TRI RESONANCE MULTI SLOT PATCH ANTENNA

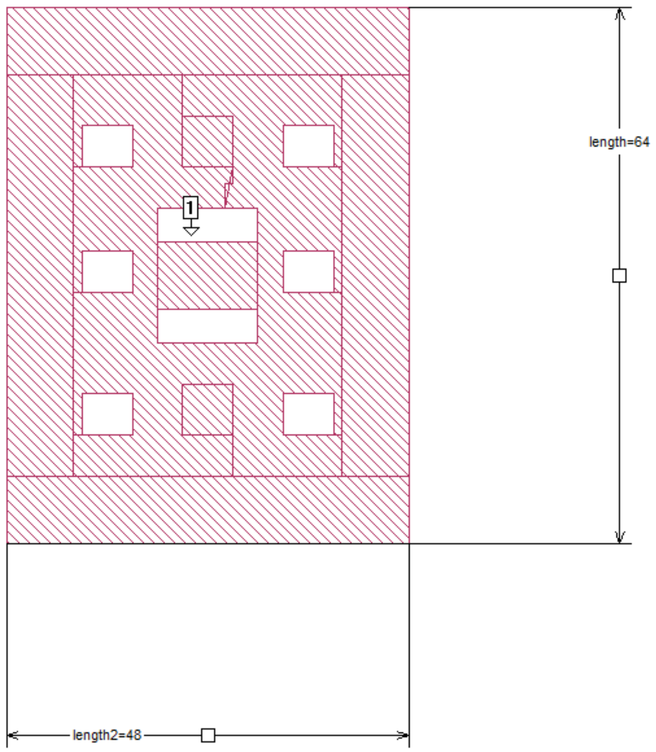
Kemal Temur, Sehabeddin Taha Imeci
Department of Electrical and Electronics Engineering,
International University of Sarajevo, Sarajevo, Bosnia and Herzegovina

INTRODUCTION

- Microstrip patch antenna has been studied in use for as long.
- Antenna is a transducer designed to transmit or receive electromagnetic waves.
- In its most basic form, a Microstrip patch antenna consists of a radiating patch on one side of a dielectric substrate which has a ground plane on the other side
- The demand for conformability, portable, low cost, light weight has increased.
- Microstrip antennas are attracting much attention in broad range of multifunctional wireless communication systems .
- The patch and the ground plane may have various geometric configurations and input impedances are usually 50 Ω or 75 Ω.

