Workshop « Soft Material Models »

Low-Profile, Highly-efficient, and All-flexible Antenna Enabled by Silver Nanowires Wireless Body-area Network

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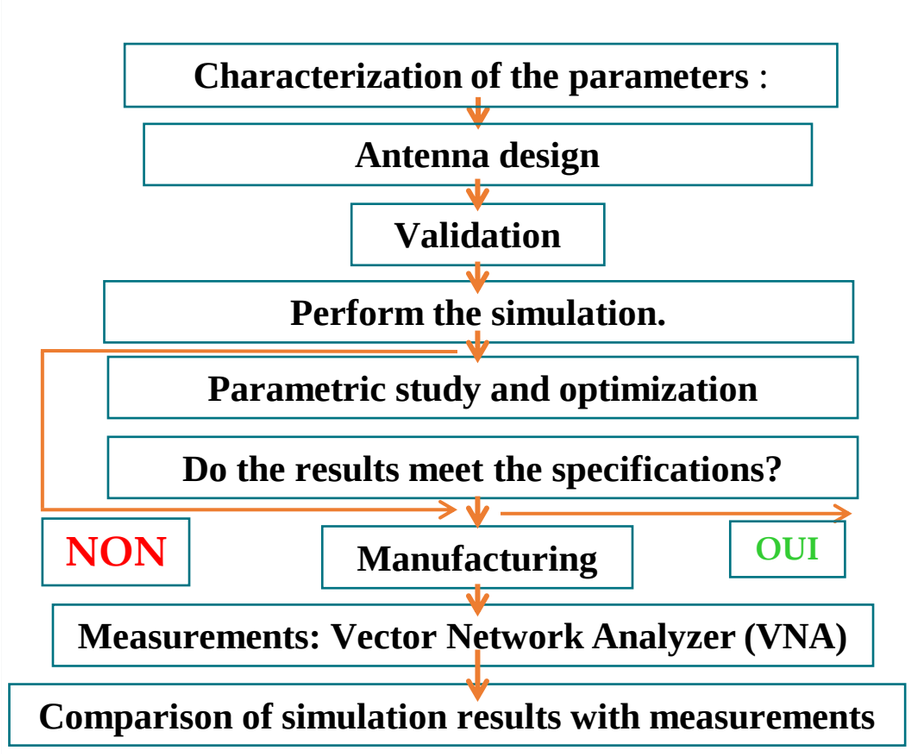
Abstract

In this work, we present a compact fully inkjet-printed wideband antenna on a flexible substrate. The proposed antenna utilizes a modified rectangular patch and a partial ground plane, both inkjet-printed using silver nanoparticle ink on a flexible Polyethylene Terephthalate (PET) substrate. The antenna has a small footprint, measuring 18.5 × 25 × 0.2 mm³ (0.25 λ_o × 0.34 λ_o × 0.027 λ_o at 4.09 GHz), and exhibits a low profile. Simulated results indicate a wide impedance bandwidth of 40.7% (4.09–6.14 GHz), with a peak gain of 2.61 dBi, high radiation efficiency, and total efficiency. Additionally, the standing wave ratio of the antenna is below 2. The suggested antenna offers several advantages, including its wide bandwidth, low profile, simple structure, and ease of fabrication. Based on these merits, the suggested antenna is a suitable choice for modern wireless communication systems.

