

HYBRID DIELECTRIC RESONATOR ANTENNA FOR ULTRA HIGH
FREQUENCY BAND

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ABSTRACT

A hybrid Dielectric Resonator Antenna (DRA) design using the concept of the Dielectric-Resonator-on-Patch (DRoP) is presented in this thesis. This design is introduced to overcome the narrow bandwidth and big size drawbacks experienced by the antennas in the UHF band applications. The hybrid DRA has the ability to provide wide bandwidth while maintaining its compact structure. Firstly, two antenna designs which are the aperture-coupled square microstrip patch antenna (RMPA) and dielectric resonator antenna (RDRA) are presented to investigate the characteristic of the antennas individually. Two different aperture shapes, rectangular and circular are used to clarify the difference between them. Then, both antennas are combined together into the hybrid DRA structure. All three antennas are designed and optimized using Computer Simulation Technology (CST) microwave studio software and the Taconic RF-35 is used as the substrate for the prototype fabrication. The antenna performances such as the reflection coefficient magnitude (S_{11}), bandwidth, radiation pattern and gain are measured. In the RMPA design, both configurations managed to obtain a compact size, with a reduction of more than 25% compared to the reference antenna. On the other hand, by maintaining the size of the DRA at $7\text{cm} \times 7\text{cm} \times 1.4\text{cm}$, a wide bandwidth of around 30% is recorded using the circular aperture in the RDRA design. The hybrid DRA combined both RMPA and RDRA, resulting in wider bandwidth of 60%, from 0.77 to 1.43GHz with an average gain of 3.4dBi. The dimension of the dielectric resonator antenna is compact, which is $0.257\lambda_o$ and also low-profile with a height of $0.051\lambda_o$.

ABSTRAK

Sebuah reka bentuk antenna penyalun dielektrik (DRA) hibrid yang menggunakan konsep penyalun-dielektrik-atas-tampalan (DRoP) dikemukakan dalam tesis ini. Reka bentuk ini diperkenalkan untuk mengatasi masalah lebar jalur yang sempit dan saiz yang besar yang dialami oleh antenna-antenna di dalam aplikasi-aplikasi jalur UHF. Antenna DRA hibrid dapat menghasilkan lebar jalur yang luas di samping mengekalkan saiz strukturnya yang kompak. Pertama, dua reka bentuk antenna iaitu antenna mikrojalur tampalan segi empat sama (RMPA) dan antenna penyalun dielektrik segi empat sama (RDRA) yang disuap-alur dibentangkan untuk mengkaji ciri antenna secara individu. Dua bentuk alur yang berbeza iaitu segi empat dan bulat digunakan untuk menerangkan perbezaan yang wujud. Kemudian, kedua-dua antenna digabungkan membentuk struktur antenna DRA hibrid. Ketiga-tiga antenna direka bentuk dan dioptimumkan menggunakan perisian CST Microwave Studio dan Taconic RF-35 digunakan sebagai substratum di dalam pembikinan prototaip. Prestasi-prestasi antenna yang penting seperti S_{11} , lebar jalur, corak sinaran dan gandaan diukur. Di dalam reka bentuk RMPA, kedua-dua konfigurasi berjaya menghasilkan saiz yang kompak, dengan pengurangan saiz lebih dari 25% berbanding antenna rujukan. Sebaliknya, dengan mengekalkan saiz DRA pada $7\text{cm} \times 7\text{cm} \times 1.4\text{cm}$, penambahan lebar jalur sebanyak lebih kurang 30% dicatat apabila alur bulat digunakan di dalam reka bentuk RDRA. Antenna hibrid menggabungkan RMPA dan RDRA, menghasilkan lebar jalur yang lebih baik iaitu 60%, dari 0.77 hingga 1.43GHz dengan purata gandaan sebanyak 3.4dBi. Antenna penyalun dielektrik mempunyai saiz yang kompak, iaitu $0.257\lambda_o$ dan juga berprofil rendah dengan ketinggian $0.051\lambda_o$.