Sonoelastographic Shear Velocity Imaging: Experiments on Tissue Phantom and Prostate

K. Hoyt, K. J. Parker and D. J. Rubens
Rochester Center for Biomedical Ultrasound
University of Rochester, Rochester, NY 14627 USA

***Abstract*—In this paper, we introduce and evaluate a novel sonoelastographic technique for imaging shear velocity distributions from propagating shear wave interference patterns (termed crawling waves). A mathematical relationship between local crawling wave spatial phase derivates and shear velocity is presented with phase derivatives estimated using an autocorrelation-based technique. Results from homogeneous phantoms illustrate the ability of sonoelastographic shear velocity imaging to accurately quantify the true shear velocity distribution as verified using time-of-flight measurements. Results from a heterogeneous phantom reveal the ability of sonoelastographic shear velocity imaging to distinguish a stiff circular inclusion with shear velocity contrast comparable to that measured using mechanical testing techniques. High contrast visualization of focal carcinomas in an in-vitro prostrate specimen demonstrates the feasibility of this novel sonoelastographic imaging technique in tissue.**

$$\left|U(x,y,t)\right|^2 = 2A^2 \exp(-\alpha D)\times \left[\cosh(2\alpha x)+\cos(2k_S x+\Delta k_S x+\Delta\omega_S t)\right] \tag{5}$$

Finally, sampling of the crawling wave displacement field described by eqn (5) results in

$$(\quad)\qquad(\quad)$$

frequency o[redacted]s lower compared to the softer phant[redacted]rease in the true shear velocity dist[redacted]velocity sonoelastograms, an increase i[redacted]responds to an increase in shear veloci[redacted]independent of vibration frequency, a[redacted]ion frequencies, the shear velocity son[redacted]ifacts that are attributed to increased att[redacted]ere not compensated for using ampl[redacted]Statistical results were obtained fro[redacted]d compared to measured shear velocit[redacted] these results indicate, the shear veloc[redacted]closely match the true distribution i[redacted] frequencies investigated.

[redacted]

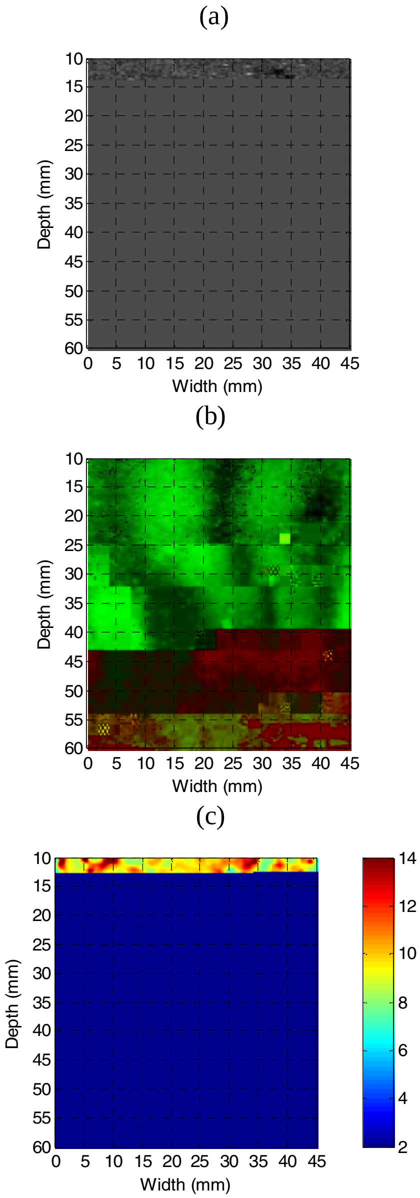

Figure 4. Results from in-vitro prostate gland experiments. Results depict the matched (a) B-mode ultrasound image, (b) crawling wave sonoelastogram and