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Design and Development of A Semi-Cricle Csrr Antenna for 5g Communication

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Abstract: *This project investigates about the design and the development of a semi-circle CSRR structure. In order to reduce the mutual coupling and to verify the improvement in the isolation among the closely placed antenna elements, A semi-circle complementary split ring resonator (CSRR) filtering structure is used. Different from the previous reports the filtering elements offer an enhancement in the range of 2.5GHZ as compared to the simple ,which is useful for transmitting the information to the farther distance with high directivity at slower speeds. The entire configuration has been simulated using the MATLAB. Finally the proposed design is experimentally validated. Then the proposed design antenna is suitable for transmitting the information to the farther distance.*

I. Introduction

It was originally written to provide easy access to matrix software developed by the LINPACK and EISPACK projects. After- wards, it gradually became the language of general scientific calculations, visualization and program design. Today, Matlab engines incorporate the LAPACK and BLAS libraries, embedding the state of the art in software for matrix computations. It received more functionalities and it still remains a high-quality tool for scientific computation. Matlab excels at numerical computations, especially when dealing with vectors or matrices of data. It is a procedural language, combining an efficient programming structure with a bunch of predefined mathematical commands. While simple problems can be solved interactively with Matlab, its real power is its ability to create large program structures which can describe complex technical as well as non-technical systems. Mat- lab has evolved over a period of years with input from many users. In university environments, it is the standard computational tool for introductory and advanced courses in mathematics, engineering and science. In industry, Matlab is the tool of choice for highly-productive research, development and analysis.

Antenna Tool Box:

Antenna Toolbox uses the method of moments (MoM) to compute port properties such as impedance, surface properties such as current and charge distribution, and field properties such as the near-field and far-field radiation pattern. You can visualize antenna geometry and analysis results in 2D and 3D. You can integrate antennas and arrays into wireless systems, and use impedance analysis to design matching networks.

Dielectric Modeling: Account for the effects of the substrate in antennas and finite antenna arrays
Design and analyze patch, cavity, and reflector antenna or array structures by using dielectric material as substrates. Characterize dielectric substrates using the dielectric utility function and the constants and properties listed in Dielectric Catalog.

Import Antenna Arrays as a Planar Mesh:

Design antenna arrays with custom planar geometries Use the customArrayMesh class to design a planar array object. Analyze the custom mesh array for its port, surface, and field characteristics using array analysis functions.

Conformal Antenna Arrays:

Position the antenna elements of an array at arbitrary position Design conformal antenna arrays using any antenna elements from Antenna Toolbox as unit cells. You can also specify an array of any shape and antenna arrangements. Analyze unit cells of the array and extract the embedded pattern using array analysis functions.

Multi-Axis Tilt Property for Antennas and Antenna Arrays:
Rotate an antenna or an array around any arbitrary axis Use the TiltAxis property to a rotate the antenna and array elements around any arbitrary axis.

Polar Plot:
Interactively visualize the radiation pattern and perform measurements using polarpattern Use the polarpattern function to plot antenna and array characteristics in polar coordinates. In the polar plot, you can:

- Use markers to enable measurements of the plotted data
- Visualize N-dB beamwidth
- Change the orientation of the data Custom Pattern and Field: Visualize any arbitrary 3-D radiation pattern data or electric/magnetic field data using patternCustom and fieldsCustom

Use the patternCustom function to plot and visualize 2-D or 3-D radiation patterns from user specified or lab-measured antenna data recorded in CSV, text, or MAT files.
Use the fieldsCustom function to plot and visualize electric or magnetic fields from user specified or lab-measured antenna data recorded in CSV, text, or MAT files.

Radiation Pattern Import/Export:
Import and export radiation pattern data using the MSI file format with msiread and miswrite Use the msiread function to read data from MSI files that have .msi or .pln extensions. Use the msiwrite function to write data into MSI files that have .pln extension.

Rectangular Horn and Waveguide Antennas:
Design, visualize, and analyze rectangular horn and waveguide antennas with parameterized geometry Use the horn and waveguide antennas class to design and analyze a rectangular horn and waveguide antennas, respectively.
To view the structure of horn or waveguide metal antennas, use the show function.

