

A Null Steering Antenna with Constant Accuracy and Wide Field-of-View for Use with Amplitude-Only Direction Finding

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Direction-finding (DF), or radio location, is a fundamental and essential technique for numerous fields, including mobile communications, satellite communications, radars, and radio astronomy. These days, the Internet of Things (IoT) has been extensively popular and applied to localization services thanks to low-cost and low-energy consumption. Since IoT devices only retrieve amplitude levels of received signals, amplitude-only DF with high accuracy becomes a significant research interest.

This paper discusses a design of a null-steering antenna for amplitude-only DF. The critical factor for the DF antenna to estimate direction is how wide the antenna can detect directions of incoming signals and how much the antenna estimates direction accurately. In other words, the antenna needs to steer a deep null at wide angles. These two factors are strongly affected by antenna spacing. This paper clarifies the points thoroughly considering a two-element antenna array.

In addition, this paper describes an improved antenna design for deep null-steering. The proposed antenna is shown in Figure 1(a). The authors have recently reported and experimentally demonstrated that the antenna generates a -30 dB null in the scanning region [1]. However, the null depth was evaluated at a single frequency, and the null-steering performance with electronic reconfigurability was not investigated. Here, we discuss further information on the bandwidth characteristics in both simulation and experiment results. Simulated results reveal that the proposed antenna can steer almost -40 dB null within 80 MHz bandwidth. The experiment results at sampling frequencies of 2.36, 2.40, and 2.44 GHz is shown in Figure 1(b). The antenna can successfully reconfigure a null direction stably in the bandwidth. Although the proposed antenna is devised for DF purposes, it can be extended the usage to other applications thanks to the excellent null-steering performance at low-cost.

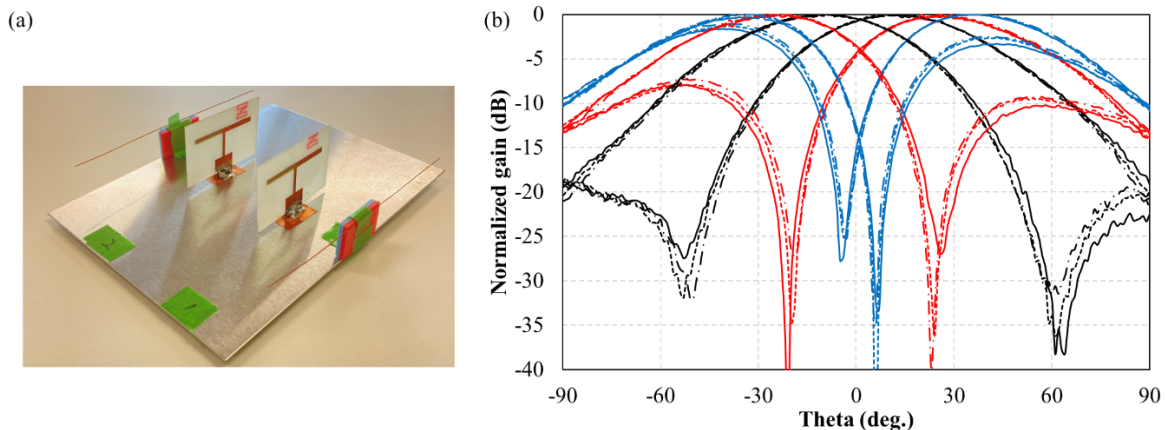


Figure 1. (a) Fabricated antenna array that steer a deep null in wide angles. (b) Measured antenna radiation patterns of the prototype. Six different phase shifts are applied between two antenna elements to demonstrate null reconfigurabilities. Solid lines, dashed lines, and dot-dashed lines are the patterns measured at 2.36, 2.40, and 2.44 GHz, respectively.

References

- [1] J. Tamura and H. Arai, "Compact Null Steering Antenna With Two Parasitic Elements for Angle-of-Arrival Estimation," *IEEE Antennas and Wireless Propagation Letters*, vol. 19, no. 7, pp. 1123-1126, July 2020, doi: 10.1109/LAWP.2020.2991100.