-edge programme of papers and posters, supported by workshops and exhibits with a broad international representation.

Professor Damien Walmsley opened the Medical Sessions on Day 1, and the first part of the morning consisted of papers from Myra Flitcroft, Dan Cotter and Fernando Bejarano. Myra and Fernando discussed their work in improving transducer designs for medical applications, whilst Dan presented some new developments in surgical aspirator tip designs, with their efficacy examined by thermal imaging.

Daniel Cotter

After a refreshment break sponsored generously by Integra LifeSciences, UIA Vice President Mark Schafer presented a detailed comparison of kHz and MHz frequency interactions with tissue, demonstrating the potential for significant therapeutic benefit, particularly at a stem cellular level. Matthew Urban then discussed novel approaches to ultrasound elasticity imaging, which can potentially use conventional Doppler scanning systems to deliver 'push' pulses to induce radiation force creep.

Mark Schafer

There followed the Networking Unconference - an idea in which the stimulating corridor and elevator discussions that occur during paper sessions at Symposia are given a central slot, effectively turning the conference inside out. Looking around the room, having a 30 minute slot for ad hoc discussion was clearly of stimulating benefit to the delegates, and offered the opportunity for more detailed discussions on the papers presented so far, with findings shared and new contacts made.

Words and pictures by Mark Hodnett, Damien Walmsley, and Dominick DeAngelis

Unconference in action

The afternoon session commenced with our invited speaker, Dr Tom Matula, Director of the Center for Industrial and Medical Ultrasound at the Applied Physics Laboratory, University of Washington. In a fascinating and stimulating talk, Tom brought together his many years of cutting edge research, to describe the roles of microbubbles in ultrasound therapeutics.

Tom Matula

Continued on page 4

2012 Symposium Program, Continued

Building on some of the measurement themes within Tom's presentation, Klaus-Vitold Jenderka described detailed, robust techniques to characterise HIFU fields, including modified hydrophones and thermoacoustic sensors. He also showed the successful outcome of a collaborative European project to determine HIFU-level powers up to 500 W.

UIA President Mark Hodnett then discussed work at the National Physical Laboratory which made measurements in tissue-mimicking materials, simultaneously monitoring applied HIFU acoustic fields, and the resulting cavitation, to determine pressure thresholds and investigate different signal processing methods. Following refreshments, the Medical sessions were concluded by David Brubaker, who gave an insight into dynamically driving Hi-Q ultrasonic transducer using non resonant techniques, and Pedro Acevedo, who outlined his methods for analysing and reducing cross-talk during matrix array manufacture.

The first evening saw the traditional UIA Cheese and Wine reception, held in the Mark Hopkins dining room, and building on the success of Sunday's Sonoma wine tour, delegates enjoyed sampling homegrown reds and whites, and a broad international selection of cheeses, breads and condiments.

Damien Walmsley introducing David Brubaker

Tuesday 17 April commenced with a continental breakfast at 7:30, before a morning of informative lectures and workshops, including hands-on sessions for delegates to try some new industrial applications. First up, we were honoured, and delighted to welcome Yosi Bar-Cohen from JPL, who fascinated us with his vast experience in biomimetic sensors and actuators, presenting numerous examples of nature-inspired engineering systems.

Leo Klinstein & Bob Aldaz

Mark Hodnett, Damien Walmsley and Dan Cotter

L to r: Mrs. Bar-Cohen, Jeff Vaitekunas, Stewart Sherrit, and Yosi Bar-Cohen

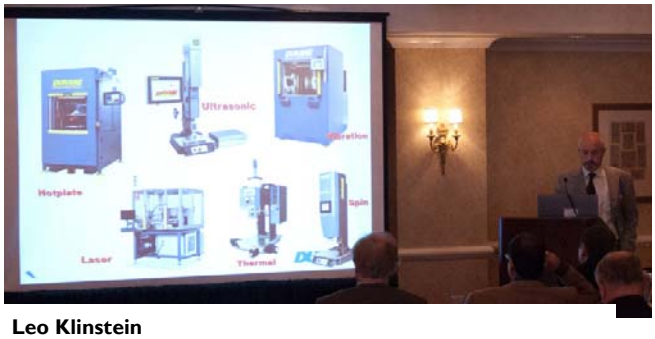
Dean Constantine, Mike Query, Toby Ban and Eric Lawrence

