**Lab 5：1 × 2 Circular Inset-fed Patch Antenna Array**

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| **Introduction**  In the realm of modern wireless communication systems, antennas play a pivotal role in facilitating the transmission and reception of electromagnetic signals. Patch antennas, characterized by their low-profile design and ease of integration, have gained considerable attention for various applications, including satellite communication, radar systems, and wireless networks. Among patch antenna configurations, the inset-fed patch antenna array stands out as a versatile solution offering enhanced performance and flexibility.  This lab focuses on the design and characterization of a specific type of inset-fed patch antenna array: the 1 × 2 Circular Inset-fed Patch Antenna Array. This configuration, characterized by its circular geometry and dual radiating elements, presents unique advantages in terms of radiation pattern control, polarization diversity, and impedance matching. By leveraging the principles of antenna array theory and microstrip antenna technology, this report aims to explore the performance capabilities and practical applications of such an antenna configuration.  Through theoretical analysis, numerical simulations, and experimental validation, this study endeavors to elucidate the S11 parameters and radiation pattern associated with the 1 × 2 Circular Inset-fed Patch Antenna Array.   1. What is Circular Patch Antenna?   Circular patch antennas are a type of microstrip antenna characterized by their circular radiating element. They are widely used due to their low profile, simple design, and ease of fabrication. A circular patch antenna typically consists of a metallic patch placed on a dielectric substrate, with a ground plane on the opposite side. The circular shape of the patch allows for omnidirectional radiation patterns, making them suitable for applications where uniform coverage in all directions is desired. Circular patch antennas find applications in various wireless communication systems, including satellite communication, RFID systems, and mobile devices.   1. What is Microstrip Inset-fed?   Microstrip inset-fed refers to a feeding technique used in microstrip patch antennas, where the feeding point is located within the radiating patch element. In inset-fed configurations, the feed line is connected to the patch at a specific distance from its edge, typically at the center or a point along the radius. This feeding technique offers several advantages, including impedance matching, improved radiation efficiency, and control over the antenna's resonant frequency. By adjusting the position of the feeding point, designers can tune the antenna's performance parameters such as impedance bandwidth and radiation pattern. Microstrip inset-fed antennas are widely used in various applications due to their simplicity, low cost, and versatility.   1. What is Antenna Array?   An antenna array is a configuration of multiple individual antennas arranged in a specific geometric pattern to achieve desired radiation characteristics. Antenna arrays offer several advantages over single-element antennas, including increased gain, directivity, and beam steering capabilities. There are various types of antenna arrays, such as linear arrays, planar arrays, and conformal arrays, each with its own unique advantages and applications. Antenna arrays find widespread use in radar systems, wireless communication networks, and satellite communication systems. They are employed in both transmit and receive modes, enabling complex signal processing techniques such as beamforming and spatial diversity to improve system performance in terms of coverage, capacity, and interference rejection.  **Lab results & Analysis**：  Use the website below, we can get that rp = 22.84mm, wf100 = 0.7mm and wf50 = 2.4mm when designing a 1×2 circular microstrip inset-fed patch antenna array for operating at ~ 2.4 GHz.   |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | var | wsub | lsub | hsub | rp | wg | cf | wf100 | d | lf50 | wf50 | | mm | 60 | 120 | 0.787 | 22.84 | 1 | 5 | 0.7 | 62.5 | 3 | 2.4 |   And the design is in below:     1. S11   Direct simulation, get:    So we need to optimize the parameters.    Comparing all of the values, we find that when rp = 24.7mm, we have best reflection coefficient.  So the final S11 is:     1. Radiation pattern (Total Gain on E&H plane)   phi=0deg    phi=90deg | |
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| **Score** |  |