

無線通訊應用之帶通頻蔽體與內部天線效能最佳化之探討

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摘要

本篇論文將探討帶通屏蔽體(bandpass shielding enclosure, BPSE)與其內部天線之間的最佳化設計。經由研究顯示，效能的最佳化取決於內部的天線與帶通屏蔽體相鄰之周期性元件的相對位置與內部天線的型式。對於此最佳化設計，內部的天線宜採用高介電係數的介質共振天線，這不僅是為了天線尺寸所考量，且是為了能夠將內部的天線更靠近BPSE的金屬側邊。除此之外，也將探討出內部天線與BPSE周期性元件的適當相對位置。根據這些探討顯示，此天線能夠放置於非常靠近BPSE的角落，而這個位置是最符合用來擺放天線的位置。

關鍵詞：屏蔽、頻率選擇面、無線通訊系統

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參考文獻

- [1]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.
- [2]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.
- [3]S. G. Mao, C. M. Chen, and D. C. Chang, “ Modeling of Slow-Wave EBG Structure for Printed-Bowtie Antenna Array ” IEEE Antenna and Wireless Propag. Lett., vol. 1, pp. 124-127, 2002 [4]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.
- [5]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.
- [6]Robert E. Collin, “ Foundations for Microwave Engineering 2nd , ” McGraw-Hill, 1992 [7]B. A. Munk, Frequency Selective Surface Theory and Design, Wiley, 2000.
- [8]C. N. Chiu, C. H. Kuo, and M. S. Lin, “ Bandpass shielding enclosure design using multipole-slot arrays for modern portable digital devices, ” IEEE Trans. Electromagn. Compat., vol. 50, no. 4, pp. 895-904, Nov. 2008.
- [9]C.-N. Chiu and Y.-F. Kuo, “ Bandpass shielding enclosure design for modern handheld communication device with internal electric-dipole and magnetic-loop antennas, ” Microw. Opt. Tech. Lett., vol. 50, no. 8, pp. 2223-2226, Aug. 2008.
- [10]C. N. Chiu and Y. F. Kuo “ A bandpass shielding enclosure for modern hand held communication devices ”, IEICE Trans. Commun., vol. E90-B, pp.1562-1562 2007.
- [11]C. C. Chen "Transmission of microwave through perforated flat plates of finite thickness", IEEE Trans. Microwave. Theory Tech., vol. MTT-21, pp. 1-6, Jan. 1973 .
- [12]C. C. Chen, “ Transmission through a conducting screen perforated periodically with aperture, pp. es, ” IEEE Trans. Microwave Theory Tech., vol. MTT-18, pp. 627-632, Spet. 1970.
- [13]R. B. Kieburz and A. Ishimaru "Scattering by a periodically apertured conducting screen", IRE Trans. Antenna Propagat., vol. AP-9, pp. 506-514, Nov. 1961 .
- [14]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.
- [15]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.
- [16]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.
- [17]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.
- [18]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.
- [19]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.
- [20]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.
- [21]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.
- [22]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.
- [23]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.
- [24]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.
- [25]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.

- [26]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.
- [27]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.
- [28]Ansoft HFSS Website.
- [29]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.
- [30]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.
- [31]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.
- [32]A. Monorchio, G. Manara, U. Serra, G. Marola, and E. Pagana, " Design of Waveguide Filters by Using Genetically Optimized Frequency Selective Surfaces, " IEEE Microwave and Wireless Components Letters, Vol. 15, pp. 407-409, June 2005.
- [33]袁帝文, 高頻通訊電路設計, 高立圖書有限公司, 民國93年版.