ANTENNA DESING

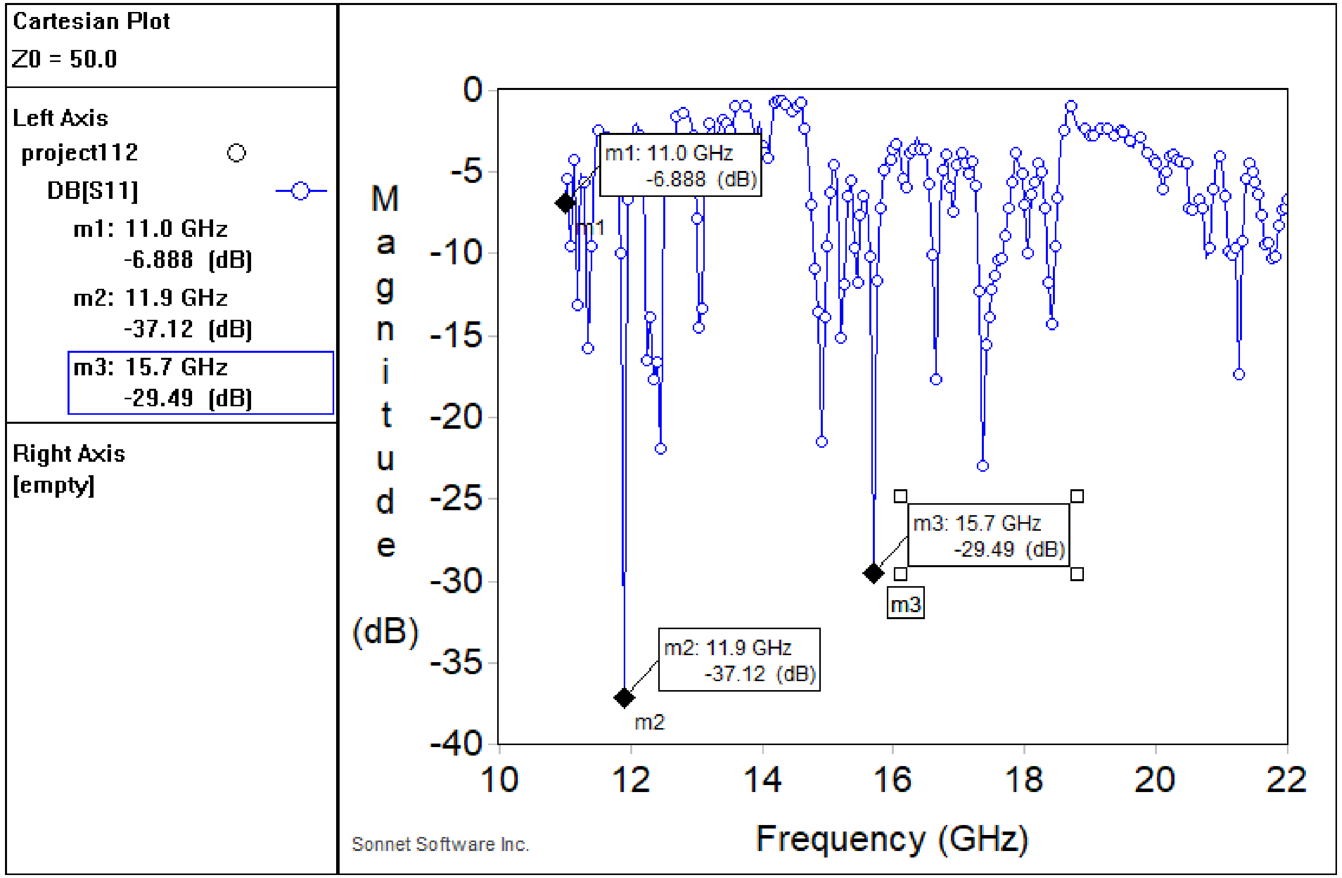
- The geometry of the slot antenna is shown in Figure. The size of the antenna is 48x64 mm.
- A dielectric substrate with dielectric permittivity $\varepsilon reff"$ of 4.3 and thickness $h1$ of 1mm has been used in this design.
- The antenna consists of square slots and rectangle slots. Also this slot made on ground helps in the reduction of overall weight and size of proposed antenna