Symposium Technical Program, Continued

The next session, which gained good feedback from delegates, combined the invited presentation of Dr Yunbo Liu from the Food and Drug Administration, who talked about the regulatory approach and some HIFU and elastography case studies in 510k submissions, and a subsequent panel discussion, in which UIA Board Members and delegates related their own experiences and recommendations for prospective submissions, with the aim of easing the process for those seeking marketing clearance for their new products.

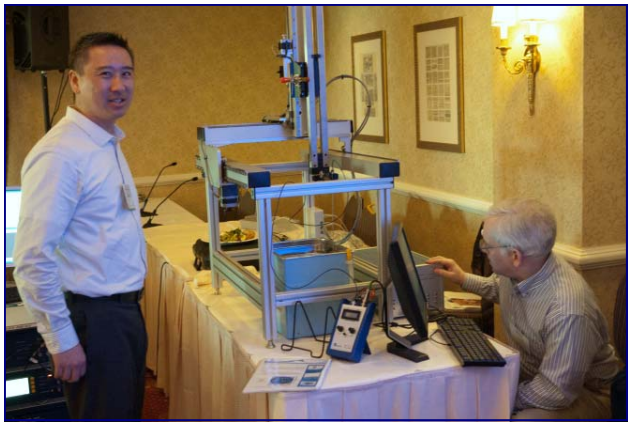
Dr. Yosi Bar-Cohen

After a break for refreshments, UIA Board Member Leo Klinstein and Bob Aldaz from Dukane Corporation showed delegates pneumatic and servo-based approaches for plastics welding, with the opportunity to see and use a real industrial working system, widely used in the production of plastic medical components.



Leo Klinstein

Lunch was taken in the Club Lounge, and following this, Claudio Zanelli, Sam Howard and Petrie Yam from Onda Corporation demonstrated their measurement technology for ultrasonic cleaning tanks. Based on an acoustic emission detection approach, and using a wireless interface to a software RMS meter, the system offers a robust development and QA tool for manufacturers and users of ultrasonic cleaning systems, up to the MHz ranges.



Continued on page 5

Symposium Technical Program, Continued

Our final workshop presentation was given by Eric Lawrence and Toby Ban from Polytec Limited, demonstrating the versatility of contactless measurements that can be carried out using 1D, 2D and 3D laser vibrometry systems. A real-time scan, taking less than 60 seconds, showed the vibration modes in a 120 kHz plate, and several case studies showcased novel applications of the systems, including through-beam detection using the acousto-optic effect, facilitating tomographic reconstruction.

Our second Symposium day concluded with the poster presentations and student competition, which again demonstrated a high standard of scientific research spanning healthcare and industrial applications.

Hassan Al-Budairi

The Poster Committee unanimously agreed on our winner, Azadeh Moini from Stanford University, who receives a prize of $250 for her work in developing intracardiac imaging devices employing CMUT ring arrays. Many congratulations to Azadeh, for a stimulating and articulate poster.

Attention then turned to the Symposium dinner, for which we were hosted by the Boudin Sourdough Bakery for a delicious three-course meal, which was then followed by a night-scape tour of San Francisco. Taking in views of the Golden Gate Bridge, and from the misty hills above the city, we were later treated to champagne and truffles.

Day 3: Industrial Sessions

The industrial ultrasound sessions were kicked off by UIA Board Member David Grewell, providing us with new insight into the commercial potential of producing biofuels, from oleaginous yeast, demonstrating the benefits of using ultrasound and toluene in a combined extraction and production process.

