

High Frequency Triply Resonant Broadband Transducer Array Development at NUWC

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Abstract: With the Navy's current emphasis on detection in littoral environments requires the use of broadband sonar signal processing and frequency agility. This has prompted the need for new classes of broadband sonar transducers that can transmit and receive these complex signals. NUWC has developed and built a new class of novel high-frequency (HF) broadband (electro-acoustic) transducers and arrays that can be configured into conformal arrays for use on the bow or sail of present and future classes of submarines, unmanned undersea vehicles (UUVs), and on torpedo homing sonar systems. This transducer design, the Triply Resonant Tonpilz (TRT), is a mechanical series arrangement of a piezoelectric ceramic stack, two center masses, two compliant springs, and a tail and head mass, all together generating three resonances. The design produces a flat transmitting response of two octaves when in an array-loaded configuration. The increase in operating bandwidth is achieved without the use of exotic and expensive transduction materials. This triply resonant transducer is a very cost competitive approach to introducing broadband into the Fleet. It provides a 5 kHz to 10 kHz increase in bandwidth at the low end of the band over a traditional tonpilz transducer. A traditional tonpilz designed to encompass this lower frequency would be at least 50% to 75% longer, which is unsatisfactory in these applications that require minimal impact on the submarine. The results of two 36 element planar HF arrays that are currently being designed, fabricated, and tested NUWC will be presented, modeled results of a more compacted (22 % smaller) Triply Resonant Tonpilz using PMN-PT single crystal as the active driver will also be presented. A smaller 9 element VHF array design that is three times smaller than the HF design will also be presented. (Work sponsored by Office of Naval Research, ONR 321SS)