AN APPROACH OF MICROSTRIP PATCH TO MAGNETO HYDRO DYNAMIC ANTENNA- A REVIEW

Mahender Singh[1], R.S Yaduvanshi[2]

[1] Department of Electronics and Communication,
Guru Tegh Bahadur Institute of Technology, Delhi (India)
[2]Department of Electronics and Communication,
Ambedkar Institute of Advanced Communication Technologies & Research, Delhi (India)

ABSTRACT

In Communication system an antenna plays a very crucial role for high frequency applications. The transfer of maximum power from Transmitter end to Receiver end by matching the impedance of an antenna. The MHD antenna is combination of magnetic field (Maxwell's equation) and hydrodynamics (Navier's Stokes equation) .This paper gives us a review of MHD antenna discussing and analysing the problem facing such as matching impedance, radiation pattern (gain, directivity, and polarisation)

Keywords: Microstrip Antenna, Dielectric Resonator Antenna, Reconfigurability, High Gain, Hybrid Structure, Return Loss

I. INTRODUCTION

An antenna (or aerial) is an electrical device which converts electric power into radio waves, and vice versa. It is usually used with a radio transmitter or radio receiver. In transmission, a radio transmitter supplies an oscillating radio frequency electric current to the antenna's terminals, and the antenna radiates the energy from the current as electromagnetic waves (radio waves). In reception, an antenna intercepts some of the power of an electromagnetic wave in order to produce a tiny voltage at its terminals that is applied to a receiver to be amplified. Antennas are essential components of all equipment that uses radio. They are used in systems such as radio broadcasting, broadcast television, two-way radio, communications receivers, radar, cell phones, and satellite communications, as well as other devices such as garage door openers, wireless microphones, Bluetooth enabled devices, wireless Computer networks, baby monitors, and RFID tags on merchandise.

II. LITERATURE REVIEW

Microstrip antennas are attractive due to their light weight, conformability, low cost and ease of fabrication [1-3].These antennas can be integrated with printed strip -line feed networks and active devices. In its most fundamental 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. For a rectangular patch, the length of the patch is usually 0.3333λ0 < L<0.5 λ_0 ,where λ0 is the free space wavelength. The patch is selected to be very thin such that t<< λ0(where t is patch thickness).The height h of the dielectric substrate is usually $0.003 \leq h \leq 0.05\ \lambda 0$ .The dielectric constant of the substrate(ε_r) is typically in the range $2.2 \leq \varepsilon_r \leq 12$[6].

Microstrip antenna radiates primarily because of the fringing fields between the patch edge and the ground plane. For good antenna performance, a thick dielectric substrate having a low dielectric constant is desirable since this provides better efficiency, larger bandwidth and better radiation [6].However such a configuration leads to a larger antenna size. In order to design a compact Microstrip patch antenna, substrate with higher dielectric constants must be used which are less efficient and results in narrower bandwidth[5].Hence a trade-off must be realized between the antenna dimensions and antenna performance.

However the major disadvantage of the microstrip patch antenna is it's inherently narrow impedance bandwidth. Much intensive research has been done in recent years to develop bandwidth enhancement techniques. These techniques includes the utilization of thick substrate with low dielectric constant[7] and slotted patch[6].The use of electronically thick substrate only results in limited success because a large inductance is introduced by the increased length of the probe feed resulting few percentage of bandwidth at resonant frequency.

Now with the loading of some specific slot in the radiating patch of the microstrip antennas, compact or reduced size microstrip antennas can be obtained [9]. The loading of the slots in the radiating patch can cause meandering of the excited patch surface current paths and results in lowering of the antenna's fundamental resonant frequency, which corresponds to the reduced antenna size for such an antenna compared to conventional microstrip antenna at same operating frequency.

Antenna miniaturization plays a vital role in the design of global positioning systems and modern personal wireless system. Many techniques have been reported to reduce the patch antenna size, such as a square-ring patch fed by a micro strip line, the use of cross end bent slots embedded in the radiating patch [10-12] and the use of slot in ground plane [13].

The purpose of these methods is to lengthen the excited surface current path, increasing the antenna length and decreasing the resonant frequency. Recently an annular-ring patch antenna with strips has been used to obtain circular polarization characteristics [14-15]. In case of a narrow annular ring patch, it is very difficult to obtain a 50 ohm impedance match.

