針對陣列天線之波束產生方式之研究

王元鈞、武維疆

E-mail: 9315099@mail.dyu.edu.tw

摘 要

當越來越多的用戶利用無線的方式通訊以及傳輸大量的資料，在今日的蜂巢式網路中，下載量會越來越大，因此，一個關於網路管理的指標—系統容量(capacity)，就越顯其重要性。在本次的研究分析一些發生在典型的CDMA蜂巢式網路中不利於系統容量的因子,它們包括了： (1).不均衡的通信量 (2).換手負擔(Handoff) (3).領航干擾(Pilot interference) 不幸的是，在傳統扇形結構的蜂巢式網路中，是無法解決以上的問題的。有鑑於此本論文針對陣列天線系統的波束產生演算法提供一個系統化的研究。第一種演算法在考慮最接近理想波束型態也就是考慮滿足最小平方誤差(MMSE)以及一些特殊的限制條件式的情況下天線的權值(weights)被推導出來,本文並且條列出第一種演算法的缺點,為了有效的避免這些缺點本文發展了以離散傅立葉(DFT)技術為基礎的Spatial Sampling Method以及以數位FIR濾波器設計技術為基礎的Windowing Method。由模擬結果可推證這三種方法每一個波束的方向、形狀、增益大小都能夠被動態地最佳化以便適應時變的分怖需求。我們證明了對每一個波束作合成(shaping)、調轉(steering)以及增益控制(gain-control)能夠有效地解決之前所提到的三個大問題。

關鍵詞 : 系統容量, 不均衡的通信量, 換手負擔, 領航干擾, 最小平方誤差, 離散傅立葉技術, FIR濾波器。

目錄

參考文獻

[1]W.C. Wu, "Application of Smart Antenna Technology to Enhance CDMA System Capacity", -Proposal of NSC project NSC 91-2213-E-212-021.

[2]Joseph C. Liberti, JR and Theodore S. Rappaport. "Smart antennas for wireless commu -nications: IS-95 and Third Generation CDMA Applications," Chap 3. Prentice Hall PT -R, 1999.

[3]Chryssomallis, M., " Smart antennas", Antennas and Propagation Magazine, IEEE , Vo -l 42, pp 129-136, 3 , June 2000.

[4]R. J. Noll and S. H. Macomber."Analysis of Grating surface Emitting Laser" IEEE jou -rnal of quantum electronics. Vol. 26. NO. 3. march 1990.

[5]C. Y. Rew, S. B. Park and J. B. Ra."Elimination of all grating lobes in ultrasonic -synthetic focusing using a linear array" IEEE ELECTRONICS LETTERS 16th vol.29 No. - 19 September 1993.

