University of Rochester

BME PhD Defense Seminar

David Bustamante

MAY 14

Supervised by
Drs. Mohammed Mehrmohammadi and Nebojsa Duric

"Generating and Monitoring Hyperthermia with a Ring-Array Ultrasound Transducer"

Seminar Abstract: Hyperthermia is an adjunct treatment in which a tumor is gently heated to 39 – 44 °C for up to one hour to enhance the effects of other cancer therapies. Broader clinical adoption remains limited because existing systems struggle to deliver controlled volumetric heating while simultaneously monitoring temperature.

The goal of this project was to design and implement a framework for delivering and monitoring hyperthermia with a ring-array ultrasound transducer. The premise of the project is that ring-array ultrasound transducers can generate hyperthermia with focused ultrasound while interleaving ultrasound tomography acquisitions to monitor changes in tissue sound speed, which changes predictably with temperature. Motivated by this premise, this project investigated the feasibility of using ring-array ultrasound transducers as a unified platform for generating and monitoring hyperthermia. Experiments evaluated the use of ring-array transducers in ex vivo and in vivo models for both hyperthermia generation and ultrasound tomography-based thermometry.

These studies demonstrated that ring-array transducers can generate hyperthermia over clinically relevant tissue volumes while maintaining a safe operating regime by optimizing focused ultrasound transmission to favor lower duty cycles and multifocal heating. In parallel, the capability of ultrasound tomography to detect temperature-related sound-speed changes was demonstrated in tissue-mimicking phantoms and in vivo. Additional studies demonstrated the feasibility of combining therapy delivery and monitoring, while also identifying important hardware, motion, and localization constraints. A three-dimensional computational model was also developed to enable treatment planning for hyperthermia generation and monitoring with a ring-array transducer, and it was validated experimentally with a high degree of accuracy. Limitations of the framework and overall approach were also evaluated and discussed to guide future studies and optimization. Together, these studies show that a ring-array ultrasound transducer provides a theranostic framework that can integrate treatment delivery, noninvasive monitoring, and treatment planning.

Thursday, May 14, 2026 | 9:00 am EST | Adolph Aud (1-7619, Med Center)
Zoom: https://rochester.zoom.us/j/93577423961

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