Three-Dimensional Synthetic Aperture Focusing Using a Rocking Convex Array Transducer

Volumetric imaging can be performed using 1-D arrays in combination with mechanical motion. Outside the elevation focus of the array, the resolution and contrast quickly degrade compared with the lateral plane, because of the fixed transducer focus. This paper shows the feasibility of using synthetic aperture focusing for enhancing the elevation focus for a convex rocking array. The method uses a virtual source (VS) for defocused multi-element transmit, and another VS in the elevation focus point. This allows a direct time-of-flight to be calculated for a given 3-D point. To avoid artifacts and increase SNR at the elevation VS, a plane-wave VS approach has been implemented. Simulations and measurements using an experimental scanner with a convex rocking array show an average improvement in resolution of 26% and 33%, respectively. This improvement is also seen in in vivo measurements. An evaluation of how a change in transducer design will affect the resolution improvement shows a potential for using a modified transducer for 3-D imaging with improved elevation focusing and contrast.

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Contributors: Andresen, H., Nikolov, S., Pedersen, M. M., Buckton, D., Jensen, J. A.
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