Conformal acoustic parametric array

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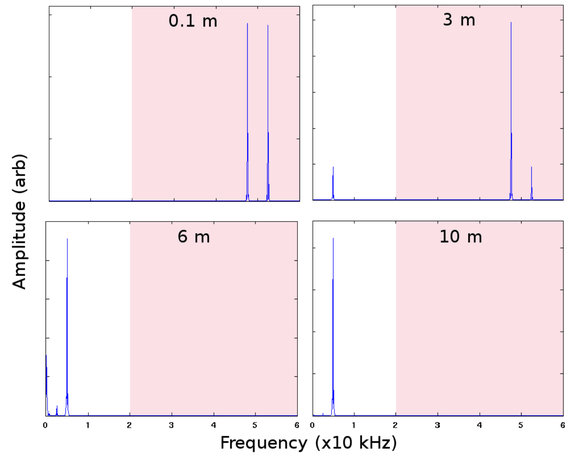
Overview

- Parametric arrays exploit the nonlinearity of air to create a beam of sound that is audible at long distances
- Current commercially-available devices, including the HyperSound HSS300 (left) and Kickstarter-funded SoundLazer (right), arrange ultrasonic transducers in planar arrays

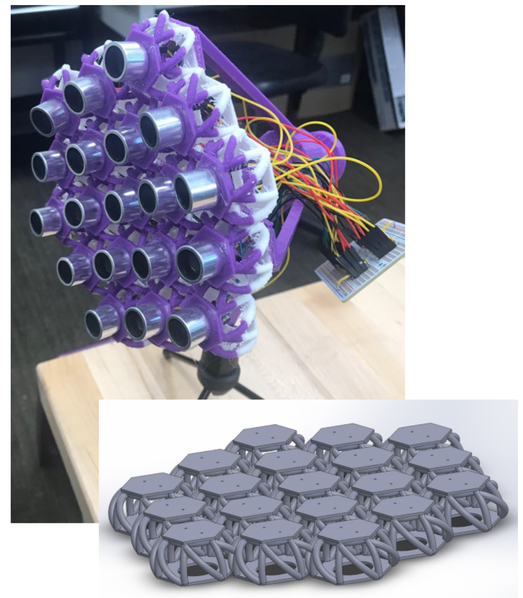
- Our goal is to create a concave parametric array to determine if the added geometrical focusing allows for tighter spatial control of the audible signal
- Transducers were mounted on a flexible 3D printed structure to create an array with variable curvature
- The existing amplifier is not sufficient to drive the new transducers
- The sound field of two commercially-available planar arrays was experimentally measured for later comparison



In this illustration of the operation of the parametric array, 47.5 kHz and 52.5 kHz ultrasonic signals are generated from a planar array. As these signal propagate through air, a 5 kHz difference signal in the audible range is created.

Attenuation is proportional to frequency squared, so this signal propagates much longer distances than the original ultrasonic signals. Since the directivity of the parametric array is determined by the generated ultrasonic signal, the parametric array allows for the creation of a spatially-controlled sound beam, like a 'flashlight for sound'.

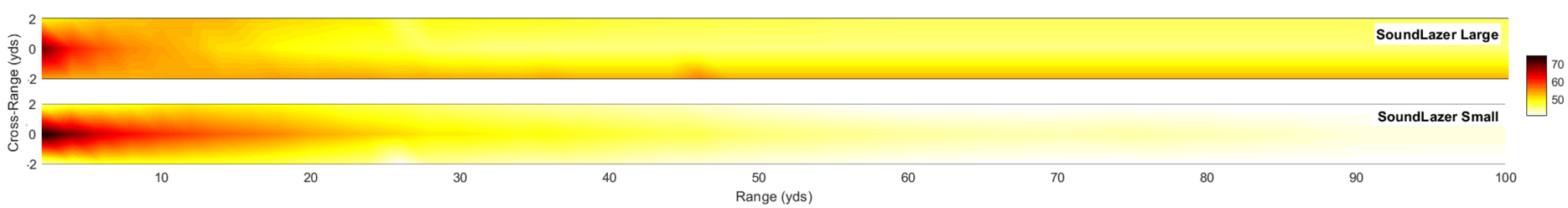
3D printed conformal array



To create a conformal array the ultrasonic transducers must be mounted on a flexible backplane. We used a 3D printer to rapidly iterate upon a NASA-inspired hexagonal fabric design[1]. The radius of curvature of this structure can be varied to change the geometrical focal distance.

Sound field measurements

The A-weighted sound pressure level was measured for large and small SoundLazer arrays using a calibrated Larson-Davis LxT Class-1 sound level meter. Multiple measurements were acquired on-axis and 2 yards off-axis in either direction over a range of 100 yards using a white noise source. The beam pattern for the large array is not as defined due to a high ambient noise level.



1. https://www.thingiverse.com/thing:2858068/