Long-term UIA contributors EWI, in the form of Mark Norfolk, then brought us up to date on their development programme for ultrasonic additive machining.

After Meggitt's generous refreshments, we had two pres-

Andrew Feeney

entations on diverse transducer types applicable to industrial applications. Andrew Feeney talked us through characterisation of modified cymbal transducers using vibrometry, demonstrating displacements approaching 40 microns.

David Grewell

Symposium Technical Program, Continued

New UIA Board Member Dominick DeAngelis then discussed his work in studying the complex dependencies of wire-bonding transducer performance on ceramic dissipation.

Concluding the morning session, our second new UIA Board Member, Wanda Wolny, gave us a fascinating insight into the development and application of thick film PZT's, which are opening up possibilities for screen printing onto flexible substrates, for both transduction and measurement devices.

After another excellent lunch in the Club Lounge, we embarked upon the afternoon Industrial session, and specifically, our mini-session examining space mission and drilling technologies. First, we were privileged to welcome our keynote speaker - Stewart Sherrit from JPL. Stewart fascinated us with a diverse set of example applications in which ultrasonic transducer and horns have been applied as tools in rock collection and sampling, but designed in novel ways to work within the harsh conditions and limitations of extraterrestrial operation. Thus, we learnt about doubly-folded and dog bone horns, and the results of a successful Antarctic field test!

Two presentations from the diverse engineering group at Glasgow then continued the story: Hassan Al-Budairi discussed his research into optimising the combined longitudinal and torsional modes of a Langevin transducer, and Session Chair Patrick Harkness then described a switchable system for exploiting longitudinal and longitudinal-torsional modes to optimise regolith penetration.

Dominick DeAngelis

Our symposium was concluded by Myra Flitcroft, talking this time about developing ultrasonic thermoacoustic engines (which included a practical demonstration of audible frequency prototypes!), and Eimear Neeson, who described her early progress in applying different shock wave techniques, such as those used conventionally in lithotripsy and HIFU, for rock fragmentation, with an ultimate aim of improving residual oil extraction. UIA President Mark Hodnett closed the Symposium by thanking the delegates for their insightful contributions, and marking our diaries with the dates for our 42nd Symposium in Orlando, FL - 22-24 April 2013.

Stewart Sherrit and Dan Cotter

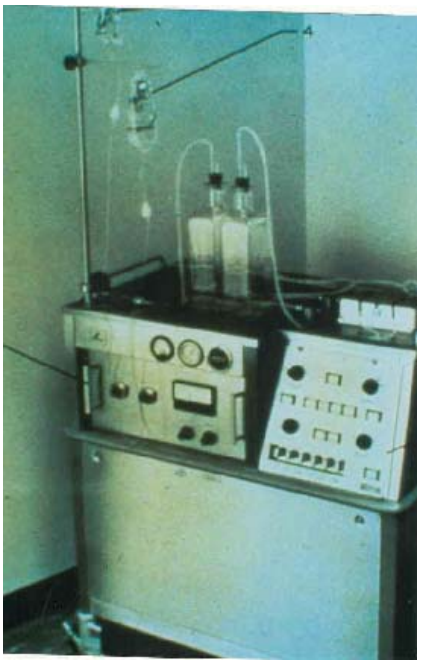
Alan Broadwin, UIA Honorary Member

Alan Broadwin was born in Brooklyn, NY. His father, a Mechanical Engineer, and mother, a public school teacher guided him to obtain a liberal arts and a technical education.

His academic background helped prepare him for the situations he confronted during his professional career. Holding a BA from Columbia College ('56), a BSME from the Columbia School of Engineering ('57) and an MSIE from Stevens Institute of Technology ('59) Alan worked in the family business designing and building industrial knitting machines some of which used punched card programming control systems similar to the original IBM punched cards. He moved from that environment to the Harris Intertype Company, designing control systems and consoles for hot metal and photo typesetting machines. During that time he participated in the development of high speed mechanical control systems, electric keyboards and a photo typesetting machine.

