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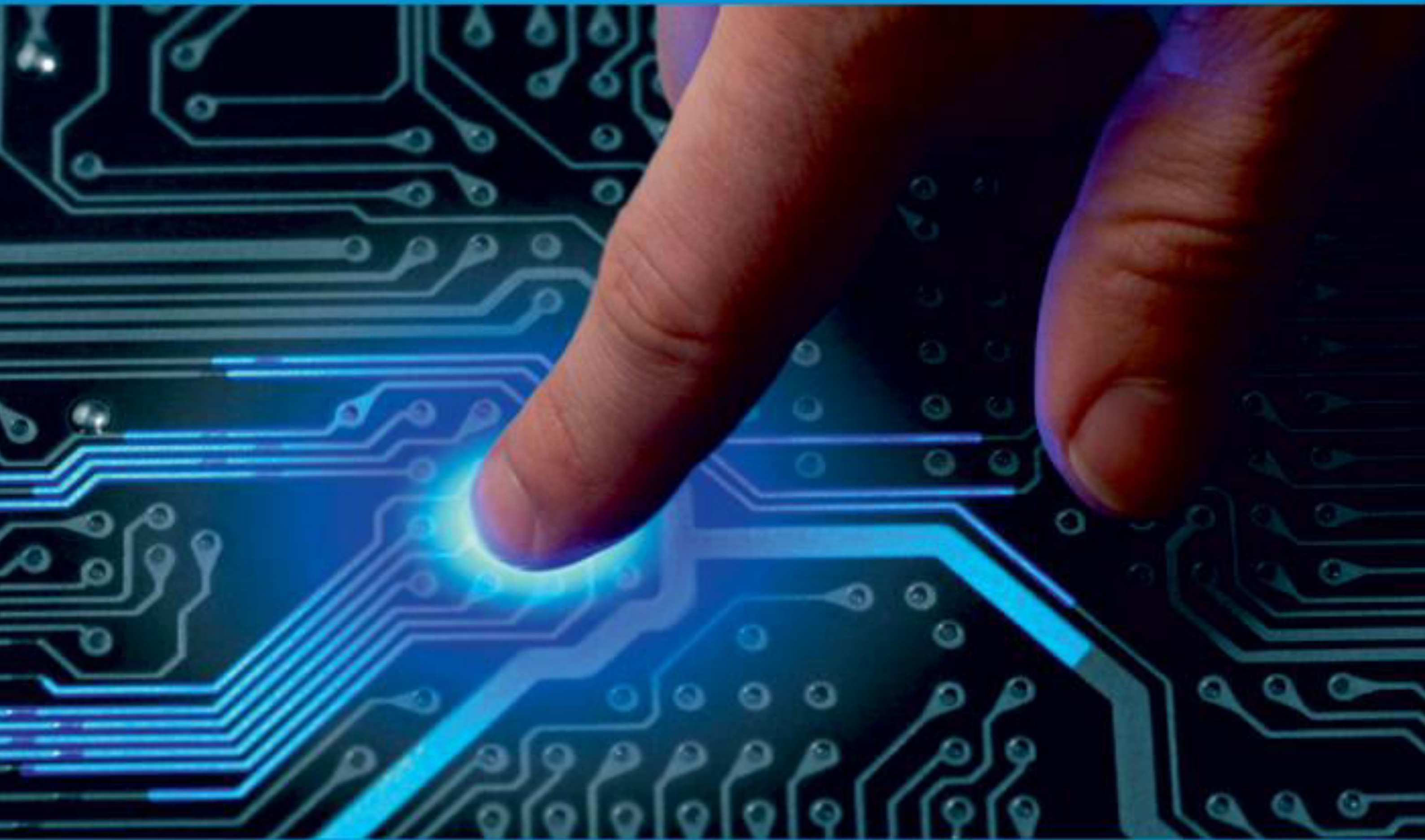

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Complex Structure FSS 4-Array Antenna for X Band Application

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ABSTRACT: This paper proposes a novel design and optimization approach for a complex structure four-array antenna tailored for X-band applications. The antenna system integrates multiple arrays to achieve enhanced performance in terms of gain, directivity, and beam forming capabilities. The antenna's geometry and parameters are optimized to meet specific performance criteria while minimizing size, weight, and complexity.

