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Final Program

2016 URSI Asia-Pacific Radio Science Conference

URSI AP-RASC 2016

August 21 - 25, 2016

Grand Hilton Seoul Hotel, Seoul, Korea

Organized by

KIEES URSI

Co-Organized by

RRA NATIONAL RADIO RESEARCH AGENCY ETRI KASI Korea Astronomy and Space Science Institute NFRI

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Program at a Glance

	Time	Room A (Emerald A)	Room B (Emerald B)	Room C (Diamond)	Room D (Convention A)	Room E (Convention B)	Room F (Convention C)	Room G (Convention D)	Room H (Convention E)	Room I (Crane)	Room J (Swan)	Room K (White Heron)
Aug. 21 (Sun.)	13:00~17:30	Short Courses (Diamond, 3F, Convention Center, Grand Hilton Seoul Hotel)										
	18:00~20:00	Welcome Reception (Lotus Hill Garden, 2F, Grand Hilton Seoul Hotel)										

	Time	Room A (Emerald A)	Room B (Emerald B)	Room C (Diamond)	Room D (Convention A)	Room E (Convention B)	Room F (Convention C)	Room G (Convention D)	Room H (Convention E)	Room I (Crane)	Room J (Swan)	Room K (White Heron)
Aug. 22 (Mon.)	10:00~10:40	Opening Ceremony (Convention A~C, 4F, Convnetion Center, Grand Hilton Seoul Hotel)										
	10:40~11:00	Coffee Break										
	11:00~12:00	[General Lecture I] Nature Inspired Optimization Techniques in Modern Engineering: Let Darwin and the Bees Help Improve your Designs (Convention A~C, 4F, Convnetion Center, Grand Hilton Seoul Hotel)										
	12:00~13:30	Lunch										
	13:30~15:30	[S-B14] Multiscale Multiphysics Techniques and Applications	[S-B12a] Novel Mathematical Methods in Electromagnetics (1)	[S-J1] New technology in Very Long Baseline Interferometry and Single Dishes	[S-K1a] Biological Effects of EMF (1)	SYP Special Session	[S-C3] Wireless Network	[S-G1] GPS/GNSS Monitoring of the Ionosphere	[S-H1] Theory and Simulation of Waves in Plasma	[S-E1] Common-Mode Issues Related to Power Electronics	[S-D1] Microwave and THz Photonics	[S-F1] Wave Propagation and Scattering
	15:30~16:00	Coffee Break										
	16:00~18:00	[S-B2] Reconfigurable Antennas and Miniaturized Antennas	[S-B12b] Novel Mathematical Methods in Electromagnetics (2)	[S-J2] Science and Technology of the Square Kilometer Array	[S-K1b] Biological Effects of EMF (2)	[C1] Spectrum Engineering Technology	[S-C4] Radio Localization Techniques	[S-G3] Radar Probing for the Ionospheric Variability	[S-H2] Generation and Characteristics of Waves in Space	[S-E2] Signal Integrity and EMI of Chip, Package, and PCB	[S-D3] Terahertz Electronics and Photonics	[S-F2a] Remote Sensing for Land and Sea (1)

