## AIP Conference Proceedings, Volume 1359 10th International Symposium on Therapeutic Ultrasound (ISTU 2010)

Table of Contents	
Preface	1
Committee Membership	3
Acknowledgments	5
PLENARY LECTURE	
High-Intensity Focused Ultrasound (HIFU) using Sonablate <sup>®</sup> devices for the treatment of benign prostatic hyperplasia and localized prostate cancer: 18-year experience Toyoaki Uchida	9
PHYSICAL STUDIES	
Characterization and quantification of HITU fields with a fiber-optic	
displacement sensor Julian Haller, Klaus-Vitold Jenderka, Volker Wilkens, and Christian Koch	19
Heating of tissues in vivo by pulsed focused ultrasound to stimulate	
enhanced HSP expression Tamara Kujawska, Janusz Wójcik, and Andrzej Nowicki	24
Development of HIFU treatment for lower extremity varicose veins Naohiko Senoo, Hiroyuki Ushijima, Jun Suzuki, Kiyoshi Yoshinaka, Juno Deguchi, Shu Takagi, Tetsuro Miyata, and Yoichiro Matsumoto	30
<b>Optoacoustic imaging for guiding and monitoring HIFU therapy</b> Parag V. Chitnis, Hans P. Brecht, Richard Su, and Alexander A. Oraevsky	36
A new acoustic lens design for electromagnetic shock wave lithotripters Pei Zhong, Nathan Smith, Neal W. Simmons, and Georgy Sankin	42

3D MRI-controlled transurethral ultrasound prostate therapy: Experimental validation of numerical simulations	
Mathieu Burtnyk, William Apoutou N'Djin, Ilya Kobelevskiy, Michael Bronskill, and Rajiv Chopra	48
Measurements of HIFU-induced lesions in BSA gel phantoms for HIFU	
treatment of varicose veins of lower extremity	
Hiroyuki Ushijima, Naohiko Senoo, Jun Suzuki, Mitsuhisa Ichiyanagi, Kiyoshi Yoshinaka, Juno Deguchi, Shu Takagi, Tetsuro Miyata, and Yoichiro Matsumoto	53
CAVITATION/MICROBUBBLE MONITORING AND BIOEFFECTS	
The mechanical effects of ultrasound contrast agents on micro-vessels N. Hosseinkhah and K. Hynynen	61
Histological findings in the brain after focused ultrasound ablation combined with definity using parameters suited for transcranial application	
Natalia Vykhodtseva, Yuexi Huang, and Kullervo Hynynen	67
Feedback loop process for controlling inertial cavitation: Experimental evidence	
Claude Inserra, Abbas Sabraoui, Lina Reslan, Jean-Christophe Bera, Bruno Gilles, and Jean-Louis Mestas	73
Synchronized passive imaging of single cavitation events	
Jérôme Gateau, Jean-François Aubry, Mathieu Pernot, Daurian Chauvet, Anne-Laure Boch, Mathias Fink, and Mickaël Tanter	79
<b>Cavitation detection using a fibre-optic hydrophone: A pilot study</b> V. Bull, J. Civale, I. Rivens, and G. R. ter Haar	85
Temperature change from oscillating bubbles within a capillary network induced by focused ultrasound	
Shaoying Liu, Nazanin Hosseinkhah, and Kullervo Hynynen	91
Evaluation of local density enhancement of microcapsules in artificial	
blood vessel during exposure to focused ultrasound Ryusuke Nakamoto, Kohji Masuda, Nobuyuki Watarai, Yuto Taguchi,	
Toshikazu Kato, Takashi Yoshinaga, Yoshitaka Miyamoto, and Toshio Chiba	97

Analysis for acoustic characterization of microbubbles under ultrasound exposure	
Wataru Baba, Yoji Nakamura, Mitsuhisa Ichiyanagi, Kiyoshi Yoshinaka, Teiichiro Ikeda, Shu Takagi, and Yoichiro Matsumoto	103
Gel phantom containing controlled air to test triggered HIFU exposure sequence	
Kengo Takimoto, Tatsuya Moriyama, Ryo Takagi, Shin Yoshizawa, and	