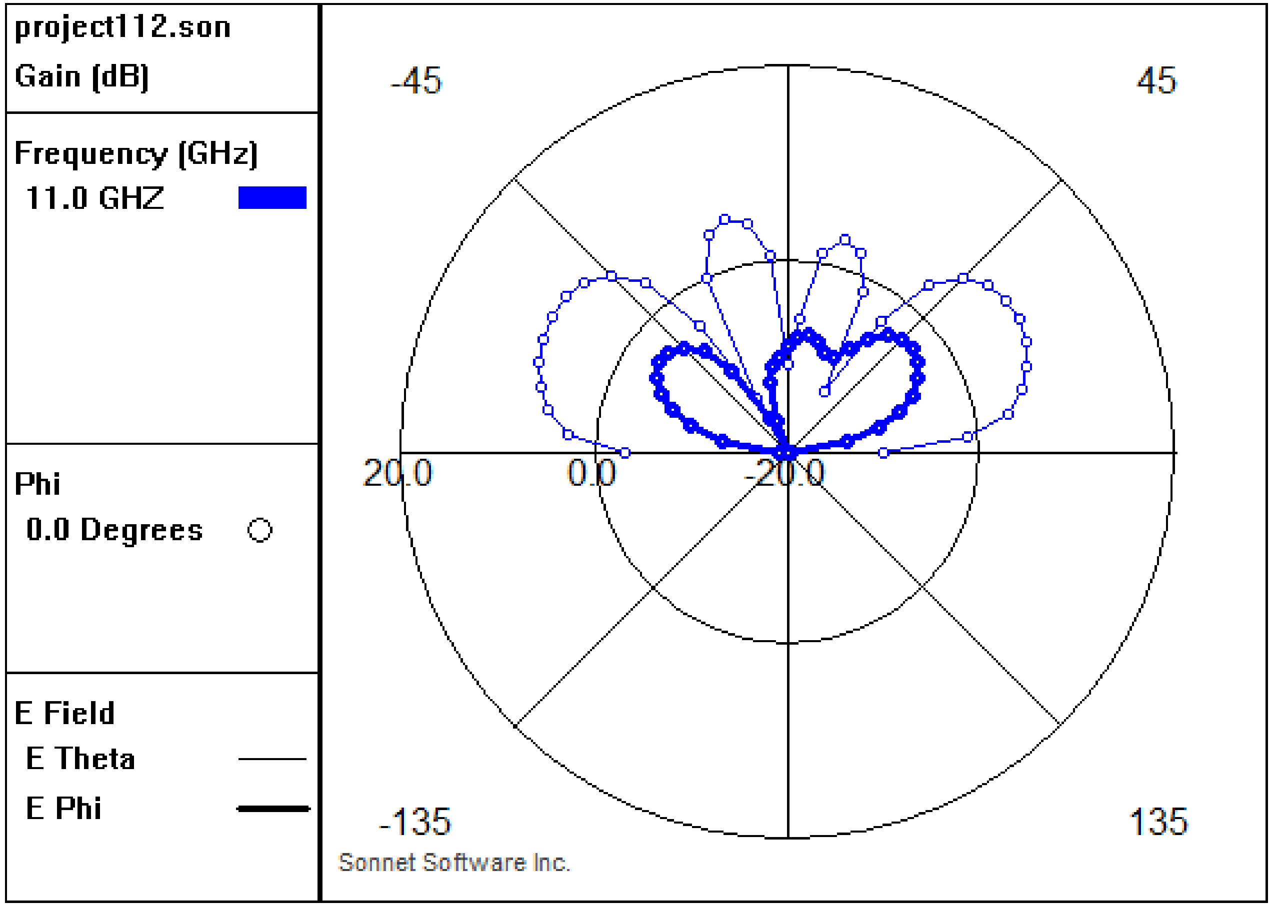
ANLYSIS RESUALT

- The simulation and analysis is completed for tri resonace multi slot patch antenna by sonnet lite software.
- The model was designed to match 50 ohm of the corporate feed

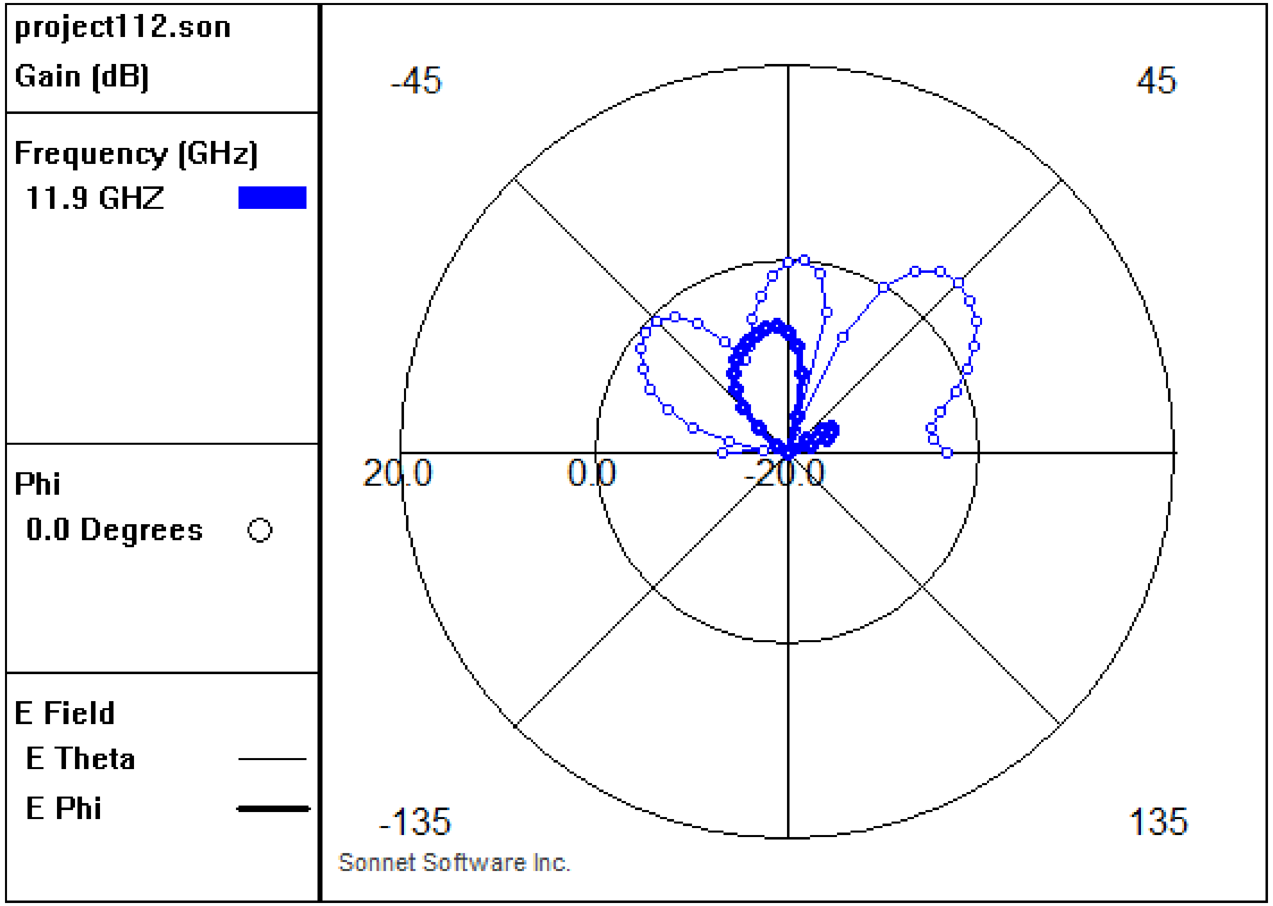
- The first important parameter which is helpful to calculate the bandwidth of the antenna structure is its S11 in decibel versus frequency.
- During this antenna feeding has been done at the point where the input match is minimized
- .Input match as a result of performed, was observed as in Figure



