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Curvilinear 3-D Imaging Using Row–Column Addressed 2-D Arrays with a Diverging Lens: Phantom Study

A double-curved diverging lens over the flat row–column-addressed (RCA) 2-D array can extend its inherent rectilinear 3-D imaging field-of-view (FOV) to a curvilinear volume region, which is necessary for applications such as abdominal and cardiac imaging. Two concave lenses with radii of 12.7mm and 25.4mm were manufactured using RTV664 silicone. The diverging properties of the lenses were evaluated based on simulations and measurements on several phantoms. The measured FOV for both lenses in contact with tissue mimicking phantom were less than 15% different from the theoretical predictions, i.e., a curvilinear FOV of 32°×32° and 24°×24° for the 12.7mm and 25.4mm radii lenses. A synthetic aperture imaging sequence with single element transmissions was designed for imaging down to 140mm at a volume rate of 88 Hz. The performance was evaluated in terms of signal-to-noise ratio (SNR), FOV, and full-width-at-half-maximum (FWHM) of a focused beam. The penetration depths in a tissue mimicking phantom with 0.5 dB/(cm MHz) attenuation were 100mm and 125mm for the lenses with radii of 12.7mm and 25.4 mm. The azimuth, elevation, and radial FWHM at 43mm depth were (5.8, 5.8, 1)\lambda and (6, 6, 1)\lambda. The results of this study confirm that the proposed lens approach is an effective method for increasing the FOV, when imaging with RCA 2-D arrays.

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