Thermally Assisted Photoacoustic Radar Imaging

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A thermally assisted method for improving photoacoustic (PA) imaging depth and signal-to-noise (SNR) ratio is presented in this talk. Uniform heating, microwave and ultrasound localized heating have been studied as heating sources for imaging purposes. The temperature rise from microwave or ultrasound excitation was experimentally measured using thermocouples in *ex-vivo* beef muscle. The SAR (Specific Absorption Rate) distribution in the radial direction of the heated spot by microwaves or ultrasound was studied experimentally and theoretically. The measured temperature on the microwave heated surface spot or the center of a HIFU focal area was compared with theoretical estimates. The analytical method showed reasonable agreement with the measured results. The study also showed that microwaves can generate over three times higher temperatures than ultrasound in 30-s-heated beef muscle with the same input power.

The uniform-heating-assisted experimental results showed that the maximum imaging depth increased by 20% through raising the temperature of absorbing biotissues (*ex-vivo* beef muscle) uniformly from 37 to 43℃, and the SNR was increased by 8%. The microwave assisted localized heating (*ex-vivo* beef muscle) can increase the imaging depth by 11%, and SNR by 5%. The temperature dependence of the parameters comprising the Gruneisen constant (to which the PA signal is proportional) was investigated. The studies showed that the Gruneisen constant of biotissues increases with temperature. The thermal expansion coefficient contributes to the increase of Gruneisen constant more than other parameters.