	Time	Room A (Emerald A)	Room B (Emerald B)	Room C (Diamond)	Room D (Convention A)	Room E (Convention B)	Room F (Convention C)	Room G (Convention D)	Room H (Convention E)	Room I (Crane)	Room J (Swan)	Room K (White Heron)
Aug. 23 (Tue.)	08:30~10:30	[S-B3] Groundwave Propagation Modeling, Simulation and Measurement	[S-B12c] Novel Mathematical Methods in Electromagnetics (3)	[S-J3] Science and Technology of Atacama Large Millimeter/Submillimeter Array	[S-K2a] Exposure Assessment and EMF Standards (1)		[S-C6] IoT and green Communications	[S-G2] Ionospheric Density Variability in the Polar Region	[S-H3a] Radio Science for Space Weather (1)	[S-A1] EM Basic Metrology	[S-D2] Ultrafast Photonics	[S-F2b] Remote Sensing for Land and Sea (2)
	10:30~11:00	Coffee Break										
	11:00~12:00	[General Lecture II] Electrodynamic Coupling Processes in the Solar-Terrestrial Environment (Convention A~C, 4F, Convnetion Center, Grand Hilton Seoul Hotel)										
	12:00~13:30	Lunch										
	13:30~15:30	[S-B4] Metamaterials & FSS	[S-B13a] Advances in Super- and High-Resolution Electromagnetic Imaging (1)	[S-J5a] Receivers for Radio Astronomy (1)	[S-K2b] Exposure Assessment and EMF Standards (2)	[S-K7] EM Biomedical Imaging	[S-C7] Massive MIMO and Millimeter Wave Communications	[S-G4] Satellite Probing for the Ionospheric Variability	[S-H3b] Radio Science for Space Weather (2)	[S-A3] Antenna Related Metrology	[S-D4] Microwave and mm-wave Integrated Circuits	[S-F3a] Remote Sensing of the Atmosphere (1)
	15:30~16:00	Coffee Break										
	16:00~18:00	[S-B5] Electromagnetic Field Theory	[S-B13b] Advances in Super- and High-Resolution Electromagnetic Imaging (2)	[B5] Fields and Waves Filter/ Resonator/Circuit	[S-K3a] Numerical Dosimetry (EMF Dosimetry) (1)	[S-KE] EMC in Biomedical Applications	[S-C8] Satellite and Terrestrial Networks	[S-G5] Observation of Ionospheric Plasma Density Variation	[S-H4] Waves in Nuclear Fusion Plasmas and Laser-Plasma Accelerator	[A1] Antenna	[S-D5] High Power RF Devices and Circuits	[S-F3b] Remote Sensing of the Atmosphere (2)
	18:00~20:00	Commission Business Meetings										

	Time	Room A (Emerald A)	Room B (Emerald B)	Room C (Diamond)	Room D (Convention A)	Room E (Convention B)	Room F (Convention C)	Room G (Convention D)	Room H (Convention E)	Room I (Crane)	Room J (Swan)	Room K (White Heron)
Aug. 24 (Wed.)	08:30~10:30	[S-B6] Wireless Power Transfer	[S-B1] Electrically Large Antennas	[S-J5b] Receivers for Radio Astronomy (2)	[S-K3b] Numerical Dosimetry (EMF Dosimetry) (2)	[S-E3] Modeling of Electromagnetic Immunity, EMS, and ESD	[C2] Radio Communication Systems and New Radio Service	[S-GH1] ULF/VLF Waves	[S-H5] Coherent Radiation Sources	[A2] Time and Frequency (Joint with ATF)	[S-D6] Low-energy Wireless Sensor Electronics	[S-F4a] Advanced Sensor and Radar Technology (1)
	10:30~11:00	Coffee Break										
	11:00~12:00	[General Lecture III] 5G, Moving Steps Closer to Commercialization (Convention A~C, 4F, Convnetion Center, Grand Hilton Seoul Hotel)										
	12:00~13:30	Lunch										
	13:30~15:30	[S-B7] Computational Technique and EM Simulation	[B1] Fields and Waves 5G and MIMO Technology	[S-J6a] Science and Technology for Solar and Heliophysics (1)	[S-K4] EMFs for New Technologies	[S-E4] EMC Problems in Mobile Devices	[C3] Channel Model, Antenna and Propagation (1)	[S-GH2] Space Weather Impact and Mitigation Efforts	[S-HG1a] Effects of Wave-Particle Interactions in Earths Magnetosphere and Upper Atmosphere (1)	[A3] Material Measurement & Network Analysis	[S-D7] Photonic/ Electromagnetic Metamaterials and Metadevices	[S-F4b] Advanced Sensor and Radar Technology (2)
	15:30~16:00	Coffee Break										
	16:00~18:00	Poster Session (Lobby, 3F, Convetion Center, Grand Hilton Seoul Hotel)										
	18:00~20:30	Banquet (Convention A~E, 4F, Convention Center, Grand Hilton Seoul Hotel)										