[6]J. Warner." Array symmetry, beam patterns, and grating lobes" Electronically Scanne -d Antennas, IEE Colloquium on Pages:2/1 - 2/3 , 21 Jan 1988.
[7]Siachalou, E.; Vafiadis, E.; Goudos, S.S.; Samaras, T.; Koukourlis, C.S.; Panas, S., -" On the design of switched-beam wideband base stations",IEEE Transaction on Antenn -as and Propagation Magazine, Vol. 46, pp. 158-167, 1 , Feb. 2004.
[8]Bialkowski, M.E.; Karmakar, N.C.," A beamforming network for a compact circular swi -tched-beam array antenna" Microwave Conference, 1999 Asia Pacific, Vol. 3, pp. 869- -872, 30 Nov.-3 Dec. 1999.
[9]Lewis, R.A.H.; Perrott, R.A.," Multiple beam stripline network for phased array appl -ications", IEE Colloquium on Multiple Beam Antennas and Beamformers, pp. 4/1 - 4/5, - 21 Nov 1989.
[10]DuFort, E.C.," Optimum networks for simultaneous multiple beam antennas", IEEE Tran -sactions on Antennas and Propagation, Vol. 40, pp. 1-7, 1 , Jan. 1992.
[11]Zoltowski, M. "High resolution sensor array signal processing in the beamspace doma -in: novel techniques based on the poor resolution of Fourier beamforming" Spectrum - Estimation and Modeling., Fourth Annual ASSP Workshop on , 3-5, pp 350 - 355, Aug -. 1988 [12]Po-Rong Chang; Wen-Hao Yang; Kuan-Kin Chan.," A neural network approach to MVDR bea -mforming problem", IEEE Transactions on , Vol 40 , pp 313-322, 3 , March 1992.
[13]McWhirter, J.G.; Shepherd, T.J.," Systolic array processor for MVDR beamforming", I -EE Proceedings F , Vol 136, pp 75-80, 2 , April 1989.
[14]Haykin, S. (2002) "Adaptive Filter Theory.", pp 94-107. Prentice Hall. Upper saddle - River, New Jersey.
[15]Applebaum, S.; Chapman, D.," Adaptive arrays with main beam constraints", IEEE Tran -sactions on Antennas and Propagation, vol 24, pp 650-662, 5 , Sep 1976.
[16]B. P. Ng.,"Designing array patterns with optimal inter-element spacings and optimal - weights using a computer-aided approach,",Int. J. Electron., Vol. 73, no. 3, pp 6 -53-664, 1992.
[17]C.Y. Tseng, and L.J. Griffiths, "A simple algorithm to achieve desired patterns for - arbitrary arrays" IEEE Transations on Signal and Processing, vol.40, no. 11, pp. -2737-2746, Nov. 1992.
[18]Goto, N.," A synthesis of array antennas for high directivity and low sidelobes", I -EEE Transactions on Antennas and Propagation, Vol. 20, pp. 427-431, 4 , Jul 1972.
[19]Suzuki, Y.; Chiba, T.," An algorithm for pattern synthesis improvement", IEEE Trans -actions on Antennas and Propagation, Vol. 34, pp. 825-829, 6 , Jun 1986.
[20]Olen, C.A.; Compton, R.T., Jr.," A numerical pattern synthesis algorithm for array -s", IEEE Transactions on Antennas and Propagation, Vol. 38, pp. 1666-1676, 10 , Oc -t. 1990.
[21]Vanpoucke, F.; Moonen, M., "Systolic robust adaptive beamforming with an adjustable - constraint", IEEE Transactions on Aerospace and Electronic Systems , Vol 31, pp 6 -58-669, 2 , April 1995 [22]Elkamchouchi, H.M.; Adam, M.A.R.M.," A new constrained fast null steering algorithm" -, Antennas and Propagation Society International Symposium, IEEE , Vol 2 , 16-21, -pp 926-929, July [23]Lonnie C. Ludeman, "Fundamentals of Digtal Signal Processing", pp 263-264, Wiley, N -ew Mexico State University.,1986.
[24]Chen, X.P.; Yu, S.L.," FIR filter design: frequency-sampling method based on evolut -ionary programming", Proceedings of the 2000 Congress on Evolutionary Computation, - Vol. 1, pp. 575-579, 16-19 July 2000 [25]Allen V. Oppenheim and Ronald W. Schafer with John R. Buck, "Discrete-Time Signal P -rocessing", Chap 7, Prentice Hall, Upper saddle River, 1999.
[26]Smith, M.J.T., " A novel FIR filter design method based on windowing", IEEE Interna -tional Symposium on , Vol 1, pp 347-350, 8-11 May 1989.
[27]Van de Vegte Joice, "Fundamentals of Digital Signal Processing", pp 315-373. Prenti -ce Hall. Upper saddle River, New Jersey, 2002.
[28]Rosloniec, S.," A new approach to designing the transmission line band stop filters - for antenna arrays", 13th International Conference on Microwaves, Radar and Wirel -ess Communications, Vol. 1, pp. 69-73, 22-24 May 2000.
[29]Emmanuel C. Ifeachor;Barrie W.Jervis,"Digital Signal Processing A Practical Approac -h", pp.303-336, Addison-Wesley, 1993.
[30]Yuan-Pei Lin; Vaidyanathan, P.P.," A Kaiser window approach for the design of proto -type filters of cosine modulated filterbanks", IEEE Signal Processing Letters, Vol -. 5, pp. 132-134, 6 , June 1998