Session 3aBA

Biomedical Acoustics: Therapeutic Ultrasound

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Chair's Introduction—9:30

Contributed Papers

9:35

3aBA1. Array-based focusing of therapeutic ultrasound to the spinal canal. Meaghan A. O'Reilly, Rui Xu, and David Martin (Sunnybrook Research Inst., Toronto, ON, Canada)

The development of clinical-scale technology for non-invasively focusing to the spinal cord has the potential to enable the translation of novel treatments, such as enhanced drug delivery via ultrasound modification of the blood-spinal cord barrier. This talk will present recent simulation and experimental results evaluating array-based focusing to the human spinal canal with non-invasive aberration correction.

9:40

3aBA2. Acoustic holograms for thalamic focusing through the temporal-bone window. Diana Andrés (Universitat Politècnica de València, Spain, Valencia, diaanbau@upv.es), Noé Jiménez, and Francisco Camarena (Universitat Politècnica de València, Spain, Valencia)

In this work, we numerically investigate the performance of acoustic holograms created using k-space simulations and a phase-conjugation method at 650 kHz to simultaneously target both thalami through the temporal bone window compared to a curved transducer. Furthermore, we calculate how a misalignment of the acoustic hologram and the skull could affect the resulting acoustic image in terms of focus pressure and treated volume. Our results show that transtemporal acoustic holograms are a robust method to improve focus quality and to enhance sonicated volumes on target deep-brain even under small misallocations of the therapeutic ultrasound device that can be used for highly selective and low-cost blood-brain barrier opening and neuromodulation applications.

9:45

3aBA3. Engulfed targeted microbubbles: Sonoporation from within the endothelial cell. Klazina Kooiman (Dept. of Biomedical Eng., Thoraxcenter, Erasmus MC Univ. Medical Center Rotterdam, Rotterdam, the Netherlands, k.kooiman@erasmusmc.nl), Inés Beekers, Simone A.G. Langeveld, Bram Meijlink 1, Antonius F. W. van der Steen, Nico de Jong (Dept. of Biomedical Eng., Thoraxcenter, Erasmus MC Univ. Medical Center Rotterdam, Rotterdam, the Netherlands), and Martin D. Verweij (Dept. of Imaging Physics, Delft Univ. of Technol., Delft, the Netherlands)

Targeted microbubbles are currently regarded as objects attached to the outside of the endothelial cell membrane; nonetheless our study shows that microbubbles targeted to the angiogenic biomarker $\alpha v\beta 3$ were fully engulfed by the human umbilical vein endothelial cells, while those targeted to the endothelial biomarker CD31 varied from partially to fully engulfed and non-targeted and IgG1? control-targeted microbubbles were not engulfed at all. The engulfed microbubbles had lower excursion amplitudes than non-engulfed microbubbles and the sonoporation threshold was lower for the engulfed $\alpha v\beta 3$-targeted microbubbles than for all other microbubble types investigated, suggesting they can augment the receptiveness to sonoporation from within the cell.

9:50

3aBA4. Multi-cavity PLGA particles as a theranostic agent. James Kwan (Univ. of Oxford, Oxford, UK, james.kwan@eng.ox.ac.uk), Xiaoqian Su, Moumita Rakshit, Prativa Das, Ipshita Gupta, Dhiman Das, Manojit Pramanik, and Kee Woei Ng (NTU, Singapore)

We have developed drug-loaded multi-cavity PLGA microparticles that act as both a cavitation nuclei and drug vehicle. Our work shows that these particle can be embedded into a tissue model, release a drug to reduce inflammation in a 3D cell culture model, and be imaged with B-mode ultrasound.

9:55–10:10 Discussion

10:10

3aBA5. Oxygen scavenging using acoustic droplet vaporization while altering droplet diameter and droplet concentration. Rachel P. Benton (Dept. of Internal Medicine/Univ. of Cincinnati, Cincinnati, OH, bentonrp@mail.uc.edu), Abby Clark, and Manaswini Nedunuri (University of Cincinnati, Cincinnati, OH)

Transiently reducing the bioavailability of oxygen within an ischemic heart at the time of reperfusion may reduce the formation of reactive oxygen species and therefore reduce the amount of cell death. In vitro studies describe how the magnitude of oxygen scavenging changes as perfluorocarbon droplet diameter and droplet concentration are varied under ultrasonic exposure from an EkoSonic intravascular catheter.

10:15

3aBA6. Self-demodulation revisited: Effect of nonlinear propagation on stable cavitation from ultrasound contrast agents. Vagisha (Electrical Eng., Indian Inst. of Technol. Gandhinagar, Gandhinagar, Gujarat, India, vagisha.18110179@iitgn.ac.in), Kenneth Bader (Dept. of Radiology, Univ. of Chicago, Chicago, IL), and Himanshu Shekhar (Discipline of Electrical Eng., Indian Inst. of Technology Gandhinagar, Gandhinagar, Gujarat, India)

Stable cavitation from microbubbles is important for both ultrasound-mediated therapy and contrast-enhanced imaging. Here, we extend the findings of prior studies, which indicate that the self-demodulation of the excitation pulse caused by nonlinear propagation can enhance stable cavitation.