## **MR-HIFU**

Usage of Magnetic Resonance Guided Focused Ultrasound Surgery (MRGFUS) in oncology	
Yair Bauer	117
Application of MR-guided focused pulsed ultrasound for destroying clots in vitro using thrombolytic drugs	
V. Hadjisavvas, K. Ioannides, and C. Damianou	126
3D conformal MRI-guided transurethral ultrasound therapy: Results of gel phantom experiments	
W. A. N'Djin, M. Burtnyk, S. McCormick, M. Bronskill, and R. Chopra	132
MR-HIFU enhanced volumetric ablations Charles Mougenot, Bruno Quesson, Chrit Moonen, and Shunmugavelu	
Sokka	138
Heart ablation using a planar rectangular high intensity focused ultrasound transducer and MRI guidance	
Andreas Couppis, Christakis Damianou, Kleanthis Ioannides, Nicos Mylonas, Demitris Iosif, Panagiotis Kyriakou, Cyril Lafon, Francoise	
Chavrier, Jean-Yves Chapelon, and Alain Birer	144
MR-guided focused ultrasound robot for performing experiments on large animals	
N. Mylonas and C. Damianou	151
Tissue necrosis monitoring for HIFU ablation with T1 contrast MRI imaging	
San-Chao Hwang, Ching Yao, Ih-Yuan Kuo, Wei-Cheng Tsai, and Hsu Chang	157

Investigations into thermally mediated drug delivery using a preclinical system for MRI-guided focused ultrasound Robert Staruch, Rajiv Chopra, and Kullervo Hynynen	163
Evaluation of hand-held strain imaging for guiding HIFU ablation: In vivo results compared with MR-images Jérémy Chenot, David Melodelima, Hubert Parmentier, Rémi Souchon, and Jean-Yves Chapelon	168

## DEVICE

Effects of tracking error on lesion formation in high intensity focused ultrasound liver tumor tracking treatments	
Cheng Chieh-Fang, Lin Win-Li, and Chen Yung-Yaw	177
Fabrication of CMUT cells with gold center mass for higher output pressure	
Hyo-Seon Yoon, Min-Chieh Ho, Nikhil Apte, Paul Cristman, Srikant Vaithilingam, Mario Kupnik, Kim Butts-Pauly, and Butrus T. Khuri- Yakub	183
1 4KUU	165
Selecting random distributed elements for HIFU using genetic algorithm Yufeng Zhou	189
A pilot study of catheter-based ultrasound hyperthermia with HDR brachytherapy for treatment of locally advanced cancer of the prostate and cervix	
Chris J. Diederich, Jeff Wootton, Punit Prakash, Vasant Salgaonkar, Titania Juang, Serena Scott, Xin Chen, Adam Cunha, Jean Pouliot, and I. C. Hsu	195
Ablation produced using a toroidal high intensity focused ultrasound device is independent of hepatic perfusion	
David Melodelima, William A. N'Djin, Julia Favre, Hubert Parmentier, Michel Rivoire, and Jean Yves Chapelon	200
Multilayer array transducer for nonlinear ultrasound imaging Neil R. Owen, Peter J. Kaczkowski, Tong Li, Dan Gross, Steven M.	
Postlewait, and Francesco P. Curra	206

Effects of Lamb waves in a single-element high intensity focused ultrasound transducer	
Kenji Otsu, Yasuhiro Kaneshima, Shin Yoshizawa, and Shin-ichiro Umemura	211
Design and fabrication of a wide-aperture HIFU annular array transducer for the treatment of deep-seated tumors Gin-Shin Chen, Hsu Chang, Yi-Yuan Kuo, Winli Lin, Wen-Shiang Chen,	
and Wen-Yih Tseng	215
Electronic beam steering for increasing the coagulated volume created with a toroidal transducer	
J. Vincenot, D. Melodelima, F. Chavrier, and J. Y. Chapelon	221
A method of estimating pressure and intensity distributions of multielement phased array high intensity focused ultrasonic field at full power using a needle hydrophone	
Yu Ying, Shen Guofeng, Bai Jingfeng, and Chen Yazhu	227
<b>BUBBLE-ENHANCED HIFU</b>	
Heating location control of HIFU treatment enhanced with microbubbles T. Nishihara, H. Utashiro, M. Ichiyanagi, K. Yoshinaka, S. Takagi, and Y. Matsumoto	235
Minimally invasive intracardiac intervention using high intensity focused ultrasound	
Takashi Mochizuki, Taizou Kihara, Kazunori Itani, Kouji Ogawa, Shin Yoshizawa, Shin-ichiro Umemura, Gontaro Kitazumi, Yasumasa Katsuike, and Toshio Chiba	241
An investigation of high intensity focused ultrasound thrombolysis Cameron Wright, Kullervo Hynynen, and David Goertz	246

## THEORETICAL CALCULATION

•

A simulation model for predicting the temperature during the	
application of MR-guided focused ultrasound for stroke treatment usin	g
pulsed ultrasound	

