# Synthesis of Different Antenna Array Geometries Using Evolutionary Algorithms and Time Modulation Strategies

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# ABSTRACT

The philosophy of time modulation was introduced in antenna array by means of ON-OFF keying modulation through periodical changes of the excitation (on-off) status of the RF switches connected to the array elements. The antenna array with time-modulation defined as a time-modulated antenna array (TMA) provides additional flexibility in synthesizing power patterns and produces time-averaged pattern of low/ultralow side-lobe level (SLL) with simple, low-cost, electronically controlled switching circuit in the array feed network by relaxing the stringent constraint of maintaining the high dynamic range ratio of static excitation amplitude. However, the generation of harmonic frequencies due to periodic commutation of the switching status put forward the challenges of minimizing wastage of unwanted harmonic power radiation and beneficially utilizing the harmonics for the present wireless communication. In this thesis, some novel approaches have been reported to show the perspective potential application of TMAs. Specifically, for a large array, large number of switches are used to modulate the static excitation amplitude of the array elements. Therefore, control and maintenance of such large number of switches is a tedious task. In this regard, array synthesis methods with different geometries such as optimum preservative boundary (OPB) consisting of un-modulated elements, fractal pattern have been proposed to realize the desired patterns with reduced hardware complexity of the array system. It is to be noted that the modulation frequency should be at least ten times less than the center operating carrier frequency. As an outcome, the small separation between the consecutive harmonic signals, limits its application only for the inter band communication. Therefore, a novel method of utilizing the repetitive self-similar property of the cantor set fractal (CSF) pattern in synthesizing time modulated linear array (TMLA) with multiband characteristics has proposed for inter-band communication systems. Finally, if element failure occurs, then the radiation patterns both at fundamental and harmonics frequencies are distorted. In such a scenario, accurate and fast detection of failed array elements with their corresponding locations and thereafter reconstruction of the array pattern with the remaining working elements are a challenging task. Thus, a new research based on differential evolution (DE) with rank-based population (RBP) is reported for the fast and accurate extraction of faulty elements from multi-pattern TMAs. Towards the end, a time-modulation strategy using trapezoidal pulse is presented to simultaneously reconfigure the degraded multiple harmonic patterns in TMAs.