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A Compact Filtering Vivaldi Antenna With High Selectivity and Wide Out-of-Band Suppression

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The recent advancements in communication technology have led to the development of integrated filter and antenna designs, commonly known as filtennas. Filtennas are increasingly being used in a wide range of wireless communication systems due to their superior performance, compact size, cost-effectiveness, and high efficiency. In recent years, there have been considerable research efforts to improve the performance of filtennas. Many of the state-of-the-art designs employ techniques such as electromagnetic bandgap structures, metamaterials, resonators, and geometry reshaping to improve the performance of filtennas [1]. Common filter elements used in filtennas include low-pass, high-pass, band-pass, and notch filters. One particular type of filtenna design, that has grown in popularity in high-power systems, is the wide out-of-band and harmonic suppression filtering antenna. This feature refers to the ability of the filtenna to effectively suppress all signals outside of the desired operating frequencies in a wide range, including harmonics, before they are transmitted or received. This can improve the overall efficiency of the antenna, the system capacity, and reduce the amount of interference [2, 3].

In this paper, we present our technique utilizing a directly integrated periodic structure together with the antenna design to realize a compact filtenna, based on a Vivaldi antenna, with a wide out-of-band and harmonic suppression. The filtering structure is seamlessly integrated with the Vivaldi antenna, resulting in a filtenna that maintains its original size without any additional modifications. The proposed filtenna's results indicate a high selectivity of the pass-band among a wide frequency range from 4GHz to 20GHz, with out-of-band suppression of $\geq$13dB in terms of the realized gain. The in-band realized gain of the filtenna represents an insertion loss of less than 1.2dB compared with the conventional Vivaldi antenna for 10%-20% pass-band fractional bandwidth, Fig. 1. The high selectivity in both the pass-band and fractional bandwidth among a wide frequency range, as well as a wide out-of-band suppression while maintaining low insertion loss, is a unique feature of the highly integrated design.

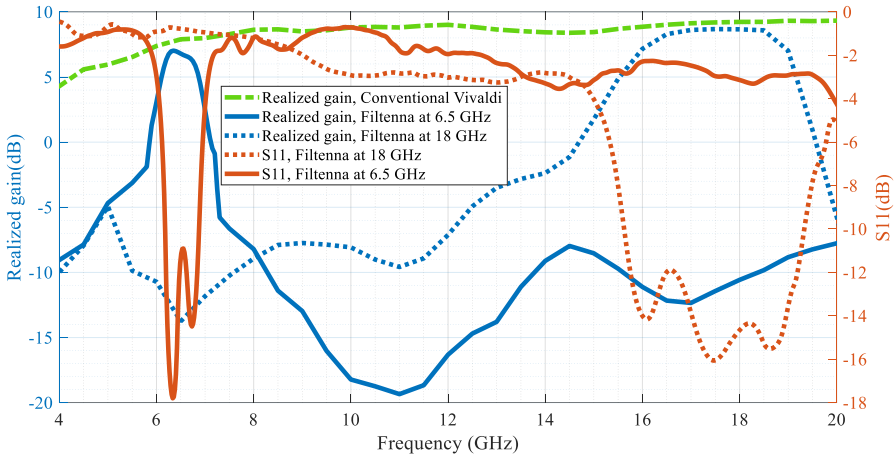

Figure 1. The simulated S11 and realized gain of the proposed filtenna, designed at 6.5GHz and 18GHz. green line: the realized gain of the conventional Vivaldi antenna.

References

[1] A. K. Gangwar, M. S. Alam, V. Rajpoot, A. K. Ojha, "Filtering antennas: A technical review," *Int J RF Microw Comput Aided Eng.*, 2021, 31(10):e22797, doi:10.1002/mmce.22797.

[2] Z. Ma and G. A. E. Vandenbosch, "Wideband Harmonic Rejection Filtenna for Wireless Power Transfer," *IEEE Trans. Antennas Propag*, vol. 62, no. 1, pp. 371-377, Jan. 2014, doi: 10.1109/TAP.2013.2287009.

[3] J.-Q. Sun *et al*, "A filtering antenna with wide out-of-band suppression based on open-stubs resonator," *Int J RF Microw Comput Aided Eng.*, 2022, 32(4):e23042. doi:10.1002/mmce.23042