9:20

1aSP2. Partial activation of modular and foldable tessellated acoustic arrays for wave focusing. Ningxiner Zhao and Ryan L. Harne (Mech. and Aerosp. Eng., The Ohio State Univ., 201 W 19th Ave., Columbus, OH 43210, zhao.2684@osu.edu)

Tessellated acoustic arrays inspired by origami structures are suggested to enable wave focusing by exploiting curvatures realized by folded configurations of the array transducer elements. The use of origami-inspired folding patterns also cultivates great portability for space-limited applications. Yet, maintaining curvatures may prohibit feasible implementation of a tessellated been studied for the acoustic energy focusing usage. This research proposes an alternative technique to achieve wave focusing with tessellated arrays that do not realize curvatures upon folding. Here, the partial activation of a tessellated array is exploited to result in constructive interference that realizes a nearfield focal region. The modeling approach to examine partially activated arrays is presented and verified against numerical simulations. Then, the changes in nearfield focusing characteristics are correlated with corresponding changes in partial activation and array folding extent. The opportunities to exploit the partial activation of relatively simple origami-inspired array structures are examined to identify strategies to simplify implementation of portable, folding acoustic arrays in applications.

9:40

1aSP3. A performance metric for screen selection with the acoustic single pixel imager. Juan Ramirez (U.S. Air Force Res. Lab., 329 East 1st St., Apt 306, Dayton, OH 45402, juan.ramirez.ee@gmail.com), Jeffrey S. Rogers, and Geoffrey F. Edelmann (Naval Res. Lab., Washington, DC)

In the recent literature, an Acoustic Single-Pixel Imager has been successfully developed for source localization in a two-dimensional waveguide. Source bearing angle estimation was carried out by applying sparse recovery techniques on sensor measurements taken over dierent imaging screens. In this paper, we show that the mutual coherence of the sensing matrix can be used as a metric to predict the source localization capability of the single-pixel imaging system. In particular, our analysis focuses on the sparsity of open cells within the imaging screen and the number of imaging screens used to maximize the probability of correct detection over varying levels of source sparsity. In this work, we develop a simulation environment to demonstrate how the mutual coherence of the sensing matrix correlates with source localization performance over source sparsity, sparsity of open screen cells, and number of measurements used for sparse recovery. Our analysis shows that the leading factor in source localization performance gains is primarily from the number of imaging screens used to measure the acoustic wave-field.

10:00

1aSP4. Mechanics and dynamics of reconfigurable curved creased origami arrays. Evgueni T. Filipov and Steven R. Woodruff (Dept. of Civil and Environ. Eng., Univ. of Michigan, 2350 Hayward, 2144 GG Brown Bldg., Ann Arbor, MI 48109, filipov@umich.edu)

The principles of origami have allowed for novel deployable and reconfigurable structures with applications from micro-robotics to adaptable architecture. Most origami patterns use rigorous mathematical definitions to achieve their desired folding kinematics; however, these geometries result in discrete and segmented structures that have sharp edges. In contrast, curved creased origami uses a more arbitrary placement of folds and can thus achieve smooth surfaces. These smooth surfaces can be useful for problems in acoustics, fluid flow, electromagnetics, wave-propagation, and more. In this talk, we first explore the geometry of the curved crease origami, where continuous curvatures and elastic bending occur over the entire surface of the thin sheet. We use a simplified bar and hinge model to approximate the folding sequence and model the behaviors of the curved crease origami. The model captures stretching and shearing of the origami, bending along principle curvature directions, and bending at the prescribed curved creases. We explore the stiffness, large deformation mechanics, buckling, and dynamic behaviors of the curved crease origami. Our results show that the curved folding can enable highly tuneable properties for these novel thin-sheet arrays.

10:20–10:40 Break

10:40

1aSP5. Deployable tessellated acoustic array with a curved Miura-ori pattern for ultrasound focusing in multilayered media. Chengzhe Zou and Ryan L. Harne (Mech. and Aerosp. Eng., The Ohio State Univ., 201 W 19th Ave., Columbus, OH 43210, zou.258@osu.edu)

High intensity focused ultrasound (HIFU) has been successfully applied to treat cancers in clinical settings. In such treatment, the ultrasonic transducer projects focused ultrasound to the diseased tissues for thermal ablation. Nevertheless, the absorption, diffusion, and reflection that occur on the propagation path of ultrasound may reduce the effectiveness of HIFU. In order to overcome this challenge, a concept of origami-inspired deployable tessellated acoustic arrays may be leveraged. Fueled by large portability, the array may be compacted for insertion to the body and guidance to the point of care where the deployed array is then used for treatment. Such a vision requires understanding how wave propagation behaviors from reconfigurable tessellated transducer arrays are tailored in a multilayer environment. Here, the curved Miura-ori tessellation is used to approximate the arc shape for focusing. An analytical modeling framework is extended to investigate the new wave propagation behaviors encountered in biological-like media. Using the analytical tool, the tessellated acoustic array is compared with the ideal arc transducer, and the results indicate that the proposed concept may be comparable with an ideal case in focusing. In addition, the deployability of the tessellated acoustic array is confirmed through experimental efforts in a controlled multilayer environment.