Dielectric
Dielectric material for use as substrate
d = dielectric(material)
d = dielectric(Name,Value)

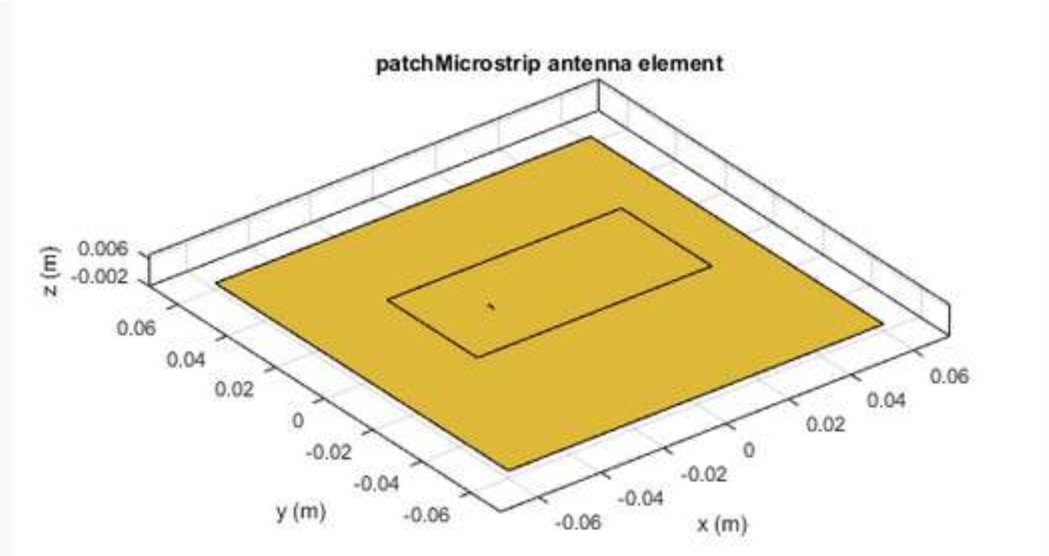
DielectricCatalog
Catalog of dielectric materials
dc = DielectricCatalog