In 1969, Alan joined the Cavitron Corporation as Senior Project Engineer to product engineer a surgical device and bring it to market, to try and exploit the patent filed by Dr. Charles Kelman on July 25, 1967 describing an opthalmic instrument for "breaking apart and removal of unwanted material", especially cataracts, using a handheld tip operating in the "ultrasonic range (about 40 KHz) with an amplitude controllable up to several thousandths of an inch". In the Fall of 1969 the company was conducting the initial clinical trials of a prototype device but unable to get through more than a couple of surgeries without the device malfunctioning. At that time in his career Alan had no background in designing medical/surgical devices, nor any background in the physics of ultrasonically vibrating devices, but the Cavitron Corporation had hired him because he was a Mechanical Engineer and because he had experience as a Program Leader running high value, large capital equipment for Harris Intertype. All of Cavitron's devices to that date were small, desk top dental "prophy" units.

The unique key to the phacoemulsifier was the surgical handpiece designed to be small and compact enough for a surgeon to hold and manipulate while viewing the eye through a microscope It needed to be autoclavable (sterilized by steam) and the vibrating member needed to be isolated from the surgeons hand and supported in a fashion that would not damp out the microscopic movement of the surgical tip. This was Alan's first challenge. His analysis and redesign of the initial handpiece yielded a robust design which enabled the clinical trials to proceed



The original Phaco Emulsifier with electromagnetic flow control system.

and was the basis of the production design for several years.

During this initial period of experimentation and development, he discovered that the cavitational bubbles generated by the 40 kHz excitation fields were creating micro/nano second pressure pulses in the eye resulting in the extraordinary effect of "chopping up" the tissue which was in contact with the distal end of the surgical tip. It was not until years later that Broadwin teamed up with Dr. Mark Schafer (UIA Vice President) to confirm those initial findings, ultimately reported by Schafer to the IEEE.

Alan Broadwin, UIA Honorary Member, cont'd

The cost reduced Phaco Emulsifier with Broadwin-Weiss fluidic control system.

In the early 1970's Robert Navin, President and Philip Hovnanian of Cavitron encouraged Alan to: a) become involved with the Ultrasonic Industry Association and b) to develop a cadre of engineers, technicians and production people who were charged with expanding the use and applications for ultrasonic surgery thus giving him the freedom to develop professionally and to start to interact with key, knowledgeable people from various disciplines in the ultrasonic industry. It was during this time that Broadwin became a member of the UIA board and hired David Wuchinich as Program Leader for the CUSA (Cavitron Ultrasonic Surgical Aspirator), Alfred Ludwicki as Mechanical Design Leader, Rocco Cardali as Production Manager and Sanford Lane as Clinical Engineer.

This group, under Alan's direction, developed the specifications and design for a high power surgical device to expand the application of ultrasonic fragmentation from ophthalmology to neurosurgery and general surgery. He received corporate approval to design the clinical protocols to evaluate safety and efficacy of the CUSA and then to make the necessary submissions and presentations to the FDA to enable the device to be marketed. In the period of 1978-1979 the first 10 units were sold. In October 1986 the company achieved $3,000,000 in sales of the CUSA in one month.

The first generation CUSA

Between 1988 and 1993 as the Cavitron Medical Systems Group continued to grow and was purchased by Pfizer Hospital Products, it integrated an electrocautery function with the ultrasonic fragmentation action. Broadwin facilitated the combination of the ultrasonic and electrosurgical equipment programs at Cavitron and Valleylab. During this time Broadwin also led efforts demonstrating the viability of ultrasonic ceramic knife blades; microsurgical ultrasonic tips; an endoscopic device for prostate, gall stone and gynecological surgery; an orthopedic device for bone and cartilage surgery; a laproscopic device for plastic surgery; a general surgical device for cardiac surgery; and an ultrasonic flexible catheter for breaking up blood clots and athrosclerotic plaque. Some of these concepts have been implemented by other companies.

