A Miniaturized Frequency Selective Surface Design for Wireless Communication Devices

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ABSTRACT

This thesis proposes a miniaturized frequency selective surface design for wireless communication devices. This miniaturized frequency selective surface has a well transmittance in the specific communication band, a good shielding effectiveness out of this band, and an excellent resonance stability performance with respect to different polarizations and angles of incident plane-waves. A band-pass shielding enclosure assembled by this miniaturized frequency selective surface only makes a slightly influence on the internal antenna impedance and antenna patterns.

This thesis discusses the procedure for designing miniaturized frequency selective surface by simulation first. Based on the simulation, this miniaturized frequency selective surface indeed achieves the performance requirements. Then we created and examined prototype of the miniaturized frequency selective surface. Both the simulated and measured results obtained demonstrate the claimed performance.

Keywords : frequency selective surface、spatial filter、miniaturized periodic element

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REFERENCES

[1]B. A. Munk, Frequency Selective Surface Theory and Design, Wiley, 2000.
[2]E. Martini, F. Caminita, M. Nannetti, and S. Maci, “ Fast Analysis of FSS Radome for Antenna RCS Reduction, ” IEEE Antennas and Propagation Society International Symposium 2006, pp.1801-1804, 9-14 July 2006.
[3]F. R. Yang, K.P. Ma, Y. Qian and T. Iton, “ A Uniplanar Compact Photonic-Bandgap (UC-PBG) Structure, and Its Applications for Microwave Circuits, ” IEEE Trans. Microwave Theory Tech., vol. 47, no. 8, pp. 1509-1514 ,Aug. 1999.
[4]A. A. Tamijani, K. Sarabandi, and G. M. Rebeiz, “ Antenna-Filter-Antenna Arrays as a Class of Bandpass Frequency-Selective Surfaces, ” IEEE Trans. Microwave Theory Tech., vol. 52, no. 8, pp. 1781-1789, Aug. 2004.
[5]M. L. Zimmerman, S.W. Lee, and G. Fujikawa, “ Analysis of Reflector Antenna System Including Frequency Selective Surfaces, ” IEEE Trans. Antennas Propag. Vol.40, no.10, pp. 1264-1266, Oct. 1992.
[6]Y. Rahmat-Samii, and A. N. Tulintseff, “ Diffraction Analysis of Frequency Selective Reflector Antennas, ” IEEE Trans. Antennas Propag. Vol. 41, no. 4, pp. 476-487, Apr 1993.
[7]G. Q. Luo, W. Hong, Z. C. Hao, B. Liu, W. D. Li, J. X. Chen, H. X. Zhou, and K. Wu, “ Theory and Experiment of Novel Frequency Selective Surface Based on Substrate Integrated Waveguide Technology, ” IEEE Trans. Antennas Propag., vol. 53, no. 12, pp. 4035-4043, Dec. 2005.
[8]F. R. Yang, K. P. Ma, Y. Qian, and T. Iton, “ A Novel TEM Waveguide Using Uniplanar Compact Photonic-Bandgap (UC-PBG) Structure, ” IEEE Trans. Microwave Theory and Tech., vol. 47, pp. 2092 – 2098, Nov. 1999.
[9]Y. E. Erdemli, K. Sertel, R. A. Gilbert, D. E. Wright, and J. L. Volakis, “ Frequency-Selective Surfaces to Enhance Performance of Broad-Band Reconfigurable Arrays, ” IEEE Trans. Antennas Propag., vol. 50, no. 12, pp.1716-1724, Dec. 2002.
