Joint DOA-Timing Estimation for Uplink DS/CDMA Communication System

洪輝鋒、武維疆

E-mail: 9223475@mail.dyu.edu.tw

ABSTRACT

This thesis proposes a blind algorithm to jointly estimate the direction-of-arrivals (DOAs) and timings (time-delays) in asynchronous DS/CDMA multiuser communication system. Making use of the space-time characteristics of an antenna-array DS/CDMA model, it is shown that the multiple signal classification (MUSIC) algorithm and the estimation of signal parameters via rotational invariance techniques (ESPRIT) that is widely used in array signal processing can be applied to extract the DOAs and timings information. Multiuser timing estimation is based on MUSIC like algorithm while ESPRIT is applied to estimate the DOA for each user. More specifically, the proposed algorithm is computationally efficient since it reduces the multiuser parameters ’ estimation problem to single-user ’s parameter estimation problems. It requires only two eigendecomposition (EVD) and several (depends on the number of subscribers) 1-dimensional searches. Furthermore, the proposed ESPRIT-MUSIC based DOA-timing estimator is near-far resistant, and no training sequences are required. Hence, it is suitable to be applied in the uplink of wireless DS/CDMA communication system.

Keywords : ESPRIT ; MUSIC ; DOA ; Timing estimator ; Near-far resistant

Table of Contents

REFERENCES

[1] V. K. Grag , K. F. Smolik , J. E. Wilkes , “ Applications of CDMA in Wireless/Personal Communication ”, Prentice Hall.

[2] J. H. Winters, “ Smart Antenna for wireless systems ” IEEE Personal Communications, Vol.5, pp. 23-27, Feb 1998.

[3] B. Suard, A. F. Naguib, G. Xu and A. J. Paulraj, “ Performance of CDMA mobile communication system using antenna arrays ” pp. IV 153-156, ICASSP 1993.

[4] J. H. Winters, J. Salz, and R. D. Gitlin, “ The impact of antenna diversity on the capacity of wireless communication system ” IEEE Trans. Commun., Vol. 42, No.2/3/4, pp. 1740-1751, Feb./Mar./Apr. 1994.

[5] A. J. Paulraj and C. B. Papadias, “ Space-Time processing for wireless communications ” IEEE SP Magazine, pp. 49-83, Nov. 1997 [6] S. Y. Miller and S. C. Schartz, “ Integrated spatial-temporal detectors for asynchronous Gaussian multiple-access channels ” IEEE Trans. Commun., Vol. 43, No.2/3/4, pp. 396-411, Feb./Mar./Apr. 1995.

[7] R. Schmidt, “ Multiple emitter location and signal parameter estimation ” IEEE Trans. Ant. Propagation, Vol. AP-34:276-290, March 1986.

[8] E. G. Strom, S. Parkvall, S. L. Miller and B. E. Ottersten, “ Propagation delay estimation in asynchronous direct-sequence code division multiple access system ” IEEE Trans. Commun., Vol. 44 No. 1, pp. 84-93, Jan. 1996.
[9] S. E. Bensley and B. Aazhang, “ Subspace-based channel estimation for code division multiple access communication system ” IEEE Trans. Commun., Vol. 44, No. 8, pp. 1009-1020, Aug. 1996.
[10]C. L. Chung, U. Mitra, “ Analysis of MUSIC-Based Delay Estimators for Direct-Sequence Code-Division Multiple-Access System ” , IEEE Trans.,Vol.47, No.1, pp. 133-138, Jan. 1999.
[11] M. C. Vanderveen, C. B. Papadias, and A. J. Paulraj, “ Joint angle and delay estimation for multipath signals arriving at an antenna array ” , IEEE Commun. Lett., vol.1, pp.12-14, Jan. 1997.
[12] R. Roy and T. Kailath, “ ESPRIT-Estimation of Signal Parameters via Rotational Invariance Techniques ” , IEEE Trans. ASSP, vol. 37, no. 7, pp.984-995, July 1989.
[13] A. J. Vanderveen, M. C. Vanderveen, and A.J. Paulraj, “ Joint angle and delay estimation using shift-invariance properties ” , IEEE Trans. Signal Processing, vol.46, pp.405-418, Feb. 1998.
[14] Y. Y. Wang, J. T. Chen, and W. H. Feng, “ TST-MUSIC for joint DOA-Delay estimation ” , IEEE Trans. Signal Processing, vol.49, no. 4, pp.721-729, Apr. 2001.
[15] R. L. Peterson, R. E. Ziemer, D. E. Borth, “ Introduction To Spread-Spectrum Communications ” , Prentice Hall.
[16] S. Hakin, “ Communication systems ” Wiley, 1994.
[17] S. Glisic, B Vucetic, “ Spread Spectrum CDMA Systems Wireless Communications ” Artech House,1997 [18] L. Harte, M. Hoenig, D. Mclauaghlin, R. K. Kta, “ CDMA IS-95 for Cellular and PCS—Technology, Economics and Services ” ,McGraw-Hill,1999 [19] L. Hui, “ Signal Processing Applications in CDMA Communications ” , Artech House, 2000.
[20] J. C. Liberti, Jr., T. S. Rappaport, “ Smart Antenna for Wireless Communications:IS-95 and Third Generation CDMA Applications ” , Prentice Hall PTR [21] A. Flieller, P. Larzabal, H. Clergeot, “ Applications of High Resolution Array Processing Techniques for Mobile Communication System ” , Prof. Intel. Vehic. '94 Sym. pp. 606-611,October 1994.
[22] N. Odachi, H. Shoki, and Y. Suzuki, “ High-speed DOA Estimation using Beamspace MUSIC ” , VTC 2000-spring Tokyo, Vol.2, pp.1050-1054, May. 2000.
[23] A. Margarita, S.J. Flores, L. Rubio, V. Almenar and J.L. Corral, “ Application of MUSIC for Spatial Reference Beamforming for SDMA in a smart Antenna for GSM and DECT ” , VTC 2001-spring, Vol.1, pp.6-9, May. 2001.
[24] Y. H. Choi “ Alternating minimization approach to generalized MUSIC and its performance ” IEE Proc.-Radar Sonar Navig, Vol. 149, No.2, April. 2002.
[25] R. Roy, A. Paulraj, and T. Kailath, “ A subspace Rotation Approach to Estimation of Parameters of Cisoids in Noise ” , IEEE Trans. Signal Processing, Vol.34, pp.1340-1342, Oct. 1986.
[26] S. Haykin, “ Advances in Spectrum Analysis and Array Processing ” , Prentice Hall PTR, 1995.
[27] J. M. Mendle, Lessons in Estimation Theory for Signal Processing, Communications, and Control, Lesson 11, Englewood Cliffs, NJ: Prentice Hall, 1995.
[28] I. Ziskind and M. Wax, “ Maximum Likelihood Localization of Multiple Sources by Alternating Projection ” , IEEE Trans. on Acoustics, Speech, and Signal Processing, Vol.36, No.10, pp. 1553-1560, Oct. 1988.
[29] E. G. Strom, S. Parkvall, S. L. Miller, B. E. Ottersten, “ Propagation Delay Estimation of DS-CDMA Signals in a Fading Environment ” , IEEE Globecom, pp.85-89, Dec. 1994.
[30] Z. Ruifeng, T. Zhenhui, “ ESPRIT-Based Delay Estimators for DS-CDMA Systems ” IEEE, ICC., Vol.3, pp.1472-1476, June. 2000.