Electromagnetic Analysis of Multilayered Chiral Slabs Embedded with Composite Materials

郭記華、許崇宜

E-mail: 9607726@mail.dyu.edu.tw

ABSTRACT

This thesis presents an efficient eigenfunction-based model for analyzing the plane-wave reflection and transmission properties of a multilayered chiral slab with an embedded fiber-reinforced plastic composite (FRPC). In this model, the fields in each layer of the chiral slab are related recursively to those in the adjacent layer through eigenfunction-based reflection and transmission matrices, while the fields on the two surfaces of the FRPC are related to each other by an eigenfunction-composed wave transmission matrix modified from the one available in the literature. The proposed analysis model has been validated by comparing our computed results with data appearing in the literature. Many sample structures have been analyzed, assuring the flexibility and robustness of the model.

Keywords : Chiral materials, fiber-reinforced plastic composites, eigenfunction.

Table of Contents

目錄 封面內頁 簽名頁 授權書. . . . . iii 中文摘要. . . . . iv 英文摘要. . . . . v 誌謝. . . . . vi 目錄. . . . . viii 圖目錄. . . . . ix 表目錄. . . . . xi 第一章 緒論. . . . . 1 1.1 研究目的與文獻回顧. . . . . 1 1.2研究方法. . . . . 2 1.3章節概要. . . . . 3 第二章 旋光性物質之介紹. . . . . 4 2.1旋光性物質的概述. . . . . 4 2.2光活化性. . . . . 5 2.3電磁活化性. . . . . 6 2.4結構關係式. . . . . 9 第三章 複材的材料的主要成分與型態. . . . . 10 3.1複材的簡介. . . . . 10 第四章 旋光性平板披覆多層複材之分析. . . . . 13 4.1多層旋光性平板之電磁分析. . . . . 13 4.2多層複合材料之電磁分析. . . . . 16 4.3多層旋光性平板與複合材料上邊界的電磁場. . . . 17 4.4圓極化反射係數與線性極化反射係數之轉換. . . . 19 第五章 結果與討論. . . . . 22 第六章 結論. . . . . 48 參考文獻. . . . . 49 附錄 A多層旋光性平板的反射係數. . . . . 53 附錄 B (4.25)式的推導. 55

REFERENCES

[1]I. V. Lindell, A. H. Sihvola, S. A. Tretyakov, and A. J. Viitanen, Electromagnetic Waves in Chiral and Bi-Isotropic Media. Boston-London: Artech House, 1994.

[2]A. Lakhtakia, V. K. Varadan, V. V. Varadan, Time-Harmonic Electromagnetic Fields in Chiral Media. New York: Springer-Verlag, 1994.

[3]D. L. Jaggard and N. Engheta,“ Chirosorb as an invisible medium, ” Electron. Lett., vol. 25, no. 3, pp. 173-174, Feb. 1989.

[4]I. A. Khan, S. C. Raghavendra, and A. B. Kulkarni,“ Polyester-based chiral materials for microwave absorption applications, ” International J. Electronics, vol. 90, pp. 159-166, Mar. 2003.

[5]D. L. Jaggard, N. Engheta, and J. C. Liu,“ Chiroshield: a Salisbury/Dallenbach shield alternative, ” Electron. Lett., vol. 26, no. 17, pp. 1332-1334, Aug. 1990.

[6]A. K. Bhattacharyya,“ Control of radar cross-section and cross polarization characteristics of an isotropic chiral sphere, ” Electron. Lett., vol. 26, no. 14, pp. 1066-1067, July 1990.

[7]I. V. Lindell and A. H. Sihvola,“ Plane-wave reflection from uniaxial chiral interface and its application to polarization transformation, ” IEEE Trans. Antennas Propagat., vol. 43, pp. 1397-1404, Dec. 1995.

[8]C. N. Chiu,“ Electromagnetic Twist-Polarizer Effect of an Advanced Composite slab coated with a Bi-Isotropi medium, ” International J. Elec. Eng., vol. 12, pp. 177-182., May 2005.

[9]A. Semichaevsky, A. Akyurtlu, D. Kern, D. H. Werner, and Bray. M. G,“ Novel BI-FDTD approach for the analysis of chiral cylinders and spheres, ” IEEE Trans. Antennas Propagat., vol.54, pp.925-932, Mar. 2006.

[10]C.-I G. Hsu and C.-N. Chiu, “ Oblique plane-wave scattering from a general bi-isotropic cylindrical shell with an interior advanced composite-material backing, ” IEEE Trans. Electromagn. Compat., vol. 48, pp. 614-620, Nov. 2006.
[11]M. S. Lin, C. M. Lin, R.B. Wu, and C. H. Chen, “ Transient propagation in anisotropic laminated composites, ” IEEE Trans. Electromagn. Compat., vol. 35, pp. 357-365, Aug. 1993.
[12]M. S. Lin and C. H. Chen, “ Plane-wave shielding characteristics of anisotropic laminated composites, ” IEEE Trans. Electromagn. Compat., vol. 35, pp. 21-27, Feb.1993.
[13]M. S. Lin, “ Propagation effects of laminate composite materials, ” Ph.D. Diss., Dept. of Elec. Eng., National Taiwan Univ., 1993.
[14]C. L. Holloway, M. S. Sarto, and M. Johansson, “ Analyzing carbon-fiber composite materials with equivalent-layer models, ” IEEE Trans. Electromagn. Compat., vol. 47, pp. 833-844, Nov. 2005.
[15]L. A. Pilato and M. J. Michno, Advanced Composite Materials. Berlin: Springer-Verlag, 1994.
[16]I.V Lindell, , A.H Sihvola and J Kurkijarvi, “ The Last Hertizan,and a Harbinger of Electromagnetic Chirality, ” IEEE Antennas Propagat. Magazine, vol.34, pp. 24-30, June. 1992.
[17]J. B. Tichener and J. R. Willis, “ The reflection of electromagnetic waves from stratified anisotropic media, ” IEEE Trans. Antennas Propagat., vol.39, pp. 35-39, Jan. 1991.
[18]洪渙淋， “ Electromagnetic Analysis of Chiral- and Composite-Material Cylinders ”， 大葉大學電信工程研究所，2004。