The Pfizer Corporation decided to exit the medical device business and close the Stamford CT facility in 1993, where Broadwin was Director of Ultrasonic Technology, Alan decided to reinvent himself. This era was the beginning of the push for companies to become registered to an international standard for Quality Systems so Alan became a certified ISO 9001 auditor, then an ISO 13485 (medical devices) auditor and finally an AS9100 (aerospace) auditor. He started his own consulting business

Alan Broadwin, continued

The second generation CUSA as a table top and floor model.

Dr. Ransohoff, Chief of Neurosurgery at NYU Medical Center, NY operating with the CUSA.

in 1993 and worked for registrars such as British Standards Institute (BSI), KEMA and Intertek. Broadwin also developed his own direct clients and helps companies develop and maintain their systems to be compliant to the required standards.

By 1998, Alan was a member of the US Technical Advisory Group to the International Electrotechnical Commission. His inputs to the international group were published in IEC 61847 (Ultrasonics – Surgical Systems – Measurement and declaration of the basic output characteristics).

Running through Alan's prestigious professional career is his significant participation in the Ultrasonic Industry Association. He served as a member of the board, as President and as a Symposium chairman. Because he was able to interact with people and ideas from such diverse fields as power ultrasonics, welding, acoustic streaming and medical devices he was able to cross the line between technology, medicine and business. He was at the focus of high risk research and engineering efforts of the Cavitron company. Being able to structure and lead a group of technically astute engineers he was able to tease from nature a series of unique medical devices. When he started his own consulting business, Ainslie, he realized that the international standards that are used to direct medical device companies and aerospace companies are focused on the same areas of process control, traceability and reliability. Thus he has been able to successfully make the transition from head of a technology driven company to a service organization which advises companies in how to structure their businesses, and his wealth of commercial and technical knowledge remains in strong professional demand.

Ultrasonic ceramic knife blades and microsurgical ultrasonic tips;

Report from Heidelberg

By Robert Muratore

Over 200 scientists, engineers, and clinicians attended the 12th International Symposium on Therapeutic Ultrasound in Heidelberg Germany, organized by Dr. Stephen Meairs of the University of Heidelberg. There was good representation from North America, Europe, and Asia.

Clinical applications of therapeutic ultrasound are maturing, and HIFU is seeing greater use in the kidney, liver, brain, prostate, uterus, and breast. Progress is being made in pancreatic cancer, with the finding that the tumors are encapsulated by a thick layer of tough fibers. Among the most exciting presentations were those on neuromodulation, growing this year to an entire dedicated session.

In the exhibit hall, two new integrated diagnostic/therapeutic devices were shown, aimed at researchers, and similar in spirit to Focus Surgery's Sonablate prostate system and to Riverside Research's "HIFU2" experimental system. Seoul Korea's Alpinion demonstrated the VIFU-2000, with a separate E-CUBE 9 diagnostic ultrasound cart and an add-on table-top controller/amplifier for therapy, complete with an integrated water tank and a three-axis controller. The single element focused therapy transducer is mounted on the side of the tank, and has a central aperture for the interchangeable diagnostic transducer. The system is sized for in vivo mouse or ex vivo tissue sample studies. Verasonics, Inc. (Redmond Washington USA) demonstrated an ambitious open architecture fully integrated system, with exquisite MATLAB level control over therapeutic and diagnostic protocols. Diagnostic data is available pre-beam forming. This V1 Research System utilizes a multi-channel switching amplifier, relying on the matching network and the transducer to filter the frequencies. In its most robust configuration, it can output 4 watts over each of 256 channels, for a total of 1 kW continuously.

