Dual Polarized Self-Complementary Connected Array Antenna Concept

Anne Claire Lepage, Xavier Begaud, Stefan Varault, Michel Soiron, Andre Barka

Dual Polarized Self-Complementary Connected Array Antenna Concept

Anne Claire Lepage, Xavier Begaud, Stefan Varault
LTCI, Télécom Paris, Institut Polytechnique de Paris
Palaiseau, France
anne-claire.lepage@telecom-paris.fr

Michel Soiron
SART
Gif sur Yvette, France

André Barka
ONERA-DEMR
Université de Toulouse
Toulouse, France

***Abstract*— In this communication, we present the results obtained within the framework of the Astrid project (DGA-ANR) SAFAS (Self-complementary Surface with Low Signature). The antenna has been designed and optimized using an analytical model of the complete structure. The antenna is able to maintain frequency bandwidth ratios of 4.6: 1 for a scanning capability of up to 60 °. These results were obtained at receiving and the aim of the article is to present the latest advances to take into account the future feeding system.**

Keywords—ultrawideband antenna array, self-complementary connected antenna

I. Introduction

There is nowadays an increasing demand for multifunctional antennas for both civilian and military platforms. Indeed, performing several missions with one device could offer considerable mass and volume reduction. As each function is defined with different specifications, the multifunctional antenna should be wideband or multi-band, dual polarized and capable of high angle scanning in case of radar applications. This article deals with self-complementary connected array antennas which have a theoretically unlimited operating bandwidth and which, in combination with one metasurface and other layers, allow the realization of compact and broadband directional antennas with scanning capability.

II. Antenna design

The self-complementary surface is a checkerboard array of square conducting patches connected to each other by a resistive card. It is noted that the antenna's performances are evaluated in the receiving mode. In this configuration, these resistances represent the input impedance of the balanced feeding system that should be placed at this position to obtain an emitting antenna. The checkerboard is placed above a ground plane to reduce the backward radiation and to facilitate the integration on the platform. A metasurface and a two-layer wide-angle impedance matching (WAIM) are placed above the array to enlarge the impedance-bandwidth at large scanning angles. The concept of this antenna has been presented in [1]. Then it has been optimised thanks to an analytical model developed by the authors [2]. Especially, an anisotropic substrate consisting in an array of metallic pins, has been introduced in order to improve the bandwidth for TM polarization at large incidence angles. The unit cell is shown in Fig.1. A first solution for the realization of this anisotropic layer has been proposed in [2]. Here, an alternative is presented. It consists of conducting lines etched on dielectric slabs placed vertically such as to form a grid of intersecting slabs, also called "egg-crate". This configuration is interesting as it could facilitate the implementation of the feeding network. After optimization with analytical models, the unit cell was simulated with the frequency domain solver of CST MWS considering an infinite array and illuminating the structure with a plane wave at different incidence angles.

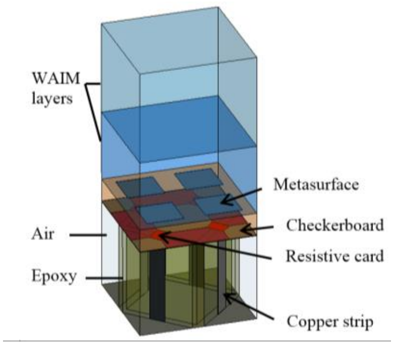

Fig. 1: Unit cell « egg-crate » type

III. Performances

The obtained bandwidths are presented in Table 1. Simulations with the FACTOPO solver adapted to the computation of finite arrays of large dimensions have been conducted.

TABLE I. Bandwidth for TE and TM polarization for different incidence angles

Incidence θ	0° (TE/TM)	45°(TE/TM)	60°(TE/TM)
f_{min} (GHz)	2.9/2.9	3.1/3.2	3.5/3.9
f_{max} (GHz)	18.0/18.0	19.0/18.7	19.5/19.0
Bandwidth @ -10 dB	6.2:1/6.2:1	5.8:1/5.6 :1	5.1:1/4.6 :1

IV. Conclusion

An ultrawideband dual polarized self-complementary connected array antenna with high-scanning capabilites has been presented. In the final paper, dimensions, simulations and measurements results with the "egg-crate" type will be added.

Acknowledgment

The research leading to these results has received funding by French Ministry of Defense (DGA), through the French National Research Agency (ANR) and Astrid Program in the framework of SAFAS project and was also supported by GENCI-CINES under Grant c2016107558.

References

[1] S. Varault, X. Begaud, A.C. Lepage, M. Soiron and A. Barka, "Self-complementary antenna array with low signature," IEEE Conf. on Antenna Measurements & Applications (CAMA), 2014, pp. 1-3.

[2] S. Varault, M. Soiron, A. Barka, A. C. Lepage and X. Begaud, "RCS reduction with a dual polarized self-complementary connected array antenna," in IEEE Trans. on Ant. and Prop., vol. 65, pp. 567-575, 2017.