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Metamaterial-inspired Electrically Small Platforms: Enhanced Directivity Properties

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With the introduction of metamaterials and metamaterial-inspired constructs, a number of advances in the performance of electrically small (ES) radiators and scatterers in the VHF, UHF, microwave, millimeter-wave, and optical regimes have been achieved. Many of these ES platforms have been based on resonant near-field parasitic (NFRP) designs. They have been fabricated and tested; these measurement results are in nice agreement with their simulated values [1].

There are a variety of applications for which it is desirable to have higher directivity and/or a large front-to-back ratios, i.e., to have the radiated power emitted primarily into one hemisphere. Several NFRP designs have explored the ability to achieve higher directivity from ES platforms. These include the use of electromagnetic band gap (EBG) structures as structured ground planes [2] and compact arrays [3]. More compact combinations of electric and magnetic NFRP elements have led to ES Huygens dipole [4]-[9] and multipole antenna systems [10]. Additional augmentations with active elements have produced efficient, broad-bandwidth, high directivity ES NFRP antennas [11] and even to ES optical Huygens nano-lasers [12].

These enhanced directivity ES systems will be reviewed. The theoretical needle-like possibilities [10], as well as designs that reach those superdirective performance characteristics [13], will also be described.

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