**Design of C, X, and Ku Band Antenna For V2X Communication**
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**Description:**
The C, X, Ku-Band Antenna for V2X Communication project focuses on the design, simulation, and analysis of a wideband, multiresonant antenna tailored to enhance Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communication in modern electric and autonomous vehicles. This cutting-edge antenna operates across the C (3.0–7.82 GHz), X (10.3 GHz), and Ku (14.4–17.42 GHz) bands, offering a comprehensive solution for high-speed data transfer and robust connectivity in diverse environmental conditions.

This paper presents the design and performance evaluation of a wideband multi-resonant antenna operating across the C, X, and Ku bands, tailored for vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication in electric vehicles. Constructed using Rogers RO4350 material with a relative permittivity of 3.66, the proposed antenna resonates at 3.0 GHz, 4.57 GHz, 4.84 GHz, 7.82 GHz, 10.3 GHz, 14.4 GHz, 16.57 GHz, and 17.42 GHz, achieving an overall gain of 9.12 dB. This design supports key applications in satellite communication, radar, and 5G systems, meeting the data exchange demands of V2V and V2I communication crucial to autonomous and connected vehicle networks. Emphasizing broad bandwidth, effective impedance matching, and ease of integration, this work highlights the multiband potential of wideband antennas in advancing electric vehicle communication systems, providing foundational insights for future V2X technology developments.

Constructed using the Rogers RO4350 substrate material, renowned for its low dielectric loss and high-frequency stability, the antenna achieves a peak gain of 9.12 dB and an excellent Voltage Standing Wave Ratio (VSWR) of $\leq 2$ across all operational bands. The design incorporates advanced slotting techniques to achieve precise impedance matching, enhance multiband functionality, and minimize signal reflection. These features ensure efficient radiation, robust performance, and compatibility with emerging 5G and satellite communication technologies.

To meet the high-performance demands of V2X communication systems, the antenna employs a compact 1x3 linear array configuration. This design enables enhanced directivity, focused signal coverage, and omnidirectional connectivity, crucial for collision avoidance, traffic management, and efficient route optimization. Simulated in Ansys HFSS, the antenna's results confirm its ability to deliver reliable and high-data-rate communication while maintaining minimal power loss and interference.

The C, X, Ku-Band Antenna's versatility, high gain, and seamless integration capabilities make it an ideal candidate for future autonomous vehicle networks and advanced connected transportation systems. It lays the foundation for further innovations in V2X technologies, driving the evolution of safer, smarter, and more efficient transportation ecosystems.