

Design of Wideband Elliptic Monopole Antenna Arrays with Constant Half-Power Beamwidth

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With the radio frequency spectrum becoming a scarce resource, the need for RF transceivers with incorporated spectrum analysis capabilities is increasing rapidly. Among the most important elements of these systems, antenna arrays with broadband spectrum coverage in terms of power reflection response, half-power beamwidth (HPBW) and gain need to be developed. Whereas a large number of ultra-wideband planar-type monopole, Vivaldi and spiral antennas have been demonstrated in the open technical literature, the realization of broadband antenna arrays remains a great challenge. This is attributed to their HPBW varying significantly with the increase of frequency. A typical example of this trend is illustrated in Fig. 1(a) for a linear antenna array. It comprises four equi-spaced omni-directional radiating elements that are excited uniformly for frequencies between 2-6 GHz and result in HPBW variation of 221%. In order to alleviate this effect, frequency selective feeding schemes have been recently proposed. They facilitate the realization of constant HPBW by progressively switching the power from the outer antenna elements to the inner ones as shown in the example case in Fig. 1(b) in which a 7% HPBW variation is obtained.

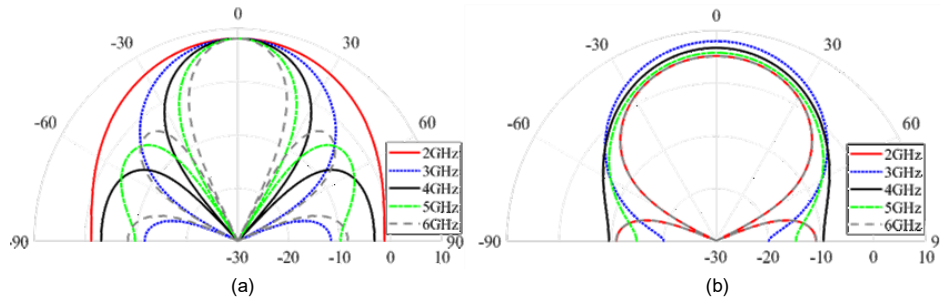


Fig. 1. Four-element antenna array that comprises elements with omni-directional radiation characteristics. (a) Conventional feeding scheme in which all elements are uniformly-fed. (b) Frequency-selective feeding scheme in which the power is switched from the outer-elements to the inner elements by incorporating RF duplexers.

The main objective of this manuscript is to study the RF performance of various antenna arrays for a 3:1 bandwidth of operation. In particular, ideally-synthesized antenna arrays that consist of even- and odd-number of elements are investigated in terms of HPBW, side-lobes and gain. The proposed study reveals that by incorporating low-pass/high-pass RF duplexers in multi-way power dividers, constant HPBW can be achieved within a broad frequency spectrum. For proof-of-concept validation purposes, a quasi-elliptic monopole antenna array and a microstrip-type power division network with incorporated low-pass/high-pass RF duplexers were designed in the 2-6 GHz range using circuit and electromagnetic analysis methods. Its design and RF-performance will be discussed at the conference.