Bridging Innovation

Industry partnership advances additive manufacturing for acoustic transducers

THE CHALLENGE Compact and autonomous underwater sensing platforms rely on acoustic transducers for transmitting and receiving signals in marine environments. These systems may be constrained to battery power and thus critically limited by less efficient or sensitive transducers. Transducers that use piezocomposite as an active layer exhibit improved efficiency and sensitivity,but have been commercially restricted by manufacturing processes that constrain possible transducer geometries to those that can be molded or cut.

Additive manufacturing (AM) can overcome the shortcomings in conventional manufacturing techniques to create novel-shaped transducers with augmented properties. Enhanced sensitivity and sidelobe reduction may be achieved through spatial distribution of the printed material that leverages AM's ability to print voids and lattice shapes easily and iteratively without expensive tooling redesign. However, printing these shapes repeatably using a benchmark material has not yet been accomplished.

THE SOLUTION MITRE does not currently possess the expertise and equipment to print piezoelectric material, and thus a three-way partnership was established between MITRE, MSI Transducers Corp. and Lithoz-America, LLC. This collaborative agreement enables MITRE to develop and implement a finite element transducer model to design transducer geometries for specific performance benefits. MSI brings their wealth of knowledge on piezoelectric material processing, packaging and testing. Lithoz offers their AM hardware and material development expertise to develop printable piezoelectric materials and geometries. Introductions to both Lithoz and MSI were made possible through the extensive network of Bridging Innovation partnerships that MITRE maintains.

THE OUTCOME Starting in FY19, the collaborative research team achieved success by manufacturing and testing the first AM samples, which had measured material and piezoelectric results that were the same or better than conventionally manufactured materials. This success served as a major project milestone and gave confidence that the printed material could compare well to conventional material and thus would be suitable in underwater transducers.

In FY20, the team began focusing on novel geometries that would realize performance benefits over conventional geometries. Early indications based on preliminary printed samples suggest that these structures will be printable and open the door to previously unreached and novel performance.

THE TRANSITION The collaborative research team is actively promoting the current state of research and achieved milestones to Navy sponsors