ACOUSTICS2008/2983
A reflex transmission method for ultrasound thermometry

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It is of great interest to develop ultrasound-based thermal imaging for monitoring thermal ablation procedures and as a tissue characterization technique. A phase contrast analysis for temperature mapping has been investigated, based on the temperature dependence of sound speed of water and tissue. The method employs reflex transmission imaging principles, planar projection and tomographic reconstruction techniques, for interrogating a region featuring a temperature contrast. Through-transmission and pulse-echo configurations were both used to image phase contrasts caused from a change in sound speed, in experimental measurements and numerical simulations. Tissue phantoms were used as a medium in which to create a steady-state sound speed contrast, and a raster scan was performed to acquire the sound field with a hydrophone. Two scans were acquired, a reference sound field and a scan featuring a phase contrast which corresponded to a 7 - 10 deg C peak temperature rise. The through-transmission configuration employed a 0.2-mm diameter needle hydrophone, while the pulse-echo measurement employed a custom-built thin-wire hydrophone to acquire the sound field between the interrogation transducer and tissue phantom. The method successfully located the location and amplitude of the phase contrast, and future steps necessary for tracking dynamic temperature changes will be discussed.