KEYWORDS: FSS, Complex Stucture, Array Antennas, X Band Applications

I. INTRODUCTION

The FSS design has a compact size which makes it favourable for low-profile band-filtering systems and multipath EM wave's insensitivity. The suggested FSS configuration has good correspondence with modelled and measured results.
The need for FSS design in the context of a complex structure four-array antenna for X-band applications lies in its ability to enhance antenna performance by providing frequency-selective filtering, improved impedance matching, and reduced electromagnetic interference. FSS can also enable beam shaping and radiation pattern control, essential for achieving desired communication or radar objectives in X-band frequencies.

II. METHODOLOGY

At microwave and optical frequency ranges, spatial filtering is the most desirable operation in all signal processing systems. Frequency selective surfaces (FSS), also called spatial filters, are used to modify the EM wave incident on such surfaces and provide dispersive transmitted and/or reflected characteristics. FSSs are usually designed by periodic metallic arrays of elements on a dielectric substrate. The change brought to the transmitted wave can be both in amplitude or phase when compared to the incident wave. In any case, selectivity may be introduced against the incident polarization to improve the irregularities in the emission pattern, which is exhibited through a change of the phase or amplitude of the transmitted wave. A variety of applications according to different requirements can be facilitated, depending on the nature of modification added to the transmitted wave.

Low profile, reduced periodicity, dual polarization, angular stability, multi-pole frequency response with higher out-of-band rejections, and easy manufacturability are some of the desired properties of FSSs. Nevertheless, achieving all the aforementioned characteristics for an optimized design has been a challenge for the FSSs designers. Different techniques to dig out best EM properties utilize various element shapes and varying geometric design parameters, such as adjusting the structure element size (patch or aperture), dielectric substrate, and tuning the inter-element spacing. In this paper, we present different varieties of FSS structures that are used for specific EM applications. Additionally, approaches for implementation, fabrication, and testing of these structures are also studied.

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III. EXPERIMENTAL RESULTS

FSSS Based on Structure

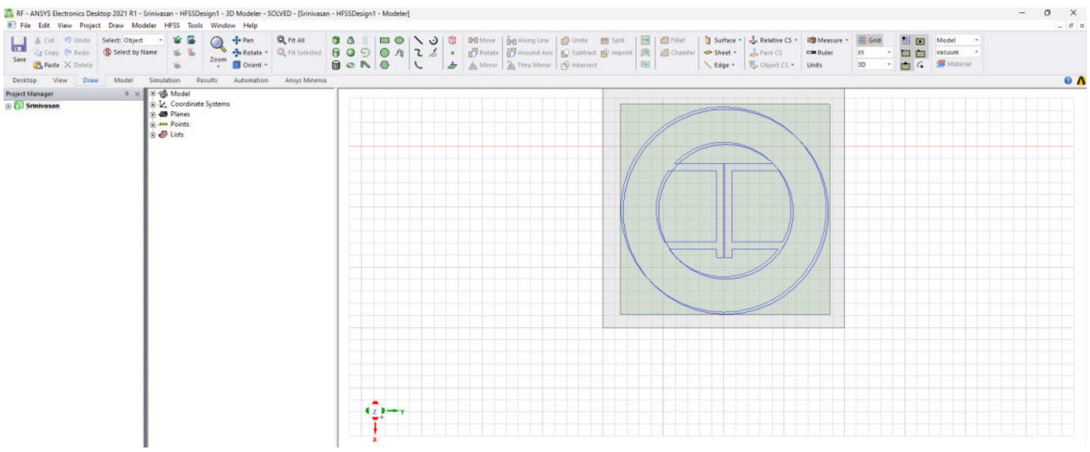
Based on the structure, we review four types of FSSs in this survey, including single layer FSSs, multilayer FSSs, antenna-filter-antenna FSSs, and three-dimensional FSSs.

