Active Frequency Selective Surface Based L-band Noise Rejection Conformal Radome

Liang Zhang, Tongyu Ding
College of Information Engineering
Jimei University
Xiamen, China
liangzhang@jmu.edu.cn

Shaoqing Zhang, Yan Wang
Aviation Key Laboratory of Science and Technology on Electromagnetic Environmental Effects
Shenyang Aircraft Design and Research Institute
Shenyang, China

***Abstract*—Active frequency selective surfaces have long been employed in the field of mutual coupling suppression and are receiving increasingly more attention due to its remarkable performances and flexibility. However, the frequency tunable range of the resonators is usually not wide enough, especially for the band-stop ones. Meanwhile, a tunable frequency selective surface usually requires a bias network, which makes the design even more difficult and limits the use of active frequency selective surfaces in building radomes. In this work, we make use of a previously designed broadband active frequency selective surface to realize a conformal tunable radome, the measured resonant frequency of which is tuned from 935MHz up to 2.405 GHz, and the designed structure is capable of suppressing narrow band noise effectively through the whole L-band.**

***Keywords*—active frequency selective surface; tunable frequency selective surface; metamaterial; radome**

I. Introduction

In recent years, a number of reconfigurable antennas have been developed for communication and radar applications [1-3], and a variety of active frequency selective surfaces (AFSS) have been developed to realize electronically steerable antennas with increasingly more flexibility [4-5]. At the same time, such tunable resonators were also reported to be excellent candidate in suppressing certain frequency noise [6-7], and therefore can be used to realize novel radomes. However, most of the reported strategies adopted a PIN diodes-based AFSS configuration, which means it can be merely switched between the two states of 'on' and 'off', thus restricting its validity in suppressing some strong narrow band noise. In previous work, we presented a broadband tunable frequency selective surface (FSS) based on varactors [8]. Fig. 1 illustrated the structure and dimensions of the designed AFSS, which is capable of tuning the frequency range from 935 MHz to 2.405 GHz. In this work we use this design to build a cylindrical radome. This tunable radome can be controlled to eliminate narrow band noise through the whole L-band (1 GHz to 2 GHz).

II. Design of the Radome

A. Design and measured results of AFSS

As can be seen from Fig. 1, the designed AFSS has only one layer, and therefore needs no via holes through it, leading to a simpler architecture. The elements are fabricated on FR4 PCB column by column.

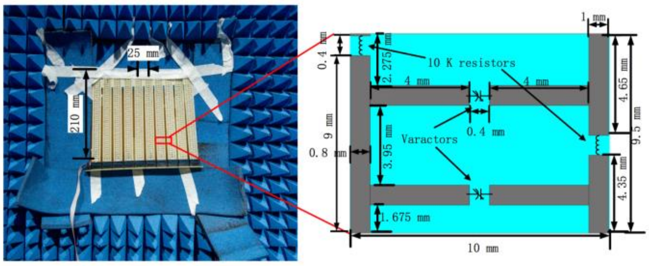

Fig. 1. Structure of the AFSS and dimensions of the unit [8].

Both measured and simulated results of this AFSS are shown in Fig. 2, which illustrated its capability of tuning the frequency range within the L-band. Detailed discussion and design as well as many more measured results concerning the tunable resonator can be found in [8].

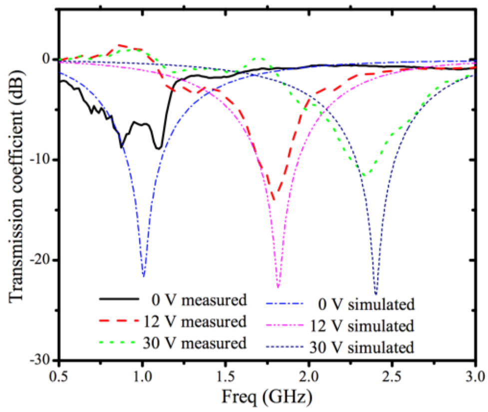

Fig. 2. Measured and simulated transmission coefficients of 0◦ incidence in the azimuth plane.

B. Design of the radome

As can be seen from Fig. 3, the radome was made of 20 columns of such AFSS from Fig. 1. All the AFSS columns were plugged into a socket connector. Biased voltages were applied to the columns through connectors. A Vivaldi antenna was placed in the center of the radome, and the antenna measurement was then conducted in an anechoic chamber.

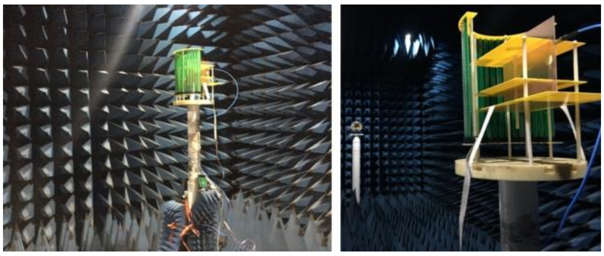

Fig. 3. Fabricated prototype and measurement environment.

III. Measured Results

To measure the noise rejection ability of the radome, we first calibrated the Vivaldi antenna and the test antenna using THRU mode without the AFSS radome. After the first calibration, the radome was installed, and the measured S_{21} was acquired, which gives the insertion loss of the radome. The measured results of transmission coefficient under 0 V, 10 V, 20 V and 30 V biased voltages are shown in Fig. 4 to Fig. 7, respectively.

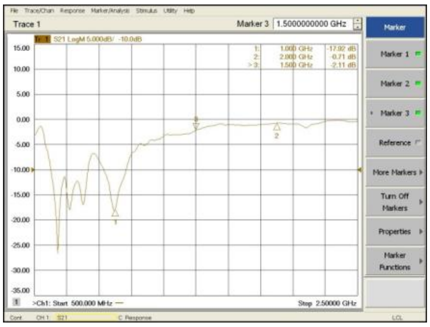

Fig. 4. Measured transmission coefficient with 0 V biased voltage.

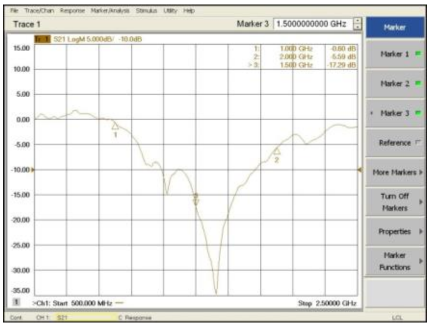

Fig. 5. Measured transmission coefficient with 10 V biased voltage.

Fig. 6. Measured transmission coefficient with 20 V biased voltage.

Fig. 7. Measured transmission coefficient with 30 V biased voltage.

It is obvious from the comparison of the selected four measured results that passband of the proposed radome was tuned from 500 MHz to 2.5 GHz as the bias voltages changed from 0 to 30 V, which verifies its capability of noise suppression within the whole L-band.

IV. Conclusion

This paper designed and fabricated an L-band radome using active frequency selective surfaces. The AFSS columns were equip with varactors, thus offering smooth tunability in a wide frequency band. Measured results demonstrated that the designed structure can suppress narrow band noise effectively through the whole L-band.

Acknowledgment

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