

Miniaturized PMUT-Based Receiver for Underwater Acoustic Networking

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Abstract—The present work reports on the novel implementation of a miniaturized receiver for underwater networking merging a Piezoelectric Micromachined Ultrasonic Transducer (PMUT) array and signal conditioning circuitry in a single, packaged device. Tests in both a large water tank and a pool demonstrated that the system can attain large enough Signal-to-Noise Ratio (SNR) for communication at distances beyond two meters. An actual communication test, implementing an Orthogonal Frequency Division Multiplexing (OFDM) scheme, was used to characterize the performance of the link in terms of Bit Error Rate (BER) vs SNR. In comparison to previous work demonstrating high-data rate communication for intra-body links and acoustic duplexing, this implementation allows for significantly larger distances of transmission, while addressing the signal conditioning and submersible packaging needs for

capabilities for acoustic signal enhancement and Direction of Arrival (DOA) estimation [7]. Large form factor Commercial Off-The-Shelf (COTS) devices implementing these functionalities exist such as acoustic ranger-locator combinations (“Underwater GPS” [8]) or Directional Acoustic Transducers [9]. Similarly to acoustic modems, these devices can operate at ranges of several kilometers. Miniaturized AVS implementations have also been explored but are reserved to measurements in air such as a thermal difference-based sensor [10], an acoustic camera [11] or a DOA estimation system based on orthogonal microphones [12]. An exception suitable for underwater DOA estimation, also being the only Micro Electro Mechanical System (MEMS) implementation