Wireless Transmission of Electrical Power Overview of Recent Research & Development

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Abstract— The aim of this research work is to give a overview of recent researches and development in the field of wireless power transmission. The methods applied for wireless power transmission like Induction, Electromagnetic transmission, Evanescent wave coupling, Electrodynamic induction, Radio and microwave and Electrostatic Induction ,arediscussed.This study also focuses on the latest technologies, merits and demerits in this field. The economic aspects are briefly discussed.

Index Terms—wireless transmission, witricity, power, solarpower

I. INTRODUCTION

In recent years, demand for small antennas on wireless communication has increased the interest of research work on compact microstrip antenna design among microwave and wireless engineers [1-6]. Microstrip antennas have many unique and attractive properties – low in profile, light in weight, compact and conformable in structure, and easy to fabricate to support the high mobility necessity for a wireless telecommunication device and for high resolution mapping for radar communication, a small and light weight compact microstrip antenna is one of the most suitable application.

The development of antenna for wireless communication also requires an antenna with more than one operating frequency. This is due to many reasons, primarily because of various wireless communication systems and many telecommunication operators use various frequencies. Therefore one antenna that has multiband characteristic is more desirable than having one antenna for each frequency band. Most effective technique is cutting slot in proper position on the microstrip patch. In this paper includes cutting three equal slots which are same hexagonal structure at the upper right, upper left and lower left corner and a circle at the center from the conventional microstrip patch antenna, to increase the return loss and gain-bandwidth performance of the simulated antenna (Figure 2). To reduce the size of the antenna substrates are chosen with higher value of dielectric constant [7-9]. Our aim is to reduce the size of the antenna as well as increase the operating bandwidth. of the families and restaurants would install microwave ovens for meal preparation. However, the safety of the microwaved food has on and off aroused some public interest. This 3 includes concern on whether harmful chemicals would be formed or nutritional quality of food would be lowered during microwave cooking. Microwaves refer to the electromagnetic waves in the frequency range of 300 to 300,000 mega hertz (MHz) (million cycles per second). Electromagnetic waves are waves of electrical and magnetic energy moving together through space. They include gamma rays, x-rays, ultraviolet radiation, visible light, infrared radiation, microwaves and the less energetic radio waves. Microwaves can pass through materials like glass, paper, plastic and ceramic, and be absorbed by foods and water; but they are reflected by metalsThe proposed antenna (substrate with $\varepsilon r = 4.4$) has a gain of 3.50 dBi and presents a size reduction of 51.33% when compared to a conventional microstrip patch (10mm X 6mm).

The simulation has been carried out by IE3D [12] software which uses the MoM method. Due to the small size, low cost and low weight this antenna is a good entrant for the application of XBand microwave communication and Ku-Band RADAR communication. The X band belongs to in the microwave radio region of the electromagnetic spectrum. It is defined by an IEEE standard for radio waves and radar engineering with frequencies that ranges from 8.0 to 12.0 GHz. The X band is used for short range tracking, missile guidance, marine, radar and airbone intercept. Especially, it is used for radar communication ranges roughly from 8.29 GHz to 11.4 GHz. The Ku-Band belongs to in the microwave radio region of the electromagnetic spectrum. It is defined by an IEEE standard for radio waves and radar engineering with frequencies that ranges from 12.0 to 18.0 GHz [10-11]. The Ku band is used for high resolution mapping and satellite altimetry. Specially, Ku Band is used for tracking the satellite

II. LITERATURE SURVEY

In 1864, James C. Maxwell predicted the existence of radio waves by means of mathematical model. In 1884, John H. Poynting realized that the Poynting Vector would play an important role in quantifying the electromagnetic energy. In 1888, bolstered by Maxwell's theory, Heinrich Hertz first succeeded in showing experimental evidence of radio waves by his spark-gap radio transmitter. The prediction and Evidence of the radio wave in the end of 19th century was start of the wireless power transmission. Nikola Tesla has been the pioneer in the field of wireless transmission of electrical power [1]. He started efforts on Manuscript received February 25, 2011; revised March 30, 2012. The authors are with from BharatiVidyapeeth Deemed University College of Engineering, Pune, India. wireless transmission at 1891 in his “experimental station” at Colorado. Nikola Tesla successfully lighted a small incandescent lamp by means of a resonant circuit grounded on one end. A coil outside laboratory with the lower end connected to the ground and the upper end free. The lamp is lighted by the current induced in the three turns of wire wound around the lower end of the coil.

