SEMINAR NOTICE

Department of Electrical and Systems Engineering

3D TEMPERATURE IMAGING USING ULTRASONIC BACKSCATTER ENERGY DURING NON-UNIFORM TISSUE HEATING

DISSERTATION DEFENSE
by

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Background: Hyperthermia alone or in conjunction with chemotherapy and radiation is used for cancer treatment. One of its limitations is lack of detailed temperature information. Ultrasound is a cheap, non-ionizing and convenient method with potential for non-invasive temperature imaging. In this study, the volumetric (3D) change in ultrasonic backscattered energy (CBE) was calibrated and used to estimate temperature during both uniform and non-uniform heating.
Methods: For accurate temperature measurement, a grid of thermocouples was calibrated using a NIST-traceable thermometer. 3D ultrasonic datasets were obtained by moving a 7.5 MHz linear, phased-array transducer in 0.6 mm steps in elevation. CBE was computed from a ratio of motion-compensated, envelope-detected images and a reference ultrasonic image. To evaluate the effects of noise, scatterer distribution, and spatial resolution on estimation errors during non-uniform heating, thermal modeling was done using finite element methods. Temperature estimation was tested in both gelatin and tissue phantoms.
Results: CBE curves obtained from turkey breast muscle during uniform heating were well matched by a linear regression that had a slope of 0.3dB/^{o}C. Cross-validation studies with uniform heating had 3D temperature estimation errors <0.5^{o}C over 20 1cm^{3} volumes. Estimated temperature errors during non-uniform heating were typically within ± 1^{o}C.
Conclusion: This work, which validated the potential of CBE as a non-invasive thermometer during both uniform and non-uniform heating, was the first of its kind. It also helped to identify some of the sources of estimation errors. 3D validation of CBE thermometry *in vitro* is an important step in making the transition from the laboratory to the clinical application of CBE temperature imaging for hyperthermia and other thermal therapies.

DATE:	Tuesday, December 15, 2009
TIME:	10:00 a.m.
PLACE:	Bryan Hall, Room 305

Dissertation advisor:
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