Dielectric Materials

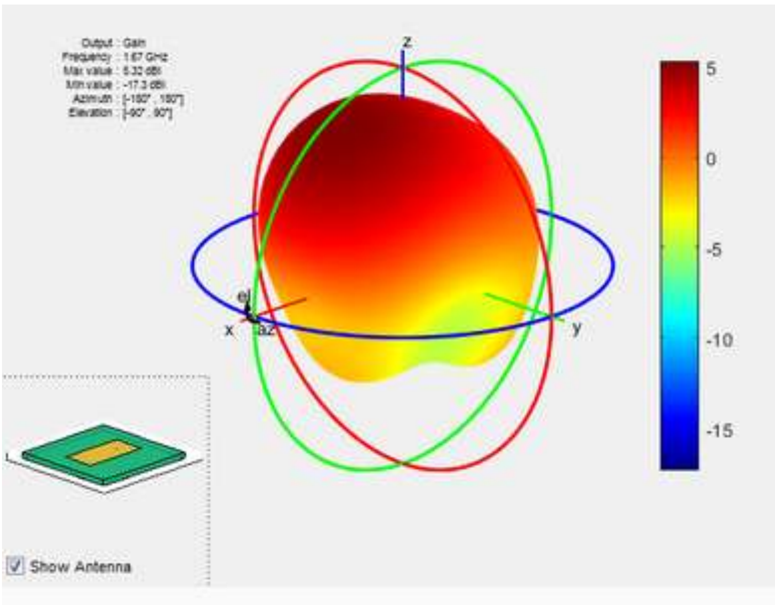
File

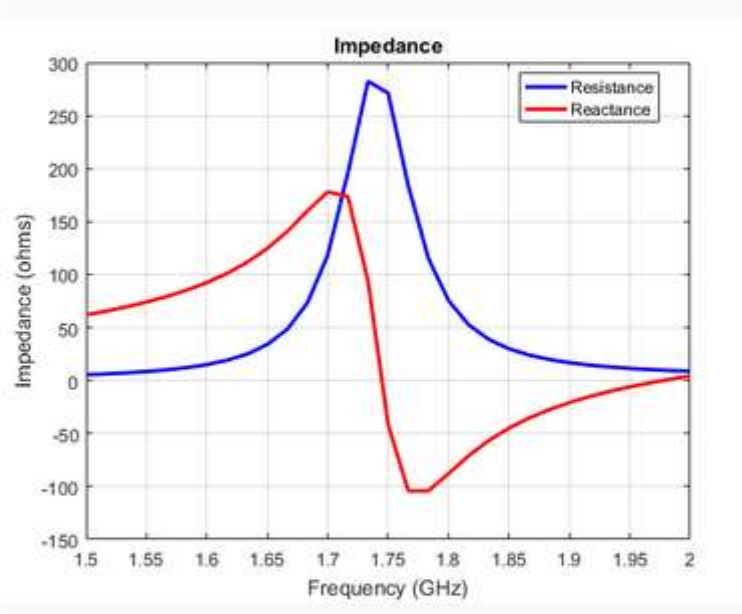
	Name	Relative_Permittivity	Loss_Tangent	Frequency	Comments
1	Air	1	0	1.0000e+009	
2	FR4	4.8000	0.0260	100.0000e+0...	
3	Teflon	2.1000	2.0000e-04	100.0000e+0...	
4	Foam	1.0300	1.5000e-04	50.0000e+006	
5	Polystyrene	2.5500	1.0000e-04	100.0000e+0...	
6	Plexiglas	2.5900	0.0068	10.0000e+009	
7	Fused quartz	3.7800	1.0000e-04	10.0000e+009	
8	E glass	6.2200	0.0023	100.0000e+0...	
9	RO4725JXR	2.5500	0.0022	2.5000e+009	
10	RO4730JXR	3	0.0023	2.5000e+009	
11	TMM3	3.4500	0.0020	10.0000e+009	
12	TMM4	4.7000	0.0020	10.0000e+009	
13	TMM6	6.3000	0.0023	10.0000e+009	
14	TMM10	9.8000	0.0022	10.0000e+009	
15	TMM10i	9.9000	0.0020	10.0000e+009	
16	Taconic RF-35	3.5000	0.0018	1.9000e+009	

patchMicrostrip
Create microstrip patch antenna
pm = patchMicrostrip creates a microstrip patch antenna
FeedOffset: [-0.0187 0]
Tilt: 0 TiltAxis: [1 0 0]

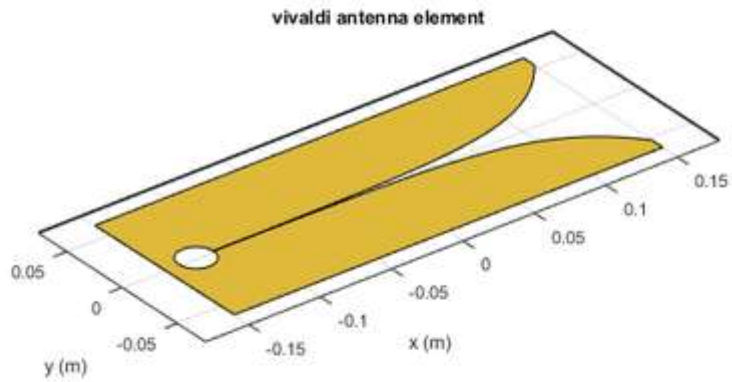


Radiation Pattern OfMicrostrip Patch Antenna
Create a microstrip patch antenna using 'FR4' as the dielectric substrate.
d = dielectric('FR4');
pm = patchMicrostrip('Length',75e-3, 'Width',37e-3, ... 'GroundPlaneLength',120e-3, 'GroundPlaneWidth',120e-3, ... 'Substrate',d)
show(pm)
Plot the radiation pattern of the antenna at a frequency of 1.67 GHz
Figure
pattern(pm,1.67e9)