MHD antenna uses fluid as dielectric. The word magneto hydrodynamics (MHD) is derived from magneto- meaning magnetic field, and hydro- meaning liquid, and -dynamics meaning movement. MHD is the study of flow of electrically conducting liquids in electric and magnetic fields [18-20]. Here author have developed and tested magneto-hydrodynamic prototype antenna with detailed physics. Ting and King determined in 1970 that dielectric tube can resonate. To our knowledge no work has been done on MHD antenna as described here. Based on our own developed theory, authors have proposed this prototype model with return loss results. Fluid antenna has advantage of shape reconfigurability and better coupling of electromagnetic signal with the probe, as no air presents in between [27]. Author have developed physics as per (16-27) for electromagnetic wave coupling with conducting fluid in presence of electric and magnetic field.. Here, author demonstrates, how the directivity, radiation resistance and total energy radiated by this magnetohydrodynamic antenna can be computed, by the elementary surface integrals. Author have developed, equations for rotating frame of conducting fluid, velocity field, electric field, magnetic field, pointing vector, current density, permittivity, permeability and vector potentials to realise an MHD Antenna [21-23]. Authors have used saline water, ionised with DC voltage applied with the help of electrodes, in presence permanent magnetic field. Fluid acts as radiating element in the PPR (propylene random copolymer) cylindrical tube. SMA connector is used to supply RF input. Volume and shape of the fluid decides the resonant frequency.

Dielectric resonator antennas (DRAs) have been investigated during the last two decades and significant advances are being made in developing them for many applications. One major aspect of the state-of-the-art research with DRA is how to enhance the element bandwidth as evident from survey of open literature, e.g., [28-30]. For DRAs with broadside radiation, different shapes [31-33] and composite structures [28], [34], [35] have been investigated. For monopole type radiation pattern, only a few handful investigations with DRAs are available in open literature. The mode in coax-fed dielectric ring resonator was used to generate monopole-like radiation in [36]. The narrow impedance bandwidth of the structure in [36] was improved by introducing an air gap between the DRA and the ground plane in [37], [38]. Two broadband variants of dielectric ring resonator have recently been proposed in the form of coax-fed disc-ring [39] and rod-ring [40] combinations, respectively. An electric monopole-fed dielectric ring has been reported as an ultra wideband antenna in [41]. Since 1970's, dielectric resonators helped achieving the miniaturization of active and passive microwave components, such as oscillators and filters [28, 29]. In a shielded environment, the resonators build with DRs can reach the unloaded Q factor of 20,000 at frequencies between 2 and 20 GHz. The principle of operation of the 7 dielectric resonators can best be understood by studying the propagation of electromagnetic waves on a dielectric rod waveguide. The mathematical description [44] and the experimental verification [45] of the existence of these waves has been known for a long time. Their massive application begun with the introduction of optical fibers.

UWB antennas, the key elements of any ultra wideband systems, has become a competitive academic and industrial topic after 2002 date of the RST standards ruling the commercial use of ultra wide band technology reported by the Federal Communications Commission (FCC). Recently, DRAs have attracted a steady increasing attention during the last decade due to their main advantages such as wider bandwidth, better radiation efficiency compared to those of their microstrip antennas counterparts and due to other additional characteristics such as light weight and low size, and their ability to support harsh environment conditions (i.e., high temperature degree). In the last few years, UWB DRAs [42-45] have been designed for high data rate local wireless communication systems, radars and imaging systems, in microwave and millimetre wave frequency ranges, responding to the extensive demand of wideband application from their higher efficiency performance. However broad band and ultra wideband DRA structures are still suffering from some designing disadvantages making them less competitive such as complex geometries, higher dielectric constant material involved and/or the incompactness of proposed DRAs.UWB DRAs have been designed for high data rate local wireless communication systems, radars and imaging systems, in microwave and millimetre wave regions, responding to the high demand of wideband application and benefiting from their higher efficiency and gain performance.

III. CONCLUSIONS

This paper describes the feature and various problem of microstrip patch antenna. It provides the technology and method to face the challenges and to improves its shortcomings i.e. bandwidth enhancement problem, gain improvement problem, impedance matching etc. This is also explained the brief structure of Dielectric resonator antenna and MHD antenna with its ultra wideband application system in higher efficient modes

REFERENCES

[1] K. F. Lee, Ed., Advances in Microstrip and Printed Antennas, John Wiley, 1997

[2] D. M. Pozar and D. H. Schaubert, Microstrip Antennas: The Analysis and Microstrip Antennas and Arrays, IEEE Press, 1995.

[3] Chen, W.-L. and G.-M. Wang, \Small size edge-fed Sierpinski carpet microstrip patch antenna," Progress In Electromagnetics Research C, Vol. 3, 195{202, 2008.