	Time	Room A (Emerald A)	Room B (Emerald B)	Room C (Diamond)	Room D (Convention A)	Room E (Convention B)	Room F (Convention C)	Room G (Convention D)	Room H (Convention E)	Room I (Crane)	Room J (Swan)	Room K (White Heron)
Aug. 25 (Thu.)	08:30~10:30	[S-B8] Negative Group Delay (NGD) Devices and Its Applications	[B2] Fields and Waves Metamaterials	[S-J6b] Science and Technology for Solar and Heliophysics (2)	[S-K5a] Biomedical Applications of EM Wave (1)	[S-E5] EMC and Information Security	[C4] Channel Model, Antenna and Propagation (2)	[G1] Radio Wave Propagation	[S-HG1b] Effects of Wave-Particle Interactions in Earths Magnetosphere and Upper Atmosphere (2)	[A4] Communication Related Metrology	[S-DBC1] Optical, Electrical and Optoelectronic Generation and Distribution of Microwave Signal	[S-F5] Radio Wave Propagation Aspects in Body Area Networks
	10:30~11:00	Coffee Break										
	11:00~12:00	[General Lecture IV] Role of Electromagnetic Waves in Magnetic Fusion Plasma Research (Convention A~C, 4F, Convnetion Center, Grand Hilton Seoul Hotel)										
	12:00~13:30	Lunch										
	13:30~15:30	[S-B9a] Computational Techniques and EM Field Simulators (1)	[B3] Fields and Waves Frequency Selective Surface	[S-JDE4] Digital Technology for Radio Astronomy	[S-K5b] Biomedical Applications of EM Wave (2)	[S-EB] EMC Modeling and Techniques	[C5] Signal Processing, Algorism and Circuit	[G2] General Ionospheric Studies (1)	[H1] Theory and Observation of Waves in the Earth's Magnetosphere		[D1] Optics and RF/THz Applications	[S-F6a] Remote Sensing of Precipitation (1)
	15:30~16:00	Coffee Break										
	16:00~18:00	[S-B9b] Computational Techniques and EM Field Simulators (2)	[B4] Fields and Waves Wideband/Dualband Antenna	[J1] Five Hundred Meter Aperture Spherical Telescope (Fast)	[S-K6] Dosimetry for WBAN Antennas and Devices	[E1] Radio Interference and Spectrum	[C6] New Radio Service	[G3] General Ionospheric Studies (2)	[H2] Waves and Particles in Solar System: General		[D2] Energy Harvesting and other Electronic Components	[S-F6b] Remote Sensing of Precipitation (2)

Session Title	[S-B8] Negative Group Delay (NGD) Devices and Its Applications
Date and Time	August 25 (Thu.) / 08:30~10:30
Room	Room A (Emerald A)
Session Organizer	Blaise Ravelo (ESIGELEC) Yongchae Jeong (Chonbuk National University)
Session Chairs	Blaise Ravelo (ESIGELEC) Yongchae Jeong (Chonbuk National University)

[S-B8-1] 08:30~08:50

[Invited] Resistive and Distributed Multiband NGD Active Circuit

B. Ravelo
IRSEEM, France

[S-B8-2] 08:50~09:10

[Invited] A Power Divider with Positive and Negative Group Delay Characteristics

Girdhari Chaudhary, Phirun Kim, Junhyung Jeong, and Yonchae Jeong
Chonbuk National University, Korea

[S-B8-3] 09:10~09:30

[Invited] Microwave Transversal and Recursive-filter based Negative Group Delay Circuits and Non-Foster Elements

Chung-Tse Michael Wu
Wayne State University, USA

[S-B8-4] 09:30~09:50

[Invited] A Compact MIMO Antenna with High Isolation for S, C and V Band Applications

Malay R. Tripathy[1], Vipin Choudhary[1], Aastha Gupta[1], and Yongchae Jeong[2]
[1]Amity University, India, [2]Chonbuk National University, Korea

[S-B8-5] 09:50~10:10

[Invited] Millimeter-Wave Negative Group Delay Network

William J. Otter, Stephen M. Hanham, Norbert Klein, and Stepan Lucyszyn
Imperial College London, UK

[S-B8-6] 10:10~10:30

[Invited] Precision E-field Uniformity Measurement of a Probe Loaded TEM Cell using an Optical Probe

Takehiro Moirioka[1], Satoru Kurokawa[1], Yoshikazu Toba[2], and Jun Ichijyo[2]
[1]National Institute of Industrial Science and Technology, Japan, [2]Seikoh Giken Co., Ltd., Japan

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A Compact MIMO Antenna with High Isolation for S, C and V Band Applications

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***Abstract*— A compact two elements MIMO antenna is designed on FR4 substrate with dimension 60×60×1.6 mm^3 and ε_r of 4.4. To achieve high isolation between the radiation elements, Defected Ground Structure (DGS) technique is applied. The mutual coupling between elements reduced considerably and gain of the antenna increased. In return loss plot, low frequency band from 1.9 to 5.6 GHz (comprising S and C bands) and high frequency band from 57 to 59.1 GHz (V Band) are obtained.**

***Keywords*— MIMO Antenna, Isolation, Mutual coupling, Negative group delay.**

I. Introduction

In recent years a lot of research is carried out in improving the data rate and throughput of different communication systems [1-5]. Multiple-input-multiple-output (MIMO) technology is becoming more important to address such challenges. The designing of a compact and simple MIMO antenna remain always attractive to researchers. But it inherits many difficulties such as high correlation coefficient, low isolation, negative group delay and these limits the performance of MIMO antenna.