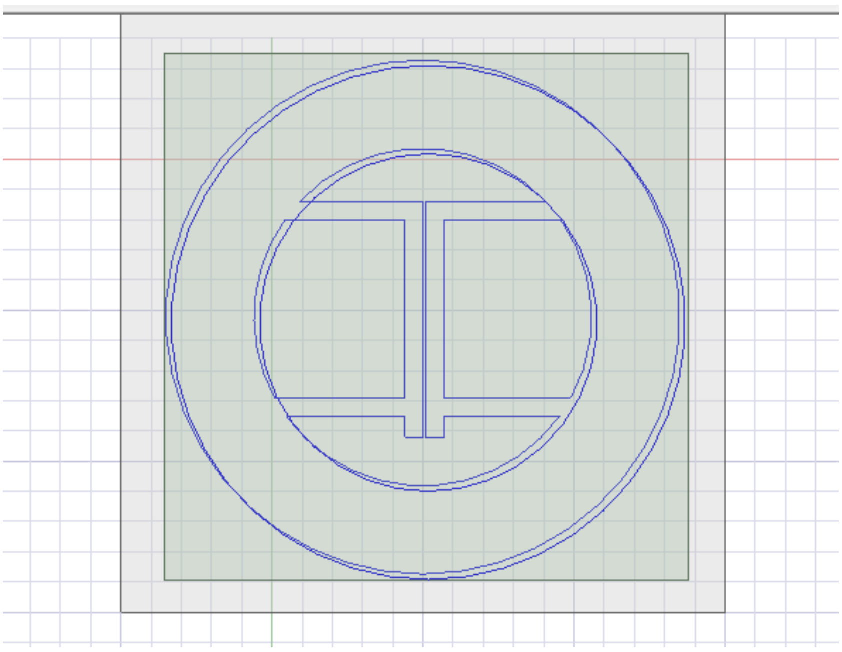
Single Layer FSSS

Single layer FSSs are composed of two-dimensional array of periodic resonant element. As is well known, FSSs act as either passband or stopband filters based on the two characteristics exhibited by the patch or slot elements. Single layer FSSs with such filter response have been used in wide