adequate spatial sampling of the piston face. The frequency-domain impulse response exhibits aliasing caused by wrap around of the heavy tail of the stable distribution. Frequency-domain accuracy is dependent upon the spatial sampling of the piston face and the density of the frequency samples. Numerical evaluations show that the frequency- and time-domain calculations converge to the same result. [This work was supported in part by NIH Grant R01 EB012079.]

2:15

3pBA3. Frequency domain calculations of pulse-echo ultrasound signals with the fast nearfield method. Robert J. McGough (Elec. and Comput. Eng., Michigan State Univ., 2120 Eng., East Lansing, MI 48824, mcgough@egr.msu.edu)

Simulations of pulse-echo signals transmitted and received by an ultrasound phased array are evaluated in the frequency domain using FOCUS, and the results are compared with the output of Field II. The frequency domain simulation approach in FOCUS calculates the fast Fourier transform of the input signal, evaluates the individual frequency components of the transmit and receive pressure transfer functions using the fast nearfield method, and then computes the inverse fast Fourier transform of the product to obtain a numerical representation of the received time signal. With this approach, synthetic aperture signals are simulated in MATLAB for each pair of transmit and receive elements for three transmit elements and sixteen receive elements. Each element is excited with a 3 cycle Hanning-weighted input pulse with a 3 MHz center frequency. The temporal sampling of the computed signal in FOCUS is 12 MHz. To achieve approximately the same accuracy, Field II requires a temporal sampling of 4 GHz. Examples of simulated radio-frequency signals, the envelopes of these signals, and the associated numerical errors will be demonstrated for each method, and formulas for converting the pulse-echo outputs generated in FOCUS and Field II into equivalent quantities will be shown.

2:30

3pBA4. Estimation of two-dimensional strain rate based on high frame rate ultrasound imaging method. Hong Chen and Jian-yu Lu (Dept. of Bioengineering, Univ. of Toledo, 2801 W. Bancroft St., Toledo, OH 43606)

Strain rate (SR) measurement of heart tissue based on ultrasound images provides useful information of tissue hardness for diagnosing heart diseases. However, current SR estimation methods utilizing speckle tracking technique are based on conventional delay and sum (DS) imaging method, which causes skewed heart image resulting in inaccurate SR. To overcome the problem, a method to combine high frame rate (HFR) imaging method with speckle tracking technique was proposed. Using only one or a few transmissions for each image; compared with 91 for DS, new method can get a snapshot of moving targets, avoiding the skewing problem in DS. Two studies, with simulated and experimental echo data, respectively, were performed to verify the method. Both plane wave and limited diffraction beam (LDB) were studied for HFR. Both SR estimations in lateral and axial directions were calculated for the new and conventional ultrasound imaging methods. Results show that the new method has comparable or lower velocity errors than DS and more accurate SR, especially in lateral direction. Moreover, it can measure high velocity for other applications such as blood flow measurement. With the full view of heart image, SR of interest can be localized and then accurately estimated.

2:45

3pBA5. Transducer designs and simulations for high frequency scanning acoustic microscopy for applications in exploring contrast mechanism and the mechanical properties of biological cells. Yada Juntarapaso, Richard L. Tutwiler (Graduate Program in Acoust., The Penn State Univ., Univ. Park, PA 16802), and Pavlos Anastasiadis (Univ. of Hawaii, Honululu, HI 96822)

Scanning acoustic microscopy (SAM) has been extensively accepted and utilized for acoustical cellular and tissue imaging including measurements of the mechanical and elastic properties of biological specimen. SAM provides superb advantages: it is a noninvasive method; it can measure mechanical properties of biological cells or tissues; and fixation/chemical staining is not necessary. The first objective of this research is to develop a program for simulating the images and contrast mechanism obtained by high-frequency SAM. Computer simulation algorithms based on MATLAB® were built for simulating the images and contrast mechanism. The mechanical properties of HeLa and MCF-7 cells were computed from the V(z) measurement data. Algorithms for simulating V(z) responses involved calculation of the reflectance function and were created based on ray theory and wave theory. The second objective is to design transducer arrays for SAM. Theoretical simulations based on Field II programs of the high frequency ultrasound array designs were performed to enhance image resolution and volumetric imaging capabilities. The new transducer array design will be state-of-the-art in improving the performance of SAM by electronic scanning and potentially providing a four-dimensional image of the specimen. Phased array beam forming and dynamic apodization and focusing were employed in the simulations.