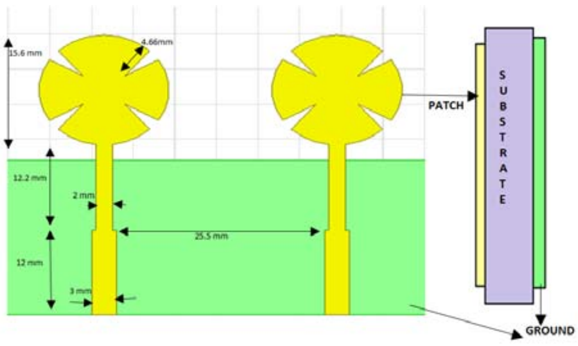
Space-time coding in MIMO antenna subset selection is discussed in a paper [6]. Wong et. al. [7] described joint channel diagonalization in multiuser MIMO antenna systems. Isolation improvement is suggested in a MIMO antenna systems [8-9]. Reconfigurable Negative Group Delay Circuit is proposed to improve the performance of a MIMO system [10]. Different applications of MIMO antenna systems in UWB, LTE/WLAN, satellite communication and Massive MIMO are presented in different papers [3, 11-15].

In this paper, to improve the isolation between antenna elements we have used DGS on the ground. This structure helped in the improvement of the performance characteristics such as gain, size reduction and mutual coupling. This design is simulated by using HFSS. From the results it is seen that this design can be used for S, C and V band applications.

This paper is organized as follow. Section II describes antenna design and characteristics. Results and discussion are presented in section III. Conclusion is made in the section IV.

II. Antenna Design

Figure 1(a) shows the design 1 for the proposed antenna. The substrate used has a dielectric constant of 4.4 with a thickness of 1.6 mm and dimensions of 60x60 mm^2. Two radiating elements with similar geometry are made on the top layer of the substrate. Both the elements have circular discs with four symmetric isosceles triangular slots. The length ‘a’ and ‘b’ of triangular slot are 4.66 mm and mm respectively. The distance between the two radiating elements is 25.5mm. The side view for the design is shown in figure 1(b). The ground of this design has the dimension of 22 × 60 mm^2.



(a) (b)

Fig. 1. (a) Antenna design 1 and (b) side view

Figure 2 shows the changes in the ground of design 1. This design can be called as design 2 henceforth. A T-shaped structure along with a single branch line is made to arise from the center of the ground. The height of this structure is 21 mm. The introduction of this ground defect structure reduced the mutual coupling considerably, thereby increasing the isolation.

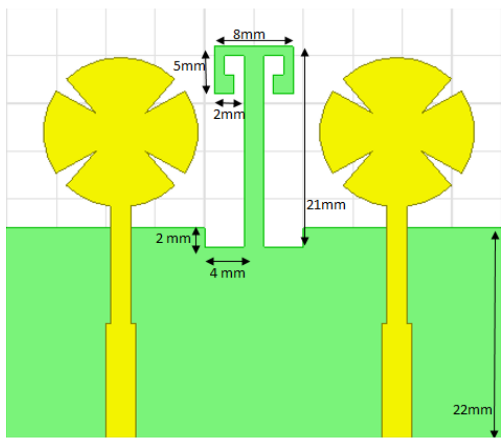
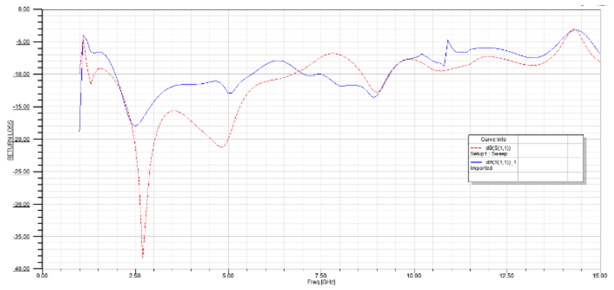


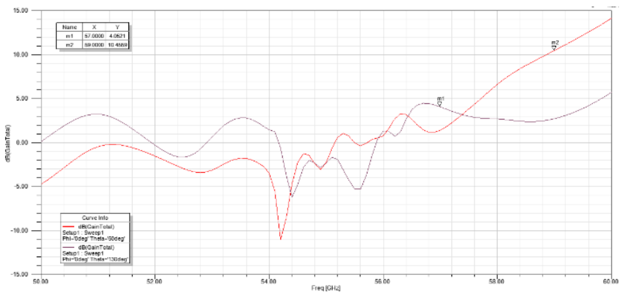
Figure 2: Design 2 with defect in the ground plane

