Ultra-Wideband (UWB) Communications

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UWB Radio Channels [1, 2, 3]

Noncoherent Receivers and Performance comparison [4, Sections II and III] and references therin; [5]

Ultra-Low Power UWB Concepts [6, 7]

The IEEE 802.15.4a Standard for Sensor Networks, Positioning, and WPAN [8, 9, 10]

Multiband OFDM for High-Rate UWB [11, 12]

Ranging with UWB [13, 14, 15]

Inter-Symbol Interference and Equalization for Noncoherent UWB [4, Section V.C] and references therin; [16]

Narrowband Interference Mitigation for Noncoherent UWB [4, Section V.B] and references therin; [17, 18]

Noncoherent Multicarrier Schemes for High-Rate Transmissions [19, 20, 21]

Energy Capture of Reduced-Complexity UWB Receivers [22]

UWB Spread Spectrum for Multiple Access [23, 24, 25]

Localization with UWB Radios [26] and references therein

Other references [27]; Feb. 2009 issue of the IEEE Proceedings on UWB (to appear)

References

[1] L. J. Greenstein, S. S. Ghassemzadeh, S.-C. Hong, and V. Tarokh, "Comparison study of UWB indoor channel models," *IEEE Trans. Wireless Commun.*, vol. 6, no. 1, pp. 128–135, Jan. 2007.

[2] A. F. Molisch, D. Cassioli, C.-C. Chong, S. Emami, A. Fort, B. Kannan, J. Karedal, J. Kunisch, H. G. Schantz, K. Siwiak, and M. Z. Win, "A comprehensive standardized model for ultrawideband propagation channels," *IEEE Trans. Antennas Propagat.*, vol. 54, no. 11, pp. 3151–3166, 2006.

[3] J. Kunisch and J. Pamp, "An ultra-wideband space-variant multipath indoor radio channel model," in *IEEE Conference on Ultra Wideband Systems and Technologies, UWBST*, Reston, VA, Nov. 2003.

[4] K. Witrisal, "A tutorial on noncoherent UWB systems," in *Design and Analysis of Noncoherent UWB Transceivers*, Sep. 2008, ch. 1, Habilitation Thesis, Graz University of Technology. [Online]. Available: http://www.spsc.tugraz.at/people/klaus/WitrisalTutorial08.pdf

[5] S. Dubouloz, B. Denis, S. de Rivaz, and L. Ouvry, "Performance analysis of LDR UWB non-coherent receivers in multipath environments," in *IEEE Intern. Conf. on Ultra-Wideband, ICU*, Sep. 2005.

[6] F. Troesch, C. Steiner, T. Zasowski, T. Burger, and A. Wittneben, "Hardware aware optimization of an ultra low power UWB communication system," in *IEEE Intern. Conf. on Ultra-Wideband, ICUWB*, Sep. 2007, pp. 174–179.

[7] L. Stoica, A. Rabbachin, H. Repo, T. Tiuraniemi, and I. Oppermann, "An ultrawideband system architecture for tag based wireless sensor networks," *IEEE Trans. Veh. Technol.*, vol. 54, no. 5, pp. 1632–1645, Sep. 2005.

[8] A. Molisch, P. Orlik, Z. Sahinoglu, and J. Zhang, "UWB-based sensor networks and the IEEE 802.15.4a standard - a tutorial," in *International Conference on Communications and Networking in China, CHINACOM*, Oct. 2006, pp. 1–6.

[9] IEEE, *Approved Draft Amendment to IEEE Standard for Information technology-Telecommunications and information exchange between systems-PART 15.4:Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low-Rate Wireless Personal Area Networks (LR-WPANs): Amendment to add alternate PHY (Amendment of IEEE Std 802.15.4)*, IEEE Std. P802.15.4a/D7, Januari 2007.

[10] Z. Sahinoglu and S. Gezici, "Ranging in the IEEE 802.15.4a standard," in *IEEE Wireless and Microwave Technology Conference, WAMICON*, Dec. 2006.