[10]S. Barbagallo, A. Monorchoi, and G. Manara, “ Small Periodicity FSS Screens with Enhanced Bandwidth Performance, ” IEEE Electo. Lett. vol., 42, no. 7, pp.382-384, Mar. 2006.
[11]R. Coccioli, F. R. Yang, K. P. Ma, and T. Iton, “ Aperture Coupled Patch Antenna on UC-PBG Substrate, ” IEEE Trans. Microwave Theory and Tech., vol. 47, no. 11, pp.2123-2130, Nov. 1999.
[12]Z. Iluz, R. Shavit, and R. Bauer, “ Microstrip Antenna Phased Array With Electromagnetic Bandgap Substrate, ” IEEE Trans. Antennas Propag., vol. 52, no. 6, pp.1446-1453, June. 2004.
[13]M. F. Abedin, and M. Ali, “ Effects of a Smaller Unit Cell Planar EBG Structure on the Mutual Coupling of a Printed Dipole Array, ” IEEE Antennas Propag. Lett., vol. 4, pp.274-276, 2005.
[14]Z. L. Wang, K. Hashimoto, N. Shinohara, and H. Matsumoto, “ Frequency-Selective Surface for Microwave Power Transmission, ” IEEE Trans. Microwave Theory and Tech., vol. 47, no. 10, pp.2039-2042, Oct. 1999.
[15]T. L. Wu, Y. H. Lin, T. K. Wang, C. C. Wang, and S. T. C., “ Electromagnetic Bandgap Power/Ground Planes for Wideband Suppression of Ground Bounce Noise and Radiated Emission in High-Speed Circuits, ” IEEE Trans. Microwave Theory Tech., vol.53, no.9, pp.3398-3406, Sep 2005.
[16]T. K. Wang, C. C. Wang, S. T. Chen, Y. H. Lin, and T. L. Wu, “ A New Frequency Selective Surface Power Plane with Broad Band Rejection for Simultaneous Switching Noise on High-Speed Printed Circuit Boards, ” IEEE Microwave and Optical Tech. Lett., vol. 35, no. 4, 917-920, Nov. 2002.
[17]S. Shahparnia, and O. M. Ramahi, “ Electromagnetic Interference (EMI) Reduction From Printed Circuit Boards (PCB) Using Electromagnetic Bandgap Structures, ” IEEE Trans. Electromag. Compat., vol. 46, no. 4, pp.580-587, Nov. 2004.
[18]H. H. Ohta, K. C. Lang, R. Mittra, “ Design of Two-Screen Frequency Selective Surface for C/Ku-Band Satellite Communications, ” Antennas and Propagation Society International Symposium, Vol.21, pp. 357-360, 1983.
[19]D. J. Kern, D. H. Werner, A. Monorchio, L. Lanuzza, and Michael J. Wilhelm, “ The Design Synthesis of Multiband Artificial Magnetic Conductors Using High Impedance Frequency Selective Surface, ” IEEE Trans. Antennas and Propag., vol. 53, no. 1, pp. 8-17, Jan. 2005.
[20]張孟偉, “ 應用於無線行動通訊之頻率可選擇屏蔽物之設計 ” 碩士論文, 私立大葉大學, 民國94年.
[21]Cheng-Nan Chiu, and Yu-Fan Kuo, “ A Bandpass Shielding Enclosure for Modern Handheld Communication Devices, ” IEICE Trans. Commun., Vol.E90-B, No.6, June 2007.
[22]B. A. Munk, R. Kouyoumjian, and L. Peters, Jr., “ Reflection properties of periodic surfaces of loaded dipoles, ” IEEE Trans. Antennas and Propag. vol. 19, pp. 612 – 617, Sep. 1971.
[23]B. A. Munk, G. A. Burrell, “ Plane-wave expansion for arrays of arbitrarily oriented piecewise linear elements and its application in determining the impedance of a single linear antenna in a lossy half-space, ” IEEE Trans. Antennas and Propag. vol. 27, pp. 331 – 343, May 1979.
[24]Robert E. Collin, “ Foundations for Microwave Engineering 2nd , ” McGraw-Hill, 1992[25]Ansoft HFSS Website.
[26]Kamal Sarabandi, Nader Behdad, “ A Frequency Selective Surface With Miniaturized Elements, ” IEEE Trans. Antennas and Propag. vol.

55, No.6, pp. 1239 – 1245, May 2007