III. METHODS OF WIRELESS TRANSMISSION OF ELECTRICAL POWER

A. Induction The principle of mutual induction between two coils can be used for the transfer of electrical power without any physical contact in between. The simplest example of how mutual induction works is the transformer, where there is no physical contact between the primary and the secondary coils. The transfer of energy takes place due to electromagnetic coupling between the two coils. [7] William C. Brown contributed much to the modern development of microwave power transmission which dominates research and development of wireless Wireless Transmission of Electrical Power Overview of Recent Research & Development SagolsemKripachariya Singh, T. S. Hasarmani, and R. M. Holmukhe International Journal of Computer and Electrical Engineering, Vol.4, No.2, April 2012 207 transmission today. In the early 1960s brown invented the rectenna which directly converts microwaves to DC current. He demonstrated its ability in 1964 by powering a helicopter from the solely through microwaves. Hidetsugu Yagi a Japanese electrical engineer also tried unsuccessfully to introduce a wireless power transmission system.

B. Electromagnetic Transmission Electromagnetic waves can also be used to transfer power without wires. By converting electricity into light, such as a laser beam, then firing this beam at a receiving target, such as a solar cell on a small aircraft, power can be beamed to a single target. This is generally known as “power beaming”. In the past, product designers and engineers have faced challenges involving power: the continuity of supplied power, recharging batteries, optimizing the location of sensors, and dealing with rotating or moving joints. Although those challenges remain, new demands that arise from increased use of mobile devices and operation in dirty or wet environments mean that designers require new approaches to supplying power to equipment.Wireless Power Transmission from the time of Tesla has been an underdeveloped technology. Tesla had always tried to introduce worldwide wireless power distribution system. But due to lack of funding and technology of that time, he was not able to complete the task. Then onwards this technology has not been developed up to the level which would be completely applicable for practical purpose. Research has always been going on and recent developments have been observed in this field. Despite advances wireless power transmission has not been adopted for commercial use. Highlight a

C. Evanescent Wave Coupling Researchers at MIT believe they have discovered a new way to wirelessly transfer power using non-radiative electromagnetic energy resonant tunneling. Since the electromagnetic waves would tunnel, they would not propagate through the air to be absorbed or wasted, and would not disrupt electronic devices or cause physical injury like microwave or radio transmission. Researchers anticipate up to 5 meters of range.

D. Electrodynamic Induction Also known as "resonant inductive coupling" resolves the main problem associated with non-resonant inductive coupling for wireless energy transfer; specifically, the dependence of efficiency on transmission distance. When resonant coupling is used the transmitter and receiver inductors are tuned to a mutual frequency and the drive current is modified from a sinusoidal to a non-sinusoidal transient waveform. Pulse power transfer occurs over multiple cycles. In this way significant power may be transmitted over a distance of up to a few times the size of the transmitter.

E. Radio and Microwave Power transmission via radio waves can be made more directional, allowing longer distance power beaming, with shorter wavelengths of electromagnetic radiation, typically in the microwave range. A rectenna may be used to convert the microwave energy back into electricity. Rectenna conversion efficiencies exceeding 95% have been realized. Power beaming using microwaves has been proposed for the transmission of energy from orbiting solar power satellites to Earth and the beaming of power to spacecraft leaving orbit has been considered.