range of applications. However, their potential use is restricted by the limited space available for the unit cell.

RESULTS

DESIGN STRUCTURE





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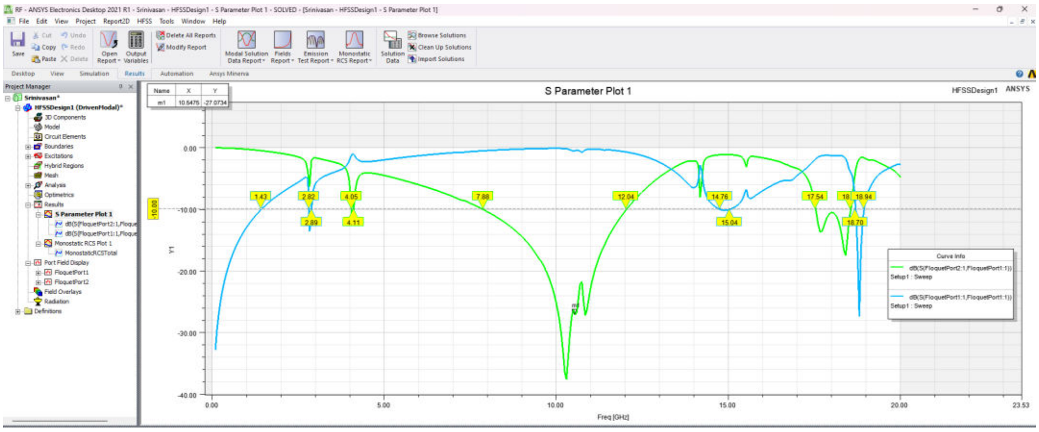
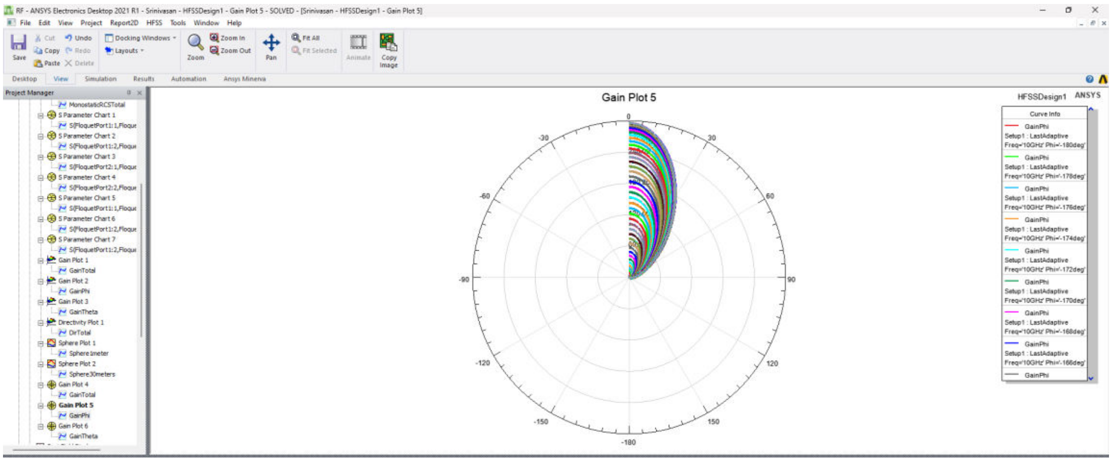
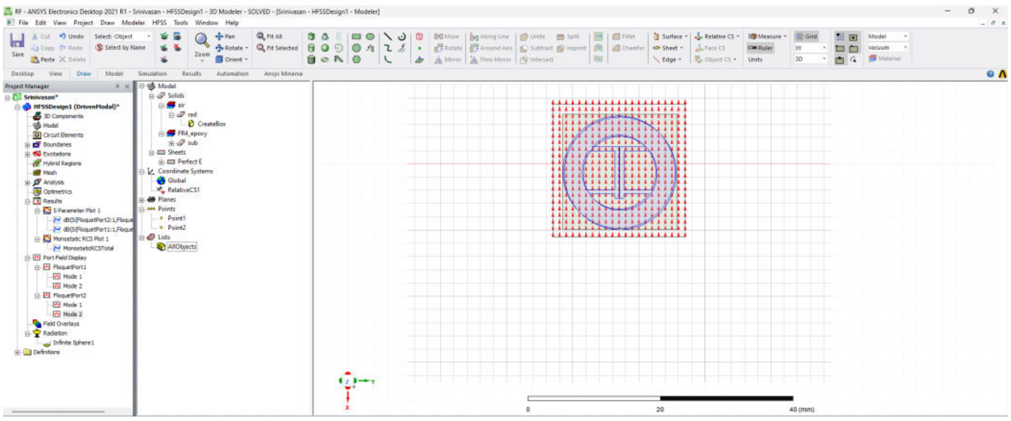
FILTER S PARAMETER OUTPUT