Immediately following the symposium, Rob Hekkenberg of the Netherlands led a meeting of the IEC Project Group on therapeutic ultrasound. About two dozen international group members and observers attended; notably absent was the United States FDA. Document 60601-2-62 (International Electrotechnical Commission Medical Electrical Equipment - Part 2-62, Particular requirements for the basic safety and essential performance of high intensity therapeutic ultrasound (HITU) equipment) is nearing completion, and is likely to be influential among regulatory agencies. Among the key elements to be considered by manufacturers are detailed characterization of the ultrasound beam, such as the size and power of the beam where it first enters the body, the peak positive and negative acoustic pressure, and the intensity of side lobes. An extensive list of hazards is presented to guide manufacturers in risk assessment. For example, there are risks due to misalignment of diagnostics and therapeutics, unskilled use of equipment, acoustic energy delivered outside the target region, and failure of equipment sub-assemblies.

The Heidelberg symposium was held in the classically ornate Kongresshaus.

JOURNAL OF Therapeutic Ultrasound

The new Journal of Therapeutic Ultrasound is designed to provide maximum dissemination of your ideas within the ultrasonics community and beyond. By publishing your work in this online, open source journal, your paper will be under your control by virtue of the Creative Commons license, and in accord with a growing worldwide accessibility movement. Your work will receive the imprimatur of peer review, indexing with major services, and measurable impact of citations and access. Supplemental material is encouraged, so you can include extended data sets, videos, and detailed methodology.

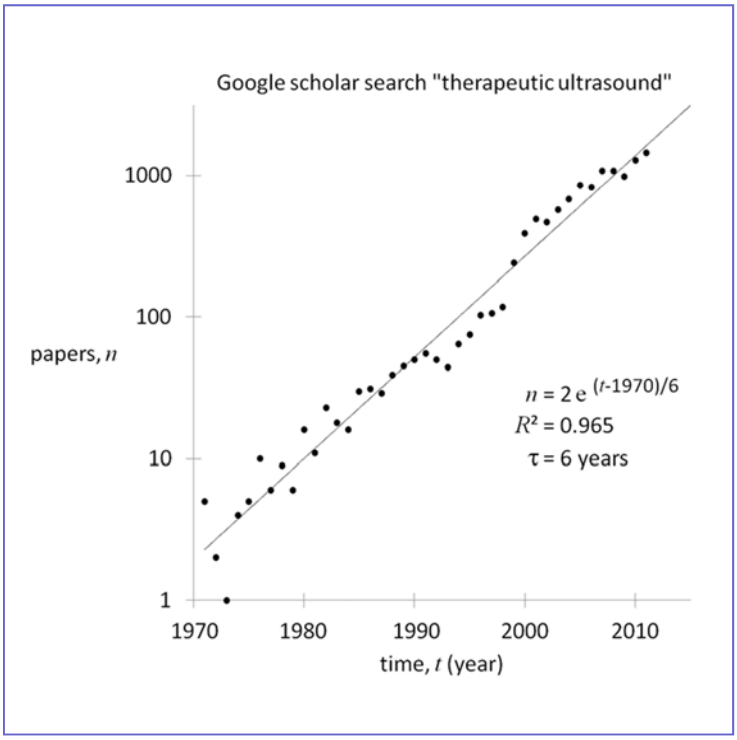
The number of therapeutic ultrasound papers published each year is growing exponentially (see Graph). Cognizant of this trend, the International Society for Therapeutic Ultrasound, the Focused Ultrasound Surgery Foundation, and BioMed Central Ltd. worked together to create the new journal. The founding editors are UIA Board member Robert Muratore and Arik Hananel.

All aspects of therapeutic ultrasound are encompassed, viz., the stimulus, inhibition, or modification of tissue function or structure via insonification. The goal of the journal is to accelerate the adoption of therapeutic ultrasound as a clinical tool; therefore, the focus is on translational and clinical research. Reviews and original research papers are welcomed in a wide range of interrelated disciplines. Of particular interest to UIA members are papers in HIFU, HITU, histotripsy, tissue ablation and emulsification mechanisms, targeted drug delivery, blood brain barrier opening, neuromodulation, bone stimulus, wound healing, oncology, therapy guidance, metrology, and standards.