F. Electrostatic Induction Also known as "capacitive coupling" is an electric field gradient or differential capacitance between two elevated electrodes over a conducting ground plane for wireless energy transmission involving high frequency alternating current potential differences transmitted between two plates or nodes

IV. CONCLUSION

This paper focused on the simulated design on differentiallydrivenmicrostrip antennas. Simulation studies of a single layer single feed micro strip printed antenna have been carried out using Method of Moment based software IE3D. Introducing slots at the edge of the patch size reduction of about 51.33% has been achieved. The 3dB beam-width of the radiation patterns are 162.96° (for f1), 123.09° (for f2) which is sufficiently broad beam for the applications for which it is intended. The resonant frequency of slotted antenna, presented in the paper, designed for a particular location of feed point (-4mm, 2.5mm) considering the centre as the origin. Alteration of the location of the feed point results in narrower 10dB bandwidth and less sharp resonances.

REFERENCES

[1] I.Sarkar, P.P.Sarkar, S.K.Chowdhury "A New Compact Printed Antenna for Mobile Communication", 2009 Loughborough Antennas & Propagation Conference, 16-17 November 2009, pp 109-112.

[2] S. Chatterjee, U. Chakraborty, I.Sarkar, S. K. Chowdhury, and P.P.Sarkar, "A Compact Microstrip Antenna for Mobile Communication", IEEE annual conference. Paper ID: 510

[3] J.-W. Wu, H.-M. Hsiao, J.-H. Lu and S.-H. Chang, "Dual broadband design of rectangular slot antenna for 2.4 and 5 GHz wireless communication", IEE Electron. Lett. Vol. 40 No. 23, 11th November 2004.

[4] U. Chakraborty, S. Chatterjee, S. K. Chowdhury, and P. P. Sarkar, "A comactmicrostrip patch antenna for wireless communication," Progress In Electromagnetics Research C, Vol. 18, 211-220, 2011 http://www.jpier.org/pierc/pier.php?paper=10101205

[5] Rohit K. Raj, Monoj Joseph, C.K. Anandan, K. Vasudevan, P. Mohanan, " A New Compact Microstrip-Fed Dual-Band Coplaner Antenna for WLAN Applications", IEEE Trans. Antennas Propag., Vol. 54, No. 12, December 2006, pp 3755-3762.

[6] Zhijun Zhang, Magdy F. Iskander, Jean-Christophe Langer, and Jim Mathews, "Dual-Band WLAN Dipole Antenna Using an Internal Matching Circuit", IEEE Trans. Antennas and Propag.,VOL. 53, NO. 5, May 2005, pp 1813-1818.

[7] J. -Y. Jan and L. -C. Tseng, " Small planar monopole Antenna with a shorted parasitic inverted-L wire for Wireless communications in the 2.4, 5.2 and 5.8 GHz. bands" , IEEE Trans. Antennas and Propag., VOL. 52, NO. 7, July 2004, pp -1903-1905.

[8] Samiran Chatterjee, Joydeep Paul, Kalyanbrata Ghosh, P. P. Sarkar and S. K. Chowdhury "A Printed Patch Antenna for Mobile Communication", Convergence of Optics and Electronics conference, 2011, Paper ID: 15, pp 102-107

[9] C. A. Balanis, "Advanced Engineering Electromagnetics", John Wiley & Sons., New York, 1989.

[10] BipaDatta, Arnab Das, Samiran Chatterjee, BipadtaranSinhamahapatra, Supriya Jana, Moumita Mukherjee, Santosh Kumar Chowdhury, "Design of Compact Patch Antenna for Multi-Band Microwave Communication", National Conference on Sustainable Development through Innovative Research in Science and Technology (Extended Abstracts), Paper ID: 115, pp 155, 2012

[11] Arnab Das, BipaDatta, Samiran Chatterjee, BipadtaranSinhamahapatra, Supriya Jana, Moumita Mukherjee, Santosh Kumar Chowdhury, "MultiBandMicrostrip Slotted Patch Antenna for Application in Microwave Communication," International Journal of Science and Advanced Technology, (ISSN 2221-8386), Vol. 2, Issue-9, 91-95, September 2012

[12] Zeland Software Inc. IE3D: MoM-Based EM Simulator. Web: http://www.zeland.com/