was assessed. *RESULTS:* Most improvement of the transmit focus occurred at the initial iteration of adaptive beam formation. Aberration correction using TSC on transmit and using TSC or BP + TSC on receive resulted in improvement of contrast in regions of both positive and negative scattering strength. Aberration correction using estimates from lines spaced 2.8 mm apart produced results equivalent to those obtained from the individual lines spaced by 0.4 mm. *CONCLUSIONS:* B-scan images were visibly improved by adaptive beam formation using random scattering to correct for aberration on transmit and receive.

709 Modeling of Pulsed Annular Arrays Using Limited Diffraction Bessel Beams

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OBJECTIVE: The main objective is to develop a method for characterizing the emitted field of pulsed annular arrays in terms of a set known set of subfields. This arose from the study of implementation of limited diffraction Bessel beams, in which a spatially quantized approximation to the ideal transducer surface pressure is needed due to the limited number of annuli available on the transducer surface. Experimental studies have shown that such beams may be implemented approximately in practice, but a detailed mathematical understanding of the quantization effects has been lacking to date. *METHODS:* The principal method is to apply Fourier-Bessel series to model the surface pressure of the transducer at each frequency in the emitted pulse. The Fourier-Bessel series is composed of a weighted set of Bessel functions of known parameters, each of which gives rise to a propagated limited diffraction Bessel beam of known properties. In this way the emitted field at each frequency is characterized as a set of known limited diffraction subfields, with the total emitted field being the summation of these subfields. *RESULTS:* The results are that the field emitted from pulsed flat annular arrays may be predicted both numerically and analytically, with a specific decomposition of the field being given at each frequency. *CONCLUSIONS:* The main conclusion is that while spatial quantization in annular arrays is unavoidable due to physical constraints, the understanding of the propagated field is now much deeper than previously. This in turn might open the possibility of better pulse design in the future.

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702 Experimental Results With an 8 × 128 Linear Phased Array

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OBJECTIVE: We present initial results from a new 1.75D array that demonstrate improved image quality over standard 1D arrays. The advantages of this new array include: (1) improved elevation focusing, (2) more effective use of adaptive imaging techniques due to the increased sampling in the elevation dimension, (3) the ability to obtain individual channel data, and (4) harmonic imaging capability. *METHODS:* A custom 1.75D array built by Tetrad Corp (Englewood, CO) provides control of individual elements and real-time independent control of transmit and receive beams. The array has 8 elements in elevation and 128 laterally (a total of 1024 elements). The diffraction-limited elevation resolution is 0.5 mm. The diffraction-limited lateral resolution is 0.23 mm. The center frequency is 6.7 MHz with a bandwidth of 50%. The array has electronic switches in the handle, which allow the elevation aperture to be changed for each transmit and receive. The array connects to the Siemens Elegra ultrasound system, which defines the lateral aperture. The single channel data for the entire array can be collected over eight transmits, with concurrent B-mode images. The single channel data are then processed offline to form adaptive images. *RESULTS:* This array is used to form high resolution images through the implementation of several adaptive and/or harmonic imaging techniques. We present results of clinical studies in the breast, thyroid, and abdomen. *CONCLUSIONS:* The improved elevation focusing and more effective use of adaptive imaging techniques available with the 1.75D array result in higher resolution, more uniform images.

111 Biopsy Needle Visualization: Comparison of Compound vs Conventional Imaging on a Curved Linear Probe

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OBJECTIVE: To investigate needle visualization during ultrasound guided biopsies using compound imaging with a curved linear probe. *METHODS:* Conventional, harmonic, compound fundamental, and compound harmonic imaging was performed on a turkey breast phantom. All images were obtained using an HDI 5000 ultrasound unit with a broad bandwidth 5–2 MHz curved linear transducer. Compound imaging ("Sono-CT") was a pre-release version implemented on curved linear probes (ATL, Bothell, WA). Images of 20- and 22-gauge 15-cm needles were obtained at multiple angles of insonation. Images were then randomized for a blinded observer to rate needle visualization. The Medical Physics Department also compared differences in needle visualization in a quantitative parametric fashion. Comparison was also made between compound and conventional imaging during percutaneous biopsy of patients with deep liver lesions. *RESULTS:* At angles less than 45 degrees, compound and harmonic images better demonstrated needle location than conventional images. The difference was most significant when using the 22-gauge needle at a 15-degree angle of insonation. In this case, the needle could be localized by compound imaging but not by conventional imaging. Improved needle visualization was also noted during deep liver biopsies performed with a curved linear transducer in compound imaging mode. *CONCLUSIONS:* There is a clear advantage in visualization of small diameter biopsy needles imaged at shallow angles of insonation using compound imaging implemented on a curved linear transducer. This new technology may be of significant clinical benefit for fine needle biopsy of deep liver lesions.

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