Context

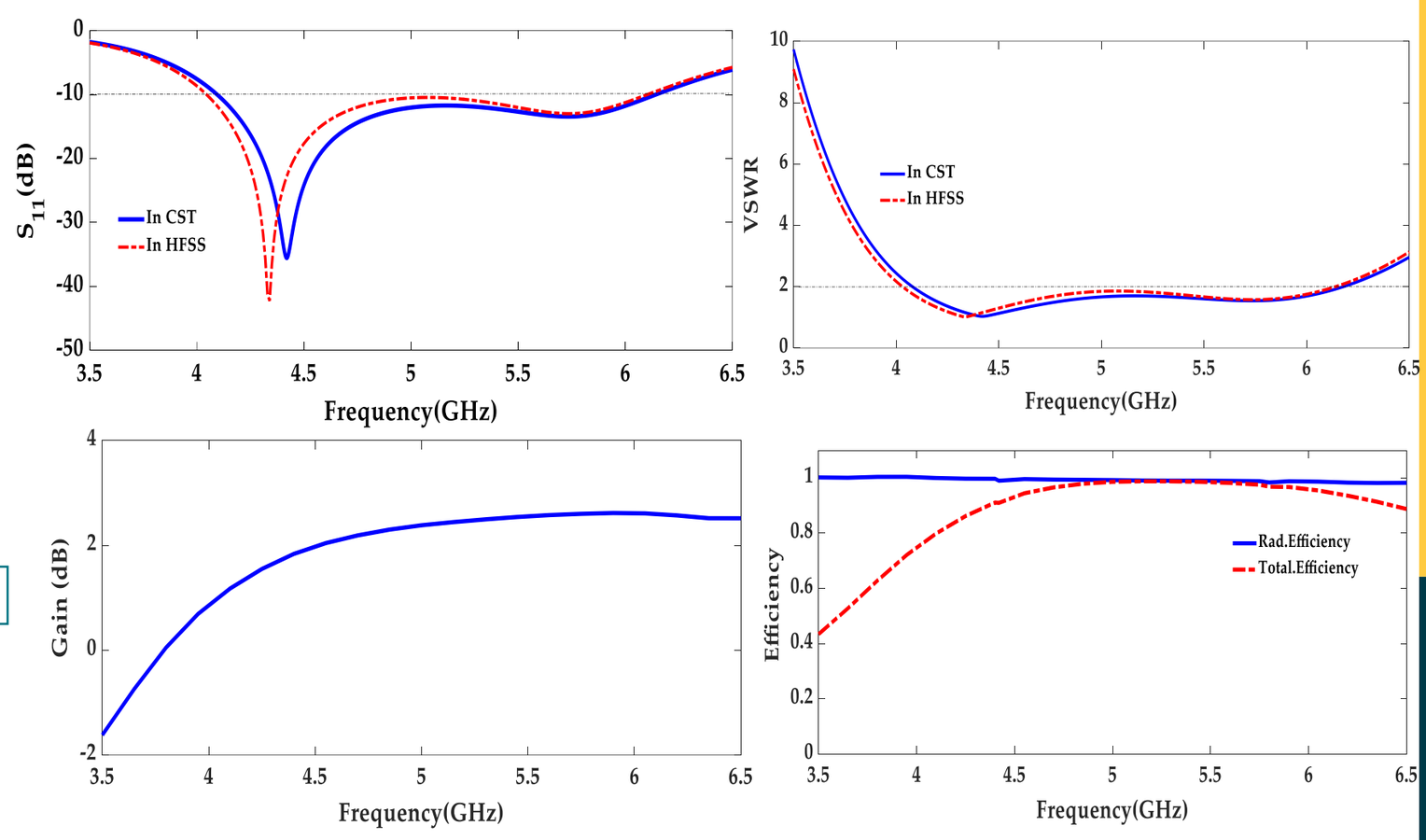
With the rapid development of Wireless Body Area Network (WBAN) technologies and wearable electronic devices, the demand for portable antennas that are flexible, compact, and high-performing has significantly increased. Portable antennas have many similar requirements to conventional antennas, such as impedance bandwidth, radiation patterns, gain, polarization, and so on. In addition to the structural designs of portable antennas, recent advancements in materials science and engineering have opened up new possibilities for high-quality flexible conductive and dielectric materials in the microwave/RF frequency range, thereby providing a wider choice of constituent materials for microwave circuits and antennas. As a result, various flexible materials have been used as low-loss antenna substrates, along with conductive layers, enabling the creation of truly flexible portable antennas [1-3].

Methodology



Results

- S_{11}(dB), G(dB), VSWR, Efficiency



Conclusion and perspectives

The work introduces a small, fully inkjet-printed wideband antenna on a flexible PET substrate. The antenna is designed for 5G applications within the sub-6 GHz band. The optimized prototype of the antenna element was simulated using CST STUDIO SUITE ver. 2019. It covers the frequency range of 4.09-6.14 GHz, making it suitable for 5G NR sub-6 GHz bands (n77/n78/n79) and 5 GHz WLAN. The antenna has compact physical dimensions of 18.5 × 25 mm2. Overall, the design achieves a planar antenna with a 40.08% impedance bandwidth, a peak gain of 2.61 dBi, and a maximum efficiency of 99%. The proposed antenna design is characterized by its simplicity, universality in operating bands, compact size, and satisfactory gain and efficiency. Future work involves fabricating and testing the antenna and comparing the simulation and measurement results to validate the design's effectiveness.

References

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