V. Hadjisavvas and C. Damianou

A TR-induced algorithm for hot spots elimination through CT-scan HIFU simulations	
Nicolas Leduc, Kohei Okita, Kazuyasu Sugiyama, Shu Takagi, and Yoichiro Matsumoto	259
Symptomatic improvement in uterine myomas after MRgFUS: 4 year follow up	
Kaoru Funaki and Hidenobu Fukunishi	265
The effect of the elastic body assumption on the focusing of ultrasounds in inhomogeneous media	
Takaaki Shimura, Kohei Okita, Shu Takagi, and Yoichiro Matsumoto	269
<b>BIOEFFECTS AND DRUG DELIVERY</b>	
Immune system modulation with LOFU and HIFU treatment of prostate cancer	
C. Guha, Z. Huagang, W. Chen, R. Carlosn, and N. T. Sanghvi	277
Color doppler sonographic evaluation of peak systolic velocity and pulsatility index in artery after pulsed HIFU exposure	202
Feng-Yi Yang, Wei-Hsiu Chiu, and Chi-Fang Yeh	283
HIFU as a neoadjuvant therapy in cancer treatment P. Zhong, F. Xing, X. Huang, H. Zhu, H. W. Lo, X. Zhong, S. Pruitt, and C. Robertson	289
A study of micro-bubble enhanced sonoporation A. Okamoto, R. Tachibana, K. Yoshinaka, K. Osada, S. Takagi, K. Kataoka, U. Chung, and Y. Matsumoto	295
Standing waves in small animal models investigating ultrasound disruption of the blood-brain barrier Meaghan A. O'Reilly, Yuexi Huang, and Kullervo Hynynen	301
A novel pinhole-assisted mechanical scanning 28-kHz ultrasonic device to open the blood-brain barrier Hao-Li Liu, Pin-Yuan Chen, and Kuo-Chen Wei	306
Sonoporation-induced apoptosis and cell cycle arrest: Initial findings Wenjing Zhong, Wai Hung Sit, Jennifer M. F. Wan, and Alfred C. H. Yu	312

An experimental model using cultured cardiac myocytes for a study of the generation of premature ventricular contractions under ultrasound	
exposure Nobuki Kudo and Masaya Yamamoto	318
Ultrasound-induced DNA damage and signal transductions indicated by	
gammaH2AX	
Yukihiro Furusawa, Yoshisada Fujiwara, Qing-Li Zhao, Mariame Ali Hassan, Ryohei Ogawa, Yoshiaki Tabuchi, Ichiro Takasaki, Akihisa Takahashi, Takeo Ohnishi, and Takashi Kondo	322
Ultrasound-targeted bubble liposome destruction enhances AG73-	
mediated gene transfer by improvement of intracellular trafficking	
Daiki Omata, Yoichi Negishi, Yoko Endo-Takahashi, Ryo Suzuki, Kazuo	
Maruyama, Motoyoshi Nomizu, and Yukihiko Aramaki	326
Characterisation of gene delivery using liposomal bubbles and ultrasound	
Risa Koshima, Ryo Suzuki, Yusuke Oda, Keiichi Hirata, Tetsuya	
Nomura, Yoichi Negishi, Naoki Utoguchi, Nobuki Kudo, and Kazuo	
Maruyama	330
Intramuscular injection of angiogenic gene with bubble liposomes	
followed by ultrasound exposure to improve angiogenesis Yoichi Negishi, Keiko Matsuo, Yoko Endo-Takahashi, Kentaro Suzuki,	
Yuuki Matsuki, Norio Takagi, Ryo Suzuki, Kazuo Maruyama, and	
Yukihiko Aramaki	335
Novel siRNA-loaded bubble liposomes with ultrasound exposure for	
RNA interference	
Yoko Endo-Takahashi, Yoichi Negishi, Ryo Suzuki, Kazuo Maruyama, and Yukihiko Aramaki	340
Anti-tumor mechanism in IL-12 gene therapy using liposomal bubbles	
and ultrasound	
Ryo Suzuki, Yusuke Oda, Risa Koshima, Keiichi Hirata, Tetsuya	
Nomura, Yoichi Negishi, Naoki Utoguchi, Shinsaku Nakagawa, and Kazuo Maruyama	345
Anti-tumor effects from dendritic cell-based cancer immunotherapy	
using liposomal bubbles and ultrasound	
Yusuke Oda, Ryo Suzuki, Keiichi Hirata, Tetsuya Nomura, Naoki	251
Utoguchi, and Kazuo Maruyama	351