III. RESULTS AND DISCUSSION

The MIMO antenna design 1 and design 2 had been analyzed and the simulated results are recorded. The return loss comparison of the antennas without any defect in the ground plane (Design 1) and with the defect in the ground plane (Design 2) is shown in figure 3. In the return loss characteristics of the proposed antenna (Design 2), dual bands are obtained with lower frequency band ranging from 1.97 GHz to 5.62 GHz and high frequency band ranging from 57 GHz to 59.1 GHz. Figure 3(a) and 3(b) shows the return characteristics in the lower and higher frequency band respectively. The readings for the return loss vs frequency plot are tabulated in Table 1.



(a)



(b)

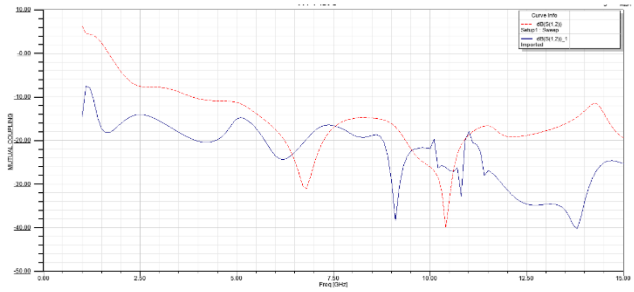
Figure 3: Return Loss Characteristics of (a) Lower and (b) Higher frequency bands.

Table 1: Return Loss values for Design 2.

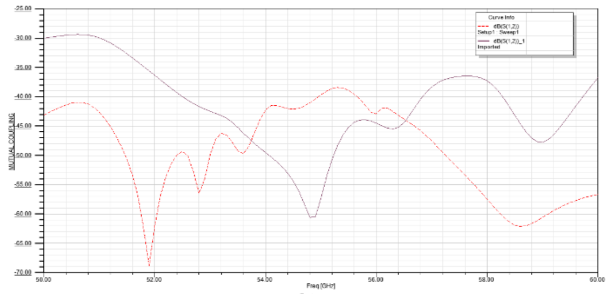
Design	Bandwidth (GHz)	Return loss
1	1.85 GHz – 6.72	• -17.7 dB at 2.4GHz • -38.4 dB at 2.7GHz • -15.8 dB at 3.4GHz • -20 dB at 5GHz
	50 – 55.56	• -15.44dB at 54.8GHz
2	1.97 – 5.62	• -17.6 dB at 2.4GHz • -16.8 dB at 2.7GHz • -12.1dB at 3.4GHz • -13dB at 5GHz
	57 – 59.1	• -15.8 dB at 58GHz

Further, the simulated S_{12} and S_{21} characteristics for the proposed antenna are shown in figure 4. Figures 4(a) and 4(b) are the isolation characteristics for the lower frequency and higher frequency bands respectively. It can be seen that the mutual coupling given by design 1 did not even crossed the required minimum value of -15 dB in the S- and C- bands in certain parts of the plot. On introducing the defect in the ground plane (design 2), the mutual coupling between the two radiating elements improved covering almost entire S-band and C-band. The maximum value of -20 dB in the lower frequency band and -47.8 dB in the higher frequency band are obtained.

The gain vs frequency plot of the proposed antenna is shown in figure 5 (a) and 5 (b) for the lower and higher frequency bands obtained respectively. The maximum gain obtained is 16.4 dB in the bandwidth of 1.97 GHz – 5.62 GHz at an operating frequency of 1.97GHz..

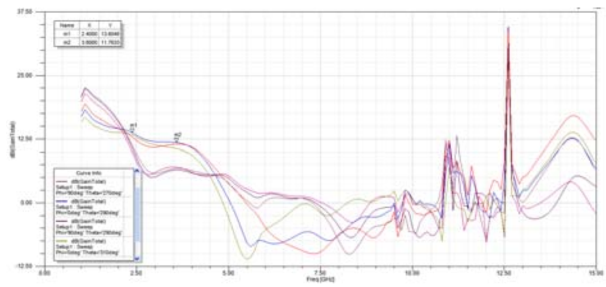


(a)

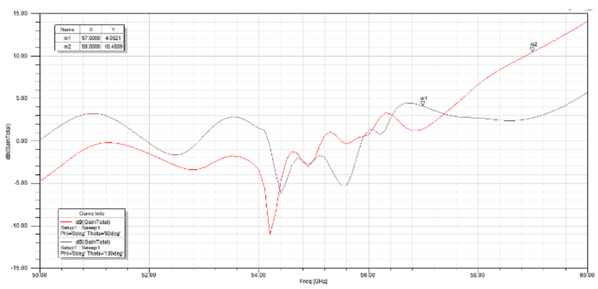


(b)

Figure 4: Isolation Characteristics in the (a) lower and (b) higher frequency bands.