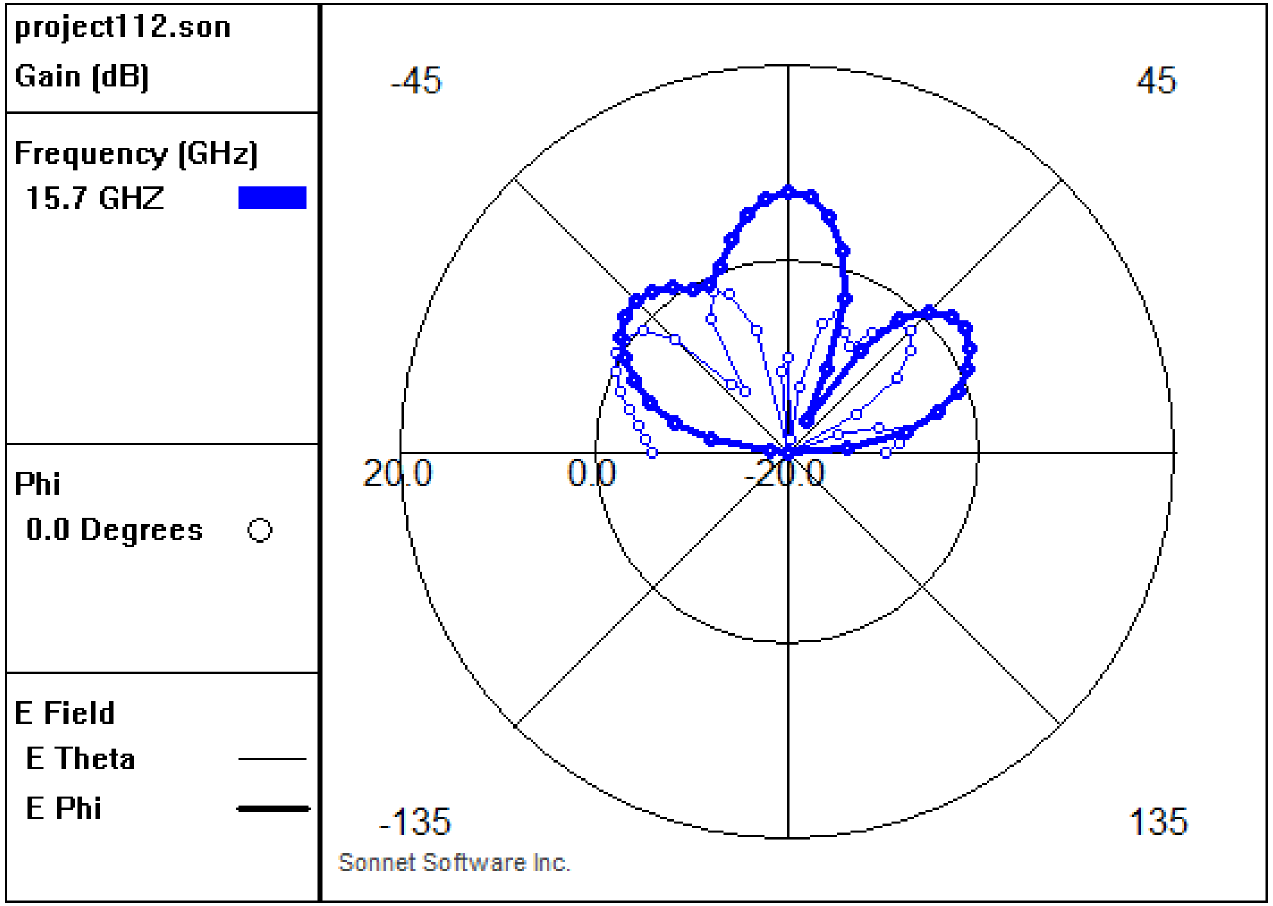
- The simulated and measured radiation patterns of the antenna at its resonance in the elevation-cut plane (phi = 0° and phi = 90°) have been illustrated.In the frequency of 11 GHz, as can be seen in Figure , 8.25 dB directional gain at Ɵ =∓60° was obtained in the electric field Ɵ polarization. Cross polarization level is less than –5dB.