MR-guided unfocused ultrasound disruption of the rat blood-brain barrier	
Kelly A. Townsend, Randy L. King, Greg Zaharchuk, and Kim Butts Pauly	356
Blood-brain barrier disruption caused by ultrasound bursts combined with microbubbles depends on anesthesia Nathan McDannold, Yongzhi Zhang, and Natalia Vykhodtseva	361
Influence of waveform on cell viability during ultrasound exposure Timur Saliev, Loreto B. Feril, Donald A. McLean, Katsuro Tachibana, and Paul A. Campbell	367
p53 response to ultrasound: Preliminary observations in MCF7 human breast cancer cells	
Janis M. Burns and Paul A. Campbell	371
Ultrasound-assisted gene transfer to adipose tissue-derived stem/progenitor cells (ASCs) Yoshitaka Miyamoto, Hitomi Ueno, Rei Hokari, Wenji Yuan, Shuichi Kuno, Takashi Kakimoto, Shin Enosawa, Yoichi Negishi, Kiyoshi Yoshinaka, Yoichiro Matsumoto, Toshio Chiba, and Shuji Hayashi	377
Toshinaka, Tolenito Watsunioto, Toshio Chioa, and Shuji Hayashi	110
TREATMENT PLANNING	
Ultrasound image-guided tracking algorithm for moving-tumor	
treatment Kai-Hsiang Chang, Ming-Chih Ho, Chi-Chuan Yeh, Feng-Li Lian, Jia- Yush Yen, and Yung-Yaw Chen	385
Real-time tissue change monitoring on the Sonablate <sup>®</sup> 500 during high intensity focused ultrasound (HIFU) treatment of prostate cancer Wo-Hsing Chen, Narendra T. Sanghvi, Roy Carlson, and Toyoaki Uchida	391
Sub-volume heating strategy to shorten treatment time in ultrasound	
surgery Xiang Ji, Guofeng Shen, Jingfeng Bai, and Yazhu Chen	397
Design of a filter against ultrasound image noise for remote diagnosis Yen-Yu Chen	402

ii

i Ç

Cooling time reduction for focused ultrasound surgery by dynamically adjusting sonication time	
Li Dehui, Shen Guofeng, Bai Jinfeng, and Chen Yazhu	412
MRI-guided transurethral ultrasound therapy of the prostate gland: Simulations under clinical conditions	
W. A. N'Djin, M. Burtnyk, I. Kobelevskiy, M. Bronskill, and R. Chopra	418
<b>BUBBLE DYNAMICS SIMULATION</b>	
The dynamics of histotripsy bubbles Wayne Kreider, Michael R. Bailey, Oleg A. Sapozhnikov, Vera A.	
Khokhlova, and Lawrence A. Crum	427
Numerical simulation of cavitation in ultrasound field	
Yoshiaki Tamura, Nobuo Tsurumi, and Yoichiro Matsumoto	431
Numerical study of the effective combination of microbubbles and ultrasound in HIFU therapy	
Kohei Okita, Kazuyasu Sugiyama, Kenji Ono, Shu Takagi, and Yoichiro Matsumoto	437
Numerical modeling of non-spherical response of therapeutic encapsulated microbubbles to ultrasound	
Chao-Tsung Hsiao and Georges L. Chahine	443

## NANOPARTICLES

Multimodal perfluorocarbon nanoemulsions for <sup>19</sup> F MRI,	
ultrasonography, and catalysis of MRgFUS-mediated drug delivery	
N. Rapoport, KH. Nam, D. A. Christensen, A. M. Kennedy, D. L.	
Parker, A. H. Payne, N. Todd, J. E. Shea, and C. L. Scaife	451

## CLINICAL STUDIES

Simulation of temperature field induced by 8-element phased array	
HIFU transducer with concave spherical surface	
Wujun Sun, Ping Zhang, Xiaojing Zhang, Xiqi Jian, and Zhihua Li	

459

## Salvage high-intensity focused ultrasound for the recurrent prostate cancer after radiotherapy in Japan

S. Shoji, M. Nakano, Y. Nagata, and T. Uchida

# High-intensity focused ultrasound for the treatment of localized and locally advanced hormone-resistant prostate cancer: 2,5 year outcome

V. A. Solovov, S. Y. Dvoynikov, and M. O. Vozdvizhenskiy 473

### **CLINICAL MR-HIFU**

### Diffusion weighted MR imaging to evaluate treatment results after volumetric MR-guided high intensity focused ultrasound of uterine fibroids: Influence of different *B*-values

M. J. Voogt, B. Keserci, Y. S. Kim, H. Rhim, H. K. Lim, C. Mougenot, M. O. Kohler, M, A. van den Bosch, K. L. Vincken, and L. W. Bartels 483

# Efficacy of magnetic resonance-guided focused ultrasound surgery for bone metastases pain palliation

Motohiro Kawasaki, Hirofumi Nanba, Tomonari Kato, Toshikazu Tani, and Takahiro Ushida

### 488

465

#### **Author Index**