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全向性平面天線之可重置設計

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摘要

本計畫將對於具有全向性輻射之平面天線提出頻率、極化及場型切換的相關設計技術。首先將分析操作於 TM02 模態之共平面圓形環微帶天線的特性，在先期研究中發現其共振頻率可藉由在輻射金屬片邊緣加入負載改變。若負載為電容，共振頻率會隨電容增加而降低；若負載為短路片，共振頻率可隨短路片數目增加而往高頻移動，而在這頻率變動的範圍，天線不僅可達成阻抗匹配且在 φ 平面可產生均勻的輻射場。因此，計畫第一年將結合開關二極體及變容二極體完成可重置頻率的天線設計。計畫的第二年首先將提出一個新的全向性圓極化天線結構，此結構由四個 L 型微帶天線組成方型環狀陣列，且每個 L 型輻射金屬片經由短路牆接地。當利用一個頂端負載的單極天線作為饋入時，此環狀陣列可同時產生兩個輻射場型相同但極化正交之模態。在先期研究中發現，藉由調整短路牆的寬度及數目可改變這兩個模態的共振頻率，而當這兩個模態適當耦合時，天線可產生圓極化輻射且場型為均勻的圓錐狀。由於圓極化的極性由這兩個模態共振頻率的大

小關係決定，因此可藉由開關二極體控制短路牆的數目，使天線具有極化重置的能力。計畫第三年將探討場型重置的設計，採用的天線結構為共平面圓形環微帶天線。在先期研究中發現當探針饋入點不在天線中心時，仍可激發 TM02 模態，但在輻射金屬片上的電流分佈與 φ 有關，這使得輻射場型在 φ 平面不再是全向性，而會產生一個明顯的主波束，此主波束的方向與饋入點所在的方位角相同；因此，若天線埋入四個在不同方位角的探針，並經由一個切換器選擇其中一個作為天線饋入，則天線的主波束可在 φ 平面中四個方向變換。為了要有場型變換的效益，達到既廣且遠的通訊範圍，主波束指向性不能太低也不能太高，如何獲得適當的指向性將是計畫研究之重點。

Reconfigurable Designs for Planar Antennas with Omnidirectional Radiation Characteristic

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Abstract

The designs for omnidirectional planar antennas with switchable frequency, polarization, and radiation pattern are respectively studied in the three-year project. To begin with, the characteristics of a coplanar annular-ring microstrip antenna operated at TM02 mode are investigated. It is found that its resonant frequency can be changed by adding a load at the radiating edge. If the load is a capacitor, the resonant frequency is decreased with the increasing of capacitance. If the load is a shorting strip, the resonant frequency can be increased with increasing the number of the shorting strips. Moreover, while the frequency is varied, the antenna can remain good impedance matching and generate radiation patterns with uniform fields in the φ plane. As a result, a frequency reconfigurable antenna can be implemented with pin diodes or varactor diodes, and it will be realized in the first year of the project. The second year of the project will propose a new circularly-polarized (CP) antenna. The proposed antenna structure consists of four L-shaped patch antennas arranged in a square-ring formation. Each patch antenna is shorted to the ground plane through conducting walls. With a top-loaded monopole feed, two orthogonal resonant modes can be excited simultaneously. It is found that the resonant frequencies of the two modes are related to the width or the number of the shorting walls. In addition, if the two modes are properly coupled, the proposed antenna can generate a CP radiation with uniform conical patterns; meanwhile, the polarization sense is determined by the relation of the two resonant frequencies in magnitude. A polarization reconfigurable prototype integrated with pin diodes will be carried out. The design of reconfiguring pattern is studied in the final year. The adopted structure is the coplanar annular-ring microstrip antenna. It is found that the TM02 mode of the antenna can still be excited if the feed point is not located at the antenna center. However, the current distribution on the radiating patch is a function of φ, which makes the

radiation pattern be no longer uniform in the φ plane and with an obvious main beam. The direction of the main beam is the same as the azimuth of the feed location. So, a pattern reconfigurable planar antenna will be realized by embedding four probe pins located at different azimuths into the antenna. If a switch is used to select one of the probe pins to excite the antenna, the direction of the main beam can be switched among four azimuths in the φ plane. For the pattern reconfigurable design, how to obtain a proper directivity will also be discussed in the project.

Key words：Planar antenna;Omnidirectional antenna;

Reconfigurable antenna;Frequency diversity;

Polarization diversity;Pattern diversity