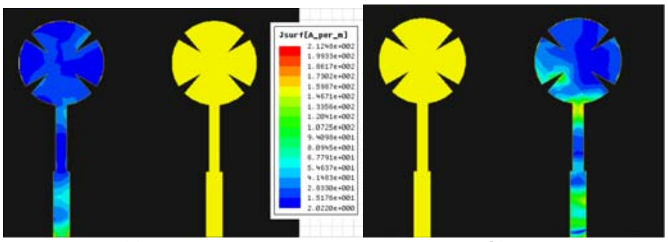


(a)



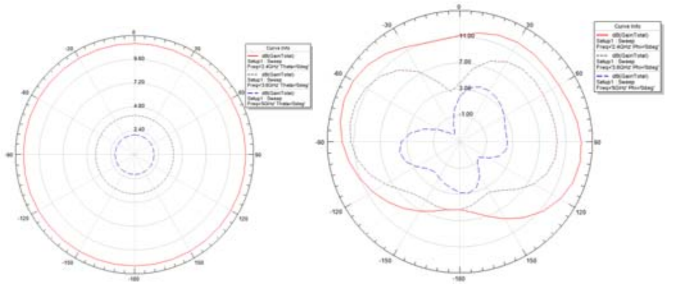
(b)

Figure 5: Gain vd Frequency plot for the frequency band of (a) 1.97GHz – 5.62GHz, and (b) 57GHz – 5.91GHz.

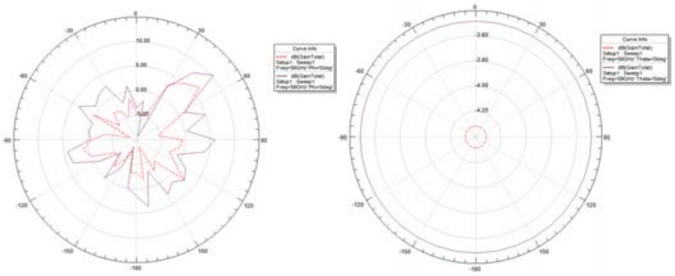


(a) (b)

Figure 6: Current Density for both the elements of the proposed MIMO antenna.



(a)



(b)

Figure 7: (a) E-plane radiation patterns and, (b) H-plane radiation patterns, at 2.4GHz, 3.6GHz and 5GHz.

In order to understand better, figure 6 shows the current density of both the elements of the proposed MIMO antenna. Firstly port 2 was shorted in order to excite port 1 and record its current density as shown in figure 6(a). Similarly, the excitation of the port 2 when port 1 is shorted is depicted in figure 6(b).

Figure 7(a) and 7(b) depicts the E-plane and H-plane radiation pattern in the operating range of 1.97GHz-5.62 GHz and 57GHz - 59.1GHz respectively. The radiation patterns are obtained at operating frequencies of 2.4GHz, 3.6GHz, 5GHz in lower frequency band. In higher frequency band the patterns are obtained at 58 GHz and 59 GHz. It is analysed that the E-plane radiation pattern is omnidirectional at 2.4 GHz and more directional at 3.6 GHz and 5 GHz. The H-palne radiation pattern is found to be stable with the changes in the frequency.

IV. Conclusion

The Multiple Input Multiple Output antenna with improved isolation between the two radiating element had been proposed in this paper. The lower frequencies obtained can be efficiently applied in the field of Mobile Satellite services, multimedia mobile broadcasting and direct-to-home services, all operating in the S-band. Apart from these, FCC had approved a satellite based Digital Audio Radio Service (DARS) broadcasting in the S-band from 2.31 – 2.36 GHz. The proposed antenna provides some useful results for the WLAN and WiMAX application frequency range. The higher frequency band obtained in this paper from 57GHz to 59.1GHz can be effectively utilised for various unlicensed wireless systems.

References

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