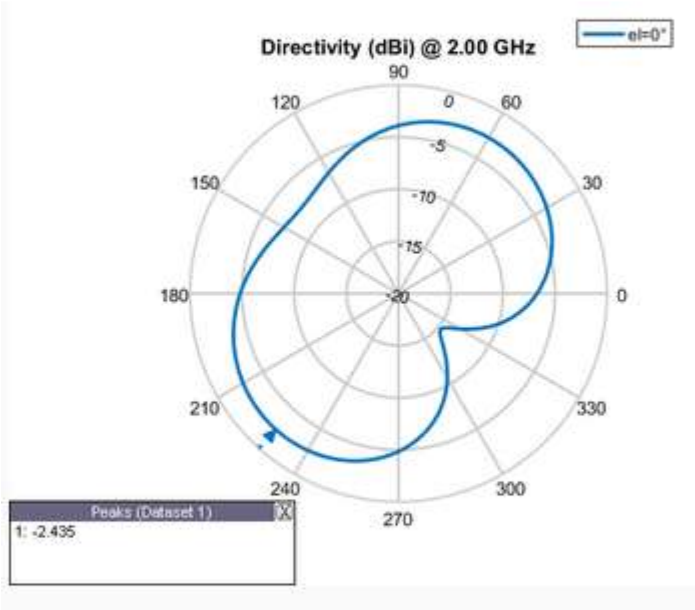




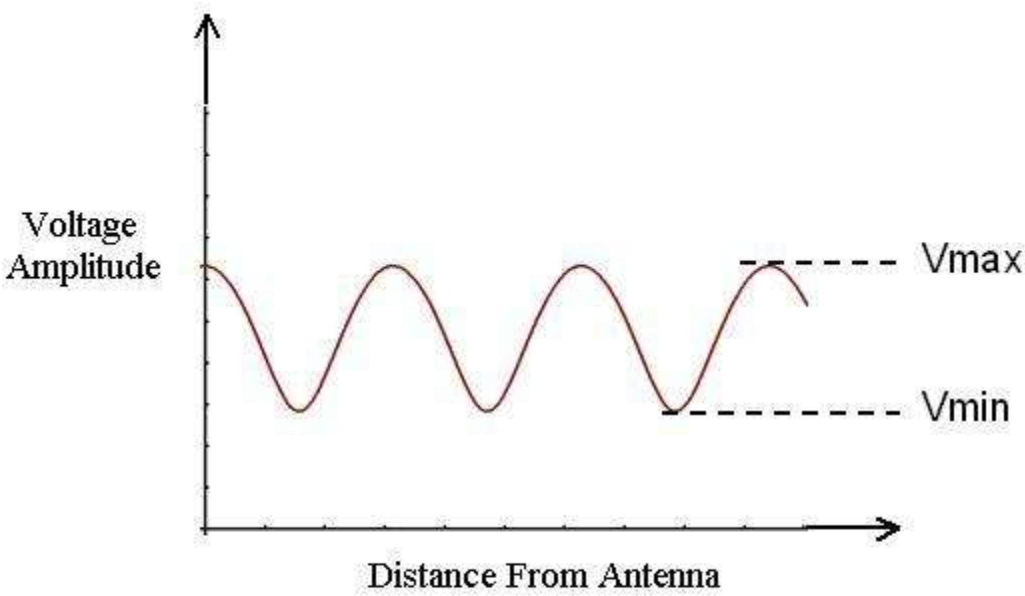
Show
Display antenna or array structure
show(object) displays the structure of an antenna or array object.
This example shows how to create a vivaldi antenna and display the antenna structure.
h = vivaldi
show(h)



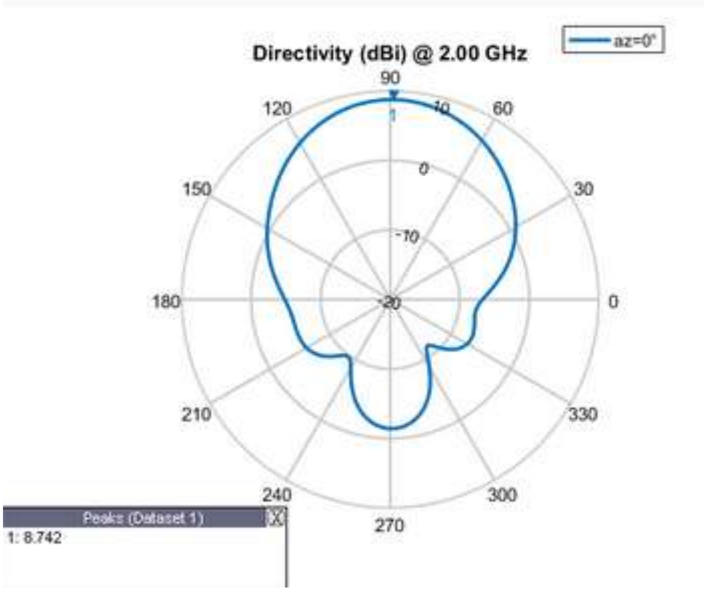
patternAzimuth
Azimuth pattern of antenna or array
Syntax
patternAzimuth (object,frequency,elevation)
patternAzimuth (object,frequency,elevation,Name,Value)
directivity = patternAzimuth (object,frequency,elevation)
directivity = patternAzimuth (object,frequency,elevation,Name,Value)
DESCRIPTION
patternAzimuth(object,frequency,elevation) plots the 2-D radiation pattern of the antenna or array object over a specified frequency. Elevation values defaults to zero if not specified.
patternAzimuth(object,frequency,elevation,Name,Value) uses additional options specified by one or more Name,Value pair arguments.