GAIN OUTPUT



MODE-1 FIELD ARRAYS



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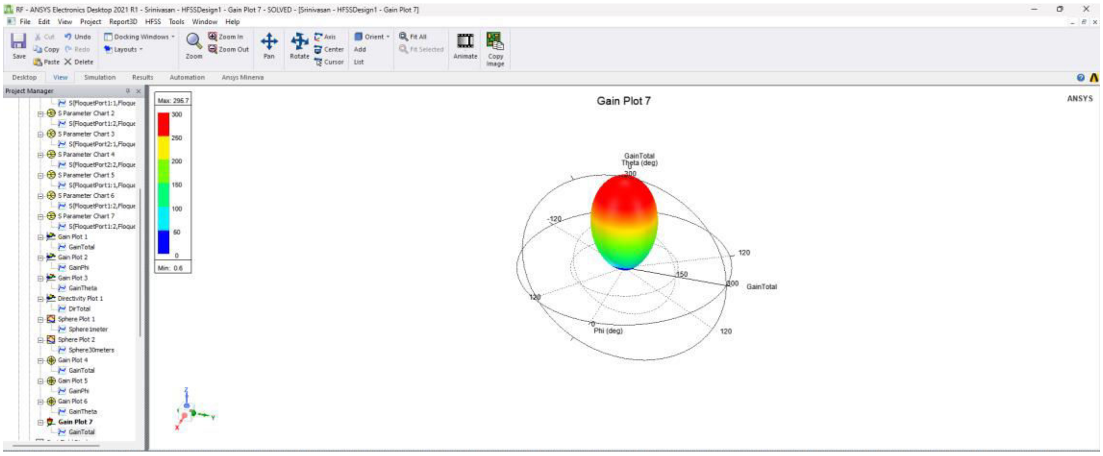
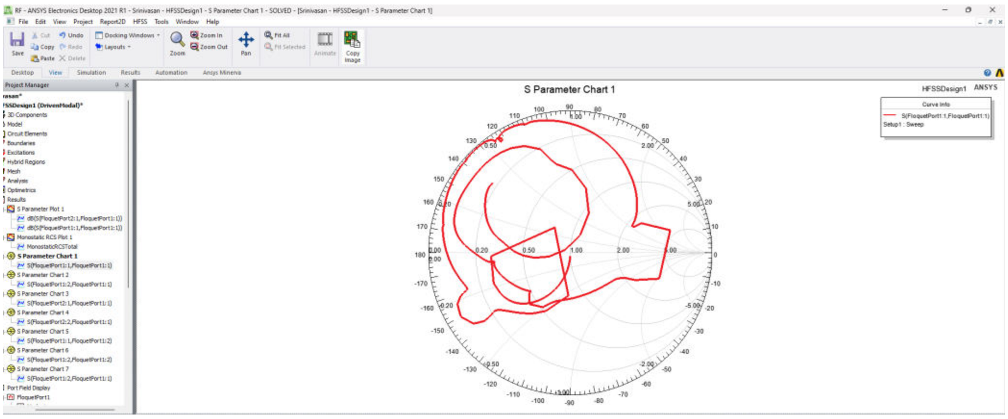
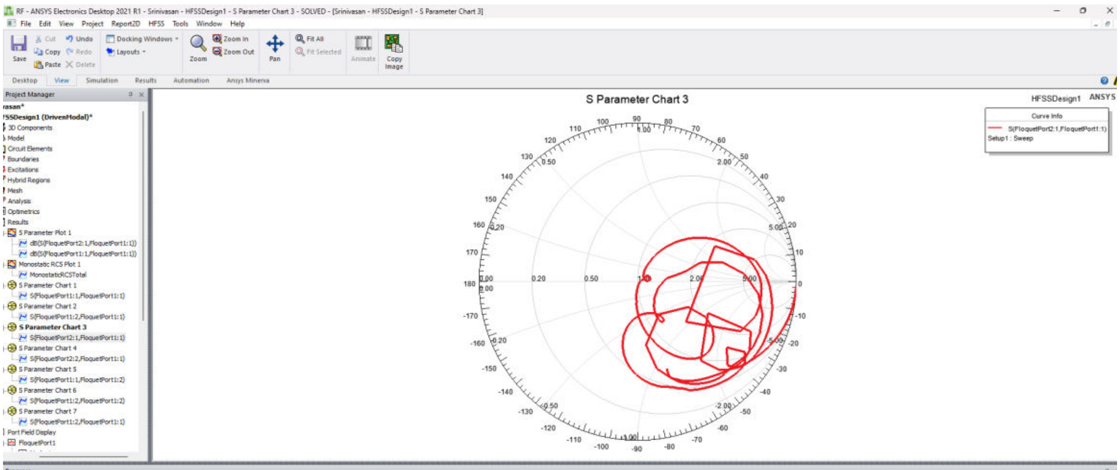
RADIATION PATTERN 3D



S-PARAMETER FOR FLOQUET PORT 1.1



S-PARAMETER FOR FLOQUET PORT 2.1



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IV. CONCLUSION

The study of an important periodic structure, named as Frequency Selective Surfaces, types, and functionalities. With recent emergent trends in communication, until now, diverse research works on FSS structures have been presented. This includes traditional single layer FSS, advanced multilayer FSS, antenna filter antenna FSS, three-dimensional FSS, convoluted/meandered FSS, fractal-based FSS, microwave absorbing FSS, active FSS, and many other types. This range consists of simple single screen 2D FSS, with low mass, cost, and volume that can be applicable in myriads of applications, to highly complex and advanced 3D active FSS whose superior performance can be compensated for their fabrication complexity. Extensive information in the form of tables is provided, when comparing different design techniques employed, array element structures, frequency ranges, bandwidths, and polarisability.

As more research is carried out in FSS architecture, modern or new implementation, and fabrication procedures are being adopted, many of the foreseen challenges will be resolved in the near future.

This will make the novel FSSs more viable alternatives to traditional low performing FSSs approaches. It is expected that this review will assist to ascertain closer linkages among theoretical background, structure parameters, and performance features in cutting edge designs of FSSs.

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