Peer review is traditional, single-blind, and confidential. Your papers will be reviewed for validity, originality, clarity, significance, and adherence to standards. The journal follows the guidelines of the Committee of Publication Ethics and the World Association of Medical Editors.

Thanks to generous support from the Focused Ultrasound Surgery Foundation, article processing charges are waived through 2014, so papers are free to authors.

Further information is available on the journal website, JTUltrasound.com.



The term "therapeutic ultrasound" was searched on Google Scholar, using a custom range of single years and excluding citations and patents. The number of papers meeting these criteria and published annually since 1970 exhibits an exponential growth with a characteristic time of about 6 years and a projected publication of about 3600 papers in 2015.

2012 - 2013 UIA Board of Directors

We welcome our two new Board members

Wanda Wolny, Meggitt

Dominick DeAngelis, KNS

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National Physical Laboratory
Teddington, Middlesex, UK

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Westport, CT, USA

Wanda Wolny
Meggitt
Denmark, Copenhagen

Hilton Orlando Lake Buena Vista, FL, USA

22 - 24 April 2013

2013 UIA Symposium Call for Papers

The Ultrasonic Industry Association invites you to submit a 200 word abstract for consideration of presentation or poster on 22 - 24 April at its 42nd Annual Symposium in **Orlando, FL, USA,** at the Hilton Orlando Lake Buena Vista Hotel. Plan now to join UIA for this international conference featuring the best of ultrasound from around the world. For more information, please go to http://www.ultrasonics.org
Please note the appropriate category and preferred format of your proposed presentation:

☐ **Industrial Applications**: NDE, Measurements, Cleaning, Atomization, Materials Processing, Effluent Processing, Joining and Fastening, Welding and Cutting, Sonochemistry, Underwater Applications, Remote Sensing, Transducer Design/ Materials.

☐ **Medical**: Surgical, Therapeutic, HIFU/LIFU, Bioeffects, Tissue Characterization, Bio-Acoustic Microscopy, Transducer Design/Materials

Preferred Presentation Method: ❑ **Paper Presentation** ❑ **Poster Session**

Deadline: 31 October 2012

Important Information: Papers will be no longer than 25 minutes; final abstracts must be submitted via e-ÔÈÐÓõ The session chair will contact you directly to discuss your proposed presentation. Bio-sketches and ×ÙÌÚÌÕÛÈÛÐÖÕ suitable for ËÐÚÛÙÐÉÜÛÐÖÕ▯ÖÕ▯È▯42!▯ÔÌÔÖÙà▯ËÌÝÐÊÌ must be submitted to the UIA office no later than **30 March 2013**. Final papers will be due shortly after symposium, at a date to be announced. **Accepted presenters receive a discounted registration fee.**

Please type or print your information below

Presentation Title _____

Authors _____

Presenters _____

Main Contact Name _____

Address _____

City _____ State/Prov _____ Country _____

Phone _____ Email _____

Symposium Chairs:

Symposium: Robert Muratore ▸ wave@quantumnow.com
Industrial: Dominick DeAngelis ▸ ddeangelis@kns.com
Medical: James Sheehan ▸ james_sheehan@verizon.net

Please submit this form to uia@ultrasonics.org

Ultrasonic Industry Association ⁞ PO Box 2307 ⁞ Dayton, OH 45401-2307 ⁞ USA
Voice +1.937.586.3725 ⁞ Fax +1.937.586.3699 ⁞ *E-mail* uia@ultrasonics.org ⁞ *Web* www.ultrasonics.org

Powering Sound Ideas

P O Box 2307
Dayton, OH 45401-2307 USA

Phone: +1.937.586.3725
Fax: +1.937.586.3699
Email: uia@ultrasonics.org

How can ultrasonics enhance the value of your business?

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

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