a prohibitively high element count which limits the field of view (FOV). Our research aims to increase the FOV of 3-D ultrasonic imaging by utilizing larger elements for an increased aperture size with no increase to the element count. Then, advanced beamformers can be applied to optimize image quality. Larger elements were tested by electronically coupling elements on a Vermon 2-D matrix array. Images were beamformed using conventional Delay-and-Sum (DAS), Null Subtraction Imaging (NSI), Directional Coherence Factor (DCF), and Minimum Variance (MV). Furthermore, a positioning system was used to acquire data in sections from a virtual large aperture, four times larger than the Vermon array with the same element count. Combined with a directional MV beamformer, the virtual array increased in resolution by 3.4% compared to a dense array which used DAS. The study suggests that larger apertures can be made from larger elements with sufficient image quality when combining with appropriate beamformers.

4:00

2pBAb8. Diffraction factor of a one-dimensional rectangular linear array for quantitative ultrasound imaging. Khalid Abdalla (Dept. of Phys., Toronto Metropolitan Univ., 350 Victoria St., Toronto, ON M5B2K3, Canada, k1abdalla@torontomu.ca), Shivani Sharma (Phys., Toronto Metropolitan Univ., Toronto, ON, Canada), and Yuan Xu (Toronto Metropolitan Univ., Toronto, ON, Canada)

The intensity of ultrasound images of a scattering medium depends on the imaging position and probe parameters. The diffraction factor describes this dependence, an essential quantity for describing an ultrasound imaging system. Accounting for the diffraction factor is crucial for quantitative ultrasound imaging. If uncorrected, diffraction alters both the amplitude and spectral shape of echoes, leading to bias in estimates of scatterer properties and attenuation. However, there is no explicit expression so far for a linear array, the most common transducer used in clinics. In this paper, we present a closed-form expression for the diffraction factor for a linear rectangular array and its applications in quantitative ultrasound imaging.

4:15

2pBAb9. Applications of beamforming using quasi-holographic back propagation for extracting information about scattering by penetrable objects. Heather A. Moon (Phys. & Astronomy, Washington State Univ., Webster Hall, 100 Dairy Rd. Rm. 1245, Pullman, WA 99164-2814, heatherannettemoon@gmail.com) and Philip L. Marston (Phys. & Astronomy, Washington State Univ., Pullman, WA)

Using ultrasonic illumination of elastic objects in water reveals contributions that can appear to be radiated from virtual sources within the structure. Beamforming by using quasi-holographic back propagation limited to supersonic wavenumbers has been used to image enhancements to backscattering [Hefner and Marston, ARLO **2**, 55–60 (2001)] and can reveal the location in space and time for the virtual sources of the scattered sound [Baik, Dudley, and Marston, JASA **130**, 3838–3851 (2011)]. In the present research, quasi-holographic back propagation of nearly backscattered bistatic signals from underwater targets is used to process the data and to take measurements of virtual sources within the target which is achieved by observing the focusing of signal amplitude in the back propagation images. The goal of the present work is to determine information about the backscattered signal showing evidence of axial focusing by axisymmetric objects and providing measurements of the location and diameter of the corresponding virtual ring source. Additionally, as a signal processing tool, unwanted source regions are removed from the back propagated data to isolate the contributions of interest in the backscatter data [Moon and Marston, JASA **158**, 4774–4784 (2025)]. [Work supported by the Office of Naval Research.]

4:30

2pBAb10. Shear wave holography construction of a simplified source condition for focused shear wave beams in soft elastic media. Branch T. Archer (Chandra Family Dept. of Elec. and Comput. Eng., The Univ. of Texas at Austin, 4806 Park Ln., Austin, TX 78732, branch.t.archer@gmail.com), John M. Cormack (Dept. of Medicine, Univ. of Pittsburgh, Pittsburgh, PA), Yu-Hsuan Chao (Dept. of Bioengineering, Univ. of Pittsburgh, Pittsburgh, PA), Kang Kim (Dept. of Bioengineering and Medicine, Univ. of Pittsburgh, Pittsburgh, PA), Kyle S. Spratt (Appl. Res. Labs., The Univ. of Texas at Austin, Austin, TX), and Mark F. Hamilton (Appl. Res. Labs. and Walker Dept. of Mech. Eng., The Univ. of Texas at Austin, Austin, TX)

Shear waves are employed in medical ultrasound imaging because they reveal variations in viscoelastic properties of soft tissue. Focused shear waves produced by a longitudinally vibrating piston at several hundred hertz are investigated experimentally in soft tissue phantoms and using an analytical model for shear wave beam generation and propagation. Experiments employed a spherically concave piston shaped to focus the shear wave beam at a depth of 4 cm in a soft tissue phantom. Our initial analytical model was confined to the source plane, with zero displacement surrounding the piston. However, the actual source condition is a traction-free surface surrounding the piston, and the edges of the piston extend 9 mm into the medium. Using shear wave holography, we infer the actual source condition by backpropagation of the displacement field several cm removed from the origin to the plane at the piston edge. We find that the actual source condition for an impulse driving function is dominated by a bipolar edge wave. However, we find that adding a central "bowl wave" inspired by the curvature of the piston further refines the source condition and provides improved accuracy in the near field.

4:45

2pBAb11. Experiment for super-resolution imaging with shear wave. Jian-yu Lu (Bioengineering, The Univ. of Toledo, 2801 West Bancroft St., Toledo, OH 43606, jian-yu.lu@ieee.org)

The spatial resolution of imaging based on waves such as optics and ultrasound is limited by the wavelength, as was found by Ernst Abbe in 1873. Previously, the author has proposed to modulate the imaging wave with a shear wave for ultrasound and photoacoustic imaging to overcome such a limit (super-resolution) (Lu, IEEE TUFFC Jan. 2024 and Lu, ASA POMA Nov. 2025). Because the speed of sound of shear wave in biological soft tissues is about three orders smaller than that of the longitudinal ultrasound waves, the half wavelength of the shear wave can be smaller than that of the diffraction-limited resolution of conventional images, especially, when objects to be imaged are deep in the tissues. Using a shear wave that has a short wavelength to modulate the phase of the longitudinal waves, combined with a technique to reduce sidelobes, a method to increase shear-wave amplitude (through shear-wave resonance), and the nonlinearity and spectrum of the shear wave, super-resolution images that can help to characterize tissues via their mechanical and nonlinear properties can be produced. In this study, an experiment of super-resolution imaging with shear wave was performed and the results will be presented.