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An integrated system to deliver impulsive radiation force and to image induced transient strain for monitoring focused ultrasound surgery

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Thermal coagulation of tissue causes an approximate three-fold increase in stiffness, which can be easily detected by various elasticity imaging methods. Advantages have been reported, for application to breast cancer diagnosis, of an elasticity imaging method that applies a highly localised transient stress deep within the tissue using a low frequency focused ultrasound radiation force impulse, and uses relatively high frequency echo imaging to measure the transient strain generated in the tissue placed between the transducers. In this paper we describe a new system that implements this concept using a focused ultrasound surgical transducer to apply the transient (<10ms) load, synchronized by a customised field programmable gate array to a Zonare C5-2 probe to image the strain. Both transducers are on the same side of the tissue and locked together for scanning to create transient strain elastograms. Performance measurements, obtained using gelatine phantoms and ex vivo thermally ablated liver tissue, indicate an elastogram spatial resolution of 2mm, and acceptable contrast for detecting regions of thermally coagulated tissue. An advantage of this configuration is that it may be easily integrated into focused ultrasound therapy.