- In the frequency 11.9 GHz with a input match value of -37.12 dB, as seen in Figure , 4.82 dB directional gain was obtained in the electric field ϴ polarization at theta =45°. Cross polarization level is less than –7dB.



- In the frequency 15.7 GHz with a input match value of -29.49 dB, as seen in Figure , there was a 7.077 dB directional gain at theta = 0° in the electric field ϕ polarization. Cross polarization level is less than –9 dB.



- A parametric study was conducted in order to see the fabrication tolerances of the antenna.
- The changes which are; slot size, dielectric thickness, dielectric(air) thickness and dielectric constant; made in the patch geometry helped to improve design parameters such as return loss, gain, resonance frequency and impedance.

Air thickness (mm)	Magnitude (S11:dB)		
11	-6,88	11	8,25
	-37,12	11,9	4,82
	-29,49	15,7	7,07
11.25	-5,44	11	8,24
	-39,02	11,9	4,85
	-29,95	15,7	7,0821
11.3	-6,79	11	8,246
	-39,42	11,9	4,865
	-30,048	15,7	7,0828

- The values in table 2 were found by changing the thickness of the dielectric material
- The changes in the resonance frequency, S11, bandwidth and gain with different dielectric thicknesses are given in Table

Dielectic thickness (mm)	Magnitude (S11:dB)	Resonance Freq.(GHz)	Gain(dB)
1mm	-6,88	11	8,25
	-37,12	11.9	4,82
	-29,49	15.7	7,07
1,2mm	-9,32	11	7,06
	-13,26	11.9	5,41
	-7,24	15.7	5,70
1,6mm	-10,85	11	5,08
	-8,71	11.9	4,81
	-6,06	15.7	6,31

- Table has the results when slots sizes were changed.
- A parametric study was done by changing the width of all rectangular patches and gaps between the edges of external antenna shown in by increasing and decreasing them with millimetres in order to see the fabrication tolerances. After simulation results we realize that there are small changes in frequencies, gain and input match, resulting with the values as seen in the Table .

Design Steps	Magnitude (S11:dB)	Resonance Freq.(GHz)	Gain(dB)
1	-6,88	11	8,25
	-37,12	11.9	4,82
	-29,49	15.7	7,07
2	-5,41	11	8,41
	-13,63	11.9	1,73
	-18,2	15.7	4,98
3	-2,18	11	7,33
	-11,33	11.9	5,06
	-1,72	15.7	6,39
4	-1,96	11	6,31
	-9,10	11.9	8,32
	-15,23	15.7	3,01

- The dielectric constant was changed to see the effect on S11 and gain. The results shown in Table .
- We do not lose any of the resonances but small changes of frequency, gain and input match occurred.

Dielectıc constant	Magnitude (S11:dB)	Resonance Freq.(GHz)	Gain(dB)
4,3	-6,88	11	8,25
	-37,12	11.9	4,82
	-29,49	15.7	7,07
4,5	-5,08	11	
	-2,88	11.9	4,27
	-3,24	15.7	8,47
4,7	-2,27	11	8,87
	-18,32	11.9	2,43
	-3,20	15.7	

CONCULUSION

- Different methods for miniaturization of a square microstrip patch were studied and a novel fractal patch with multiple-slots was developed
- In this design, a microstrip patch antenna that is desired to run between 11-22 GHz frequency values has been realized
- Gains observed in 3 frequencies. At 11 GHz, the gain of the antenna is 8.25 dB and at 11.9 GHz the gain of the antenna is 4.82 dB and, also at 15.7 GHz the gain of the antenna is 7.07 dB.