Research on Multiuser Detection for Space-Time Coded MC-CDMA Mobie Communication Systems

林國維、黃永發 ; 陳雍宗

E-mail: 9315076@mail.dyu.edu.tw

ABSTRACT

In this paper, we investigate the performance of multiuser detection in space-time coded multi-carrier code-division multiple-access (STC-MC-CDMA) mobile communication systems over frequency selective fading channels. The Alamouti’s space-time coding scheme that involves two transmit antennas is performed to investigate the transmit diversity for MC-CDMA systems. Using two transmit antennas and two receive antennas the scheme provides temporal diversity and spatial diversity. Simulation results show that the performance of minimum mean square error (MMSE) detectors is compared with orthogonality restoring combining (ORC), equal gain combining (EGC) and controlled equalization combining (CEC) detector is investigated. The performance of MMSE detector is much better than ORC, EGC, and CEC detectors with two antennas for both transmitter and receiver for STC-MC-CDMA systems. It is noted that a 10dB-gain can be achieved for the STC-MC-CDMA systems with two receive antennas comparing with the conventional single-transmit-antenna MC-CDMA systems.

Keywords : space time coding ; frequency selective fading channels ; MMSE ; temporal diversity ; spatial diversity

Table of Contents

REFERENCES

[1]T. S. Rappaport, Wireless Communications (Upper Saddle River, NJ:Prentice-Hall, 1996).

[2]B. Sklar, “Rayleigh Fading Channels in Mobile Digital Communication Systems. I. Characterization,” IEEE Communications Magazine, Volume: 35 Issue: 9, Sept. 1997, pp. 91-100.

[3]J. Leonard, JR. Cimini, YE (Geoffrey) LI, Orthogonal Frequency Division Multiplexing for Wirelesss Channels, AT&T LABS RESEARCH, 1998.

[4]R. L. Bogush, F. W. Guigliano, and D.L. Knepp, “Frequency Selective Scintillation Effects and Decision Feedback Equalization in High Data-Rata Satellite Links,” Proc. IEEE, vol. 71, no. 6 June 1983, pp. 754-767.

[5]W.C. Jakes, (Ed), Microwave Mobile Communications (New York: John Wiley & Sons, 1974).

[6]J. A. C. Bingham, “Multicarrier for Data Transmission: An Idea whose Time has Come,” IEEE Communications Magazine, May 1990, pp.

5-14.
[7]A. Brajal Chouly, and S. Jourdan,“ Orthogonal Multicarrier Techniques Applied to Direct Sequence Spread Spectrum CDMA Systems, ” Proc. of IEEE GLOBECOM ’93, Houston, USA, Nov. 1993, pp. 1723-1728.
[8]Eric Lawrey, The Suitability of OFDM as a Modulation Technique for Wireless Telecommunications, with a CDMA Comparison, James Cook University, 1997.
[9]李宗霖，“ DAB數位音訊廣播系統之COFDM技術簡介”，無線電界，11月，1999，頁37-58。
[10]F. Kuchen, D.L. Didascalou, and W. Wiesbeck,“ Terrestrial Network Planning for Digital Video Broadcasting to Mobile Receivers, ” Vechicular Technology Conference, 1998. VTC 98. 48th IEEE vol. 3, pp. 1889-1893.
[11]T. Pollet, M. Van Bladel and M. Moeneclaey,“ BER Sensitivity of OFDM Systems to Carrier Frequency offset and Wiener phase, ” IEEE Trans. Commun., vol. 43, no.2/3/4, Feb./Mar./ Apr. 1995, pp. 191-193.
[12]K. S. Gilhousen, I. M. Jacobs, R. Padovani, A. J. Viterbi, L. A. Weaver, and C. E. Wheatley,“ On the Capacity of a Cellular CDMA System, ” IEEE Trans. Veh. Technol., vol 40, May 1991, pp. 303-312.
[13]S. Verdu, Multiuser Detection, Cambridge University Press, 1998.
[14]R. Prasad and S. Hara,“ An Overview of Multi-carrier CDMA, ” Proc. of IEEE 4th Int. Symposium of Spread Spectrum Techniques and Applications, Maine, Sep. 22-25 1996, pp. 107-114.
[15]N. Yee, J.-P. Linnartz, and G. Fettweis,“ Multicarrier CDMA in Indoor Wireless Radio Networks, ” Proc. of IEEE PIMRC, Yokohama, Japan, September 1993, pp. 109-113.
[16]Z. Wang and G. B. Giannakis,“ Wireless Multicarrier Communications, ” IEEE Signal Processing Magazine, vol. 17, no. 3, May 2000, pp. 29-48.
[17]S. Hara and R. Prasad,“ Design and Performance of Multi-carrier CDMA System in Frequency-Selective Rayleigh Fading Channels, ” IEEE Trans. Veh. Technol., vol. 48, no. 5, Sep. 1999, pp. 1584-1595.
[18]J. G. Proakis, Digital Communication, New York: McGraw-Hill, 4rd ed., 2001.
[19]S. M. Alamouti,“ A Simple Transmit Diversity Techniques for Wireless Communications, ” IEEE Journal on Selected Areas in Communications, vol. 16, no. 8, October 1998, pp. 1451-1458.
[20]W. Sun and H. Li,“ A Subspace-based Channel Identification Algorithm for Forward Link in Space-Time Coded MC-CDMA Systems, ” in Proceedings of the 2002 IEEE Wireless Communications and Networking Conference (WCNC 2002), Orlando, FL, March 2002, pp. 445-448.
[21]W. Sun, H. Li and M. Amin,“ MMSE Detection for Space-Time Coded MC-CDMA, ” Proc. of IEEE ICC ’03, vol. 5, no. 5, 11-15 May 2003, pp. 3454-3456.
[22]S. L. Miller and B. J. Rainbolt,“ MMSE Detection of Multicarrier CDMA, ” IEEE Journal on Selected Areas in Communications, vol. 18, no. 11, November 2000, pp. 2356-2362.
[23]J. F. Helard, J. Y. Baudais, and J. Citene,“ Linear MMSE Detection Technique for MC-CDMA, ” Electronics Letters, vol. 36, no. 7, 2000, pp. 665-666.
[24]陳雍宗, 林國維, 黃永發,“ 具空時編碼多載波分碼多重存取行動通訊系統之最小均方誤差多用戶檢測, ” Proc. of Second Conference on Communication Application, KWIT, Taipei, ROC, 19 March 2004, pp. 44-47.