[4] K. Wong and W. Hsu, "A broadband patch antenna with wide slits," in IEEE Antennas and Propagation International Symposium, vol. 3, (Salt Lake City, Utah),pp. 1414– 1417, IEEE, July 2010.

[5] R. Garg, P. Bhartia, I. Bahl, and A. Ittipiboon, Microstrip Antenna Design Handbook, Artech House, 2000

[6] Balanis, C. A., Antenna Theory: Analysis and Design, 811{862}

[7] James ,J.R and Hall,P S: "Handbook of microstrip antennas"(Peter Peregrinies)

[8] Row J.S. Dual frequency triangular planar inverted F-antenna "IEEE Trans. Antennas Propag. 2005,53,874-6.

[9] Yogesh Bhomia ,Ashok Kajla,Dinesh yadav"V-slotted triangular microstrip patch antenna" International journal of Electronics Engineering,2(1),2010, pp 21-23.

[10] CY Huang, JY Wu, KL Wong –"Cross-slot-coupled microstrip antenna and dielectric resonator antenna for circular polarization" IEEE Trans. Antennas Propag. 1999,47,pp 605-609.

[11] Iwasaki,H.A circularly polarized small size microstrip antenna with a cross slot" IEEE Trans. Antennas Propag. 1999,44(10),pp 1399-1401.

[12] Chen, W.S. Wu, C.K and Wong K.L. "Compact circularly polarized microstrip antenna with bent slots"Electron letter ,1998.pp 1278-1279

[13] JS Row, CY Ai – "Compact design of single-feed circularly polarized microstrip antenna", Electron. Lett., 2004, 40, (18), pp. 1093-1094.

[14] J.S., Row, and Lin, K.W.: "Design of an annular-ring microstrip antenna for circlar polarization", Microw. Opt. Technol. Lett., 2004, 42, (2), pp. 156-157.

[15] Tamakuma, K., and Iwasaki, H.: "A small size circularly polarized annular microstrip antenna". IEEE AP-S Symp., 2003, Vol.3, pp. 716-719.

[16] Rajveer S Yaduvanshi and Harish Parthasarathy, "Design, Development and Simulations of MHD Equations with its proto type implementations" (IJACSA) International Journal of Advanced Computer Science and Applications,Vol. 1, No. 4, October 2010.

[17] Rajveer S Yaduvanshi and Harish Parthasarathy, "EM Wave transport 2D and 3D investigations" (IJACSA) International Journal of Advanced Computer Science and Applications,Vol. 1, No. 6, December 2010.

[18] Rajveer S Yaduvanshi and Harish Parthasarathy, "Exact solution of 3D Magnetohydrodynamic system with nonlinearity analysis" IJATIT , Jan 2011.

[19] EM Lifshitz and LD Landau,"Theory of Elasticity, 3rd edition Elsevier.

[20] EM Lifshitz and LD Landau," Classical theory of fields , 4th edition Elsevier.

[21] Bahadir, A.R. and T. Abbasov (2005), "A numerical investigation of the liquid flow velocity over an infinity plate which is taking place in a magnetic field" International journal of applied electromagnetic and mechanics 21, 1-10.

[22] EM Lifshitz and LD Landau, "Electrodynamics of continuous media" Butterworth-Heinemann.

[23] EM Lifshitz and LD Landau, "Fluid Mechanics" Vol. 6 Butterworth -Heinemann.

[24] EM Lifshitz and LD Landau, "Theory of Fields" Vol. 2 Butterworth-Heinemann.

[25] JD Jackson, "Classical Electrodynamics" third volume, Wiley

[26] Gregory H. Huff, Member, IEEE, David L. Rolando, Student Member, IEEE, Phillip Walters, Student Member, IEEE and Jacob McDonald, "A Frequency Reconfigurable Dielectric Resonator Antenna using Colloidal Dispersions" IEEE ANTENNAS AND WIRELESS PROPAGATION LETTERS,VOL. 9, 2010.

[27] A. Petosa, A. Ittipiboon, and Y. Antar, "Broadband dielectric resonator antennas," in Dielectric Resonator Antennas, K.M. Luk, K. W. Leung, and R. S. Press, Eds. Hertfordshire, U.K.: Research Studies Press Ltd., 2003.

[28] A. A. Kishk, "Experimental study of broadband embedded dielectric resonator antennas excited by a narrow slot," IEEE Antennas Wireless Propag. Lett., vol. 4, pp. 79–81, 2005.