Voltage Standing Wave Ratio:
VSWR stands for Voltage Standing Wave Ratio, and is also referred to as Standing Wave Ratio (SWR). VSWR is a function of the reflection coefficient, which describes the power reflected from the antenna.



SYNTAX
vswr(antenna,frequency,z0)
vswrant = vswr(antenna,frequency,z0)
DESCRIPTION



pattern
Radiation pattern of antenna or array
Creating a Plot

The plot function has different forms, depending on the input arguments. If y is a vector, plot(y) produces a piecewise linear graph of the elements of y versus the index of the elements of y. If two vectors are specified as arguments, plot(x,y) produces a graph of y versus x. For example to plot the value of the sine function from zero to 2π, use

```
>> x = 0:pi/100:2*pi;
>> y = sin(x);
>>plot(x,y)
```

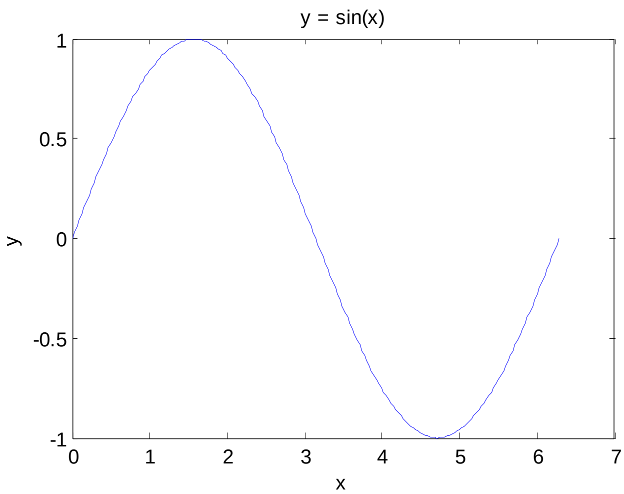


Figure.5 Sine Plot

The xlabel, ylabel and zlabel functions are useful to add x-, y- and z-axis labels. The zlabel function is only necessary for three-dimensional plots. The title function adds a title to a graph at the top of the figure and the text function inserts a text in a figure.
The following commands create the final appearance of figure 1.1.

```
>>xlabel('x');
>>ylabel('y');
>>title('y = sin(x)')
```

Multiple x-y pairs create multiple graphs with a single call to plot. Matlab automatically cycles through a predefined (but user settable) list of colors to distinguish between different graphs.
For example, these statements plot three related functions of x1, each curve in a separate distinguishing color:

```
>>x1 = 0:pi/100:2*pi;
>> y1 = sin(x1);
>> y2 = sin(x1 - 0.25);
>> y3 = sin(x2 - 0.5);
>>plot(x1,y1,x1,y2,x1,y3)
```

The number of points of the individual graphs may be even different. It is possible to specify the color, the line style and the markers, such as plus signs or circles, with: plot(x,y,'color style marker')

