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Using Coupled Oscillators for Implementing Frequency Diverse Array

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Abstract : Frequency-diverse arrays (FDAs) have garnered significant attention from researchers due to their ability to combine frequency diversity with the inherent spatial diversity of an array. The introduction of frequency diversity in FDAs enables the generation of auto-scanning patterns that are range-dependent, which can have advantageous applications in communication and radar systems. However, the main challenge in implementing FDAs lies in determining the technique for distributing frequencies among the array elements. One approach to address this challenge is by utilizing coupled oscillators, which are a technique commonly employed in active microwave theory. Nevertheless, the limited stability range of coupled oscillators poses another obstacle to effectively utilizing this technique. In this paper, we explore the possibility of employing a coupled oscillator array in the mode lock state (MLS) for implementing frequency distribution in FDAs. Additionally, we propose and simulate the use of a digital phase-locked loop (DPLL) as a backup technique to stabilize the oscillators. Through simulations, we validate the functionality of this technique. This technique holds great promise for advancing the implementation of phased arrays and overcoming current scan rate and phase shifter limitations, especially in millimeter wave frequencies.

Keywords : angle-changing rate, auto scanning beam, pull-in range, hold-in range, locking range, mode locked state, frequency locked state
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