[29] R. Chair, A. A. Kishk, and K. F. Lee, "Wideband simple cylindrical dielectric resonator antennas," IEEE Microw. Wireless Compon. Lett., vol. 15, no. 4, pp. 7241–7243, Apr. 2005.

[30] A. A. Kishk, "Wide-band truncated tetrahedron dielectric resonator antenna excited by a coaxial probe," IEEE Trans. Antennas Propag., vol. 51, no. 10, pp. 2913–2917, Oct. 2003.

[31] J. A. Evans, M. J. Ammann, and Z. Wu, "A novel hybrid inverted-L antenna with wide bandwidth," presented at the Inst. Elect. Eng. Int. Conf. Antennas and Propagation, Mar. 2003. 12

[32] A. A. Kishk, Y. Yin, and A. W. Glisson, "Conical dielectric resonator antennas for wideband applications," IEEE Trans. Antennas Propag.,vol. 50, no. 4, pp. 469–474, Apr. 2002.

[33] K. W. Leung, K. M. Luk, K. Y. Chow, and E. K. N. Yung, "Bandwidth enhancement of dielectric resonator antenna by loading a low profile dielectric disk of very high permittivity," Elect. Lett., vol. 33, no. 9, pp. 725–726, Apr. 24, 1997.

[34] A. A. Kishk, X. Zhang, A. W. Glisson, and D. Kajfez, "Numerical analysis of stacked dielectric resonator antennas excited by a coaxial probe for wideband applications," IEEE Trans. Antennas Propag., vol. 51, no. 8, pp. 1996–2006, Aug. 2003.

[35] R. K. Mongia, A. Ittipiboon, P. Bhartia, and M. Cuhaci, "Electric monopole antenna using a dielectric ring resonator," Elect. Lett., vol. 29, no. 17, pp. 1530–1531, Aug. 19, 1993.

[36] S. M. Shum and K. M. Luk, "Characteristics of dielectric ring resonator antenna with an air gap," Elect. Lett., vol. 30, no. 4, pp. 277–278, Feb. 17, 1994.

[37] P. Junker, A. A. Kishk, A. W. Glisson, and D. Kajfez, "Effect of air-gap on cylindrical dielectric resonator antenna operating in TM mode," Elect. Lett., vol. 30, no. 2, pp. 97–98, Jan. 20, 1994.

[38] S. W. Ong, A. A. Kishk, and A. W. Glisson, "Wideband disc-ring dielectric resonator antenna," Microw. Opt. Technol. Lett., vol. 35, no. 6, pp. 425–428, Dec. 2002.

[39] S. H. Ong, A. A. Kishk, and A. W. Glisson, "Rod-ring dielectric resonator antenna: research articles," Int. J. RF and Microwave Computer- Aided Engineering, vol. 14, no. 6, pp. 441–446, Nov. 2004.

[40] M. Lapierre, Y. M. M. Antar, A. Ittipiboon, and A. Petosa, "Ultra wideband monopole/dielectric resonator antenna," IEEE Microw. Wireless Compon. Lett., vol. 15, no. 1, pp. 7–9, Jan. 2005.

[41] D. Guha and Y. M. M. Antar, "Four-element cylindrical dielectric resonator array: broadband low profile antenna for mobile communications," presented at the Proc. XXVIIIth General Assembly of the URSI, New Delhi, India, 2005.

[42] G. Drossos, Z. Wu, and L. E. Davis, "Four-element planar arrays employing probe-fed cylindrical dielectric resonator antennas," Microw. Opt. Technol. Lett., vol. 18, no. 5, pp. 315–319, 1998. 13

[43] G. Drossos, Z. Wu, and L. E. Davis, "Linear array consisting of four probe-fed cylindrical dielectric resonator antennas," Microw. Opt. Technol. Lett., vol. 18, no. 6, pp. 367–370, 1998.

[44] G. P. Junker, A. A. Kishk, and A. W. Glisson, "Input impedance of dielectric resonator antennas excited by a coaxial probe," IEEE Trans. Antennas Propagat., vol. 42, no. 7, pp. 960–966, Jul. 1994.

[45] D. Kajfez, A. W. Glisson, and J. James, "Computed modal field distributions for isolated dielectric resonators," IEEE Trans. Antennas Propag., vol. 32, no. 12, pp. 1609–1616, Dec. 1984.

[46] A. A. Kishk, A. Ittipiboon, Y. M. M. Antar, and M. Cuhaci, "Slot excitation of the dielectric disk resonator," IEEE Trans. Antennas Propag., vol. 43, no. 2, pp. 198–201, Feb. 1995.