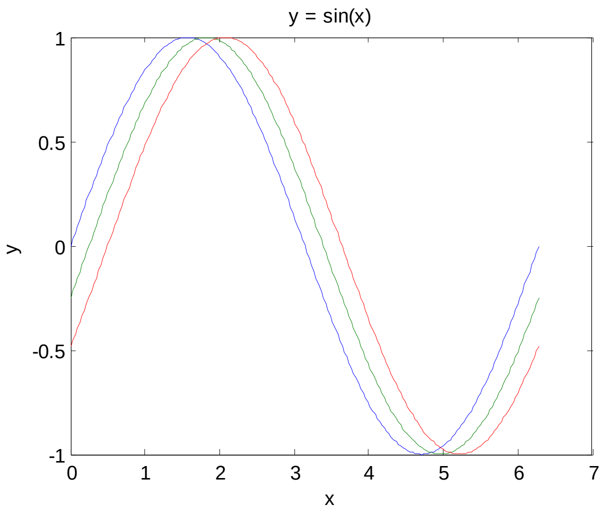
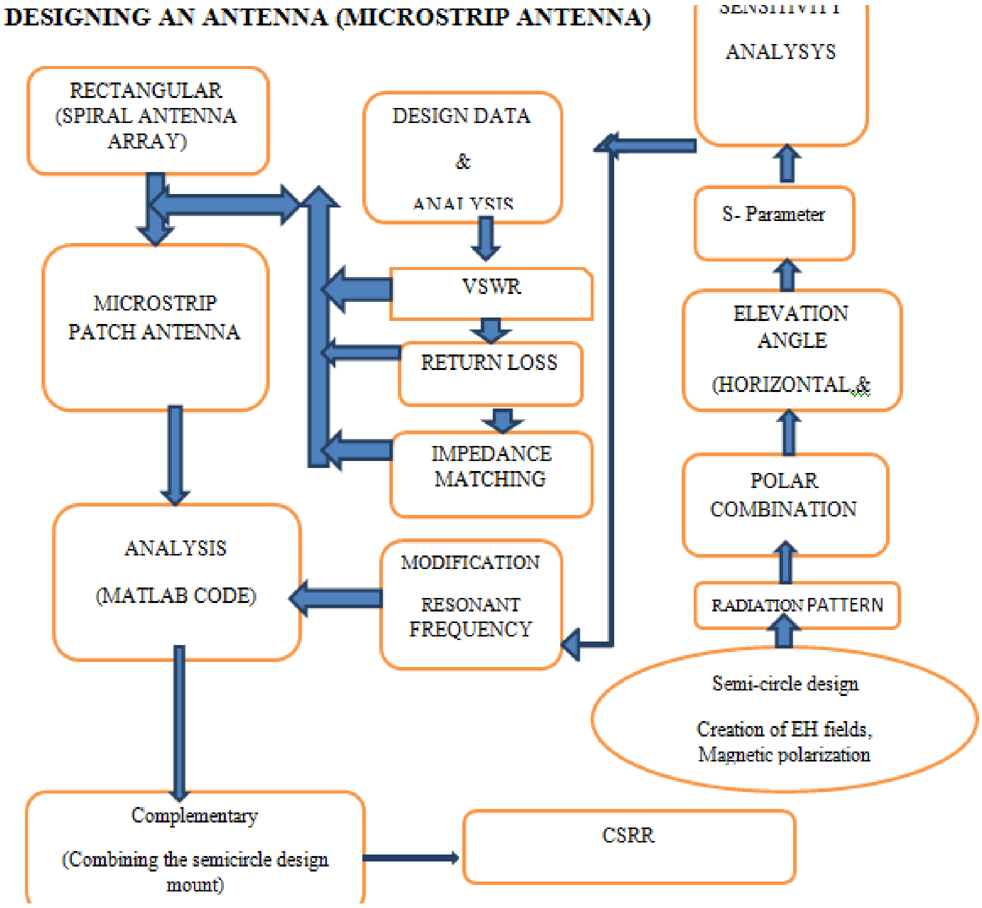


Figure.6 Multiple graphs with a single call to plot

A color style marker is a 1-, 2-, or 3-character string. It may consist of a color type.



II. Conclusion

In this work, a simple epsilon negative (ENG) CSRR band gap decoupling structure is investigated, and simulation and experiments are performed. From the experimental results, −58 dB isolation has been achieved at the operating frequency by implementing the proposed design. The improvement in isolation results in a recovery of the array pattern, which is evident from the pattern measurement performed. The computed and measured results conclude that employing the CSRR's in between the radiators offers an excellent coupling reduction. The advantage of the proposed design is its small size (equal to $\lambda/10$) and ease of fabrication compared to other meta material structures. This isolation enhancement band gap structure can be used in various compact antenna arrays. In future, this work can be continued to analyze the performance of CSRR along with numerous array elements in a linear and a planar array configurations for different element spacings to obtain compact and accurate beam steering array.