[11] A. Batra, J. Balakrishnan, G. Aiello, J. Foerster, and A. Dabak, "Design of a multiband ofdm system for realistic uwb channel environments," *IEEE Trans. Microwave Theory Tech.*, vol. 52, no. 9, pp. 2123–2138, Sept. 2004.

[12] W. D. Jones, "Ultrawide gap on ultrawideband," *IEEE Spectrum*, p. 22, Jan. 2004.

[13] I. Guvenc and Z. Sahinoglu, "Threshold-based TOA estimation for impulse radio UWB systems," in *IEEE Intern. Conf. on Ultra-Wideband, ICU*, Sep. 2005, pp. 420–425.

[14] I. Guvenc, Z. Sahinoglu, and P. Orlik, "TOA estimation for IR-UWB systems with different transceiver types," *IEEE Trans. Microwave Theory Tech.*, vol. 54, no. 4, pp. 1876–1886, Jun. 2006.

[15] J.-Y. Lee and R. A. Scholtz, "Ranging in a dense multipath environment using an UWB radio link," *IEEE J. Select. Areas Commun.*, vol. 20, no. 9, pp. 1677–1683, Dec. 2002.

[16] K. Witrisal, G. Leus, M. Pausini, and C. Krall, "Equivalent system model and equalization of frame-differential impulse radio UWB systems," *IEEE J. Select. Areas Commun.*, vol. 23, no. 9, pp. 1851–1862, Sep. 2005.

[17] C. Steiner and A. Wittneben, "On the interference robustness of ultra-wideband energy detection receivers," in *IEEE Intern. Conf. on Ultra-Wideband, ICUWB*, Singapore, Sep. 2007, pp. 721–726.

[18] Y. D. Alemseged and K. Witrisal, "Modeling and mitigation of narrowband interference for transmitted-reference UWB systems," *IEEE J. Select. Topics in Signal Proc.*, vol. 1, no. 3, Oct. 2007.

[19] S. Paquelet, L.-M. Aubert, and B. Uguen, "An impulse radio asynchronous transceiver for high data rates," in *Intern. Works. UWB Syst. Joint with Conf. UWB Syst. and Techn., UWBST & IWUWBS*, Kyoto, Japan, May 2004.

[20] M. Mroue, S. Haese, S. Paquelet, S. Mallegol, and G. El-Zein, "An implementation study of an analog CMOS detector for IR-UWB non-coherent receiver," in *IEEE International Workshop on Radio-Frequency Integration Technology, RFIT*, Dec. 2007, pp. 13–16.

[21] K. Witrisal, "Noncoherent autocorrelation detection of orthogonal multicarrier UWB signals," in *IEEE Intern. Conf. on Ultra-Wideband, ICUWB*, Hannover, Germany, Sep. 2008, invited paper.

[22] M. Z. Win and R. A. Scholtz, "Characterization of ultra-wide bandwidth wireless indoor channels: A communication-theoretic view," *IEEE J. Select. Areas Commun.*, vol. 20, no. 9, pp. 1613–1627, Dec. 2002.

[23] E. Fishler and H. Poor, "On the tradeoff between two types of processing gains," *IEEE Trans. Commun.*, vol. 53, no. 10, pp. 1744–1753, Oct. 2005.

[24] R. Qiu, H. Liu, and X. Shen, "Ultra-wideband for multiple access communications," *IEEE Commun. Mag.*, vol. 43, no. 2, pp. 80–87, Feb. 2005.

[25] V. Somayazulu, "Multiple access performance in uwb systems using time hopping vs. direct sequence spreading," in *IEEE Wireless Communications and Networking Conference, WCNC*, Mar 2002, pp. 522–525.

[26] S. Gezici, Z. Tian, G. B. Giannakis, H. Kobayashi, A. Molisch, H. V. Poor, and Z. Sahinoglu, "Localization via ultra-wideband radios: a look at positioning aspects for future sensor networks," *IEEE Signal Processing Mag.*, vol. 22, no. 4, pp. 70–84, Jul. 2005.

[27] L. Yang and G. Giannakis, "Ultra-wideband communications: An idea whose time has come," *IEEE Signal Processing Mag.*, vol. 21, no. 6, pp. 26–54, Nov. 2004.