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Abstract: Broadband Surface Acoustic Wave Generation via Chirped IDTs for Programmable Spin Control

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Controlling spin states in quantum and magnetic materials using dynamic strain fields offers a promising route toward hybrid quantum and spintronic technologies. Surface acoustic waves (SAWs) provide a versatile mechanism for generating such strain via magnetoelastic or piezomagnetic coupling. However, conventional interdigital transducers (IDTs) are limited by narrow frequency bands. This narrow bandwidth limits the ability to address spin transitions across a range of energy scales to compensate for inhomogeneous broadening.

This work focuses on designing and implementing chirped IDTs to generate broadband SAWs for tunable multi-frequency spin control. We first developed a predictive frequency-domain model of the chirped geometry on Mathcad, a computational software.

To bridge the gap between theory and application, devices are fabricated on a 1280 YX cut lithium niobate substrate using the Nanyte Beam maskless lithography tool. We use the liftoff technique to create the device patterns. This approach bypasses the need for physical photomasks, enabling rapid prototyping of complex, customizable chirp profiles and varying electrode densities. Experimental RF characterization, performed via S-parameter measurements using the Tektronix RSA518A spectrum analyzer, confirms successful broadband operation. The results show strong agreement with our modeled spectra, validating the design's efficiency.

Academic or Professional Status

Graduate Student

Author: Mr KIMEU, Felix

Co-author: SAFFORE II, Andre (Norfolk State University)

Presenter: SAFFORE II, Andre (Norfolk State University)

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