應用自組織映射圖於影像壓縮

邱俊德、劉仁俊

E-mail: 8809528@mail.dyu.edu.tw

摘 要

影像壓縮於影像儲存以及影像傳輸系統等應用方面，是一個實質而基本的要素。而在影像壓縮的領域中，向量量化是最常被使用的方法之一，藉由有效率的編碼簿來提高壓縮比。因此自組織特徵映射神經網路能針對向量量化產生出高效率的編碼簿。本論文提出以自組織映射神經網路為中心的壓縮方式，對靜態影像進行影像資料的壓縮，不僅保有向量量化的分類能力，也擁有網路拓樸的特性能產生依次序排列且維度大幅降低的編碼簿，使在影像壓縮上更有效率。此外，也選擇離散餘弦轉換做為自組織特徵映射神經網路的前處理程序，藉以分類出影像高低頻的資訊。再以分頻編碼的方法，針對直流係數和交流係數分開處理，減低輸入至SOM類神經網路的向量維度和類神經網路學習訓練與搜尋空間的複雜度。 這樣的壓縮方式下，我們的實驗結果顯示出利用離散餘弦轉換後再分頻處理的效能，在PSNR編碼增益有33?36dB的表現；而且，決定系統壓縮比的編碼簿大小也僅需6?8 bits就能有一般向量量化方法於7?9 bits的效果。

關鍵詞 : 離散餘弦轉換 ; 向量量化 ; 自組織映射 ; 編碼簿

目錄

參考文獻

[1] A. K. Jain, Fundamental of Digital Image Processing, Prestice-Hall, Englewood Cliffs, NJ, 1989.

[2] W. K. Pratt, Digital Image Processing, Wiley-Interscience, New York, 1978.

[3] Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Addison-Wesley Publishing Company, 1992.

[4] N. S. Jayant and P. Noll, Digital Coding of Waveforms Principles And Applications to Speech And Video, Englewood Cliffs, NJ, Prentice-Hall,

1984.
[5] J. Freeman and D. Skapura, Neural Networks, Algorithms, Applications, and Programming Techniques, Addison Wesley, 1993.
[6] R. M. Gray, "Vector Quantization," IEEE Acoust., Speech, Signal Processing Magazine., pp. 9-31, Apr. 1984.
[7] N. Ahamed, E. Oja, O. and K. R. Rao, "Discrete Cosine Transform," IEEE Trans. Comput., vol. C-23, pp. 90-93, Jan. 1974.
[8] K. R Rao, P. Yip, Discrete Cosine Transform - Algorithms, Advantages, Applications, Academic Press, 1990.
[9] B. Porat, A Course in Digital Signal Processing, John Wiley & Sons, 1997.
[10] R. C. Reininger and J. D. Gibson, "Distributions of The Two-Dimensional DCT Coefficients of Images," IEEE Trans. on Communication, vol. COM-31, pp. 835-839, June 1983.
[11] A. Palau and G. Mirchandani, "Image Coding with Discrete Cosine Transforms Using Efficient Energy-Based Adaptive Zonal Filtering," Acoustics, Speech, and Signal Processing, ICASSP-94., IEEE International Conference on Volume: v , vol.5 pp. V/337 -V/340, 1994 [12] G. K. Wallace, "The JPEG Still Picture Compression Standard," IEEE Trans. on Consumer Electronics, vol. 38, no. 1, Feb. 1992.
[13] N. M. Nasrabadi and R. A. King, "Image Coding Using Vector Quantization: a Review," IEEE Trans. on Communication, vol. 36, no. 8, pp. 957-971, Aug. 1988.
[14] A. Gersho and R. M. Gray, Vector Quantization and Signal Compression, London:Kluwer, 1992.
[15] A. Buzo, A. H. Gray, and J. D. Karkel, "Speech Coding Based upon Vector Quantization," IEEE Trans. Acoust. Speech, Signal Processing, vol. ASSP-28, pp. 562-574, October 1980.
[16] A. Gersho, "On the Structure of Vector Quantizers," IEEE Trans. on Inform. Theory, vol. 28, no. 2, pp. 157-162, Mar. 1982.
[17] Y. Linde, A. Buzo and R. M. Gray, "An Algorithm for Vector Quantizer Design," IEEE Trans. on Communication, vol. COM-28, no. 1, pp. 84-95, Jan. 1980.
[18] Kwok-Tung Loand Wai-Kuen Cham, "New Classified Vector Quantization of Images," Computer, Communication, Control and Power Engineering. Proceedings. TENCON ''93.,IEEE Region 10 Conference on, vol. 3, pp. 373-376, 1993.
[19] D.-S. Kim, and S.-U. Lee, "Image Vector Quantizer Based on a Classification in the DCT Domain," IEEE, Trans. on Communication, vol. 39, no. 4, Apr 1991.
[20] Yong Ho Shin and Cheng-Chang Lu, "Image Compression Using Vector Quantization and Artificial Neural Networks," Systems, Man, and Cybernetics, 1991. Decision Aiding for Complex Systems, Conference Proceedings., IEEE International Conference on , vol. 3, pp. 1487-1491, 1991.
[21] Yong Ho Shin and Cheng-Chang Lu, "A Neural Network Based Image Compression System," IEEE Trans. on Consumer Electronics, vol. 38, no. 1, Feb. 1992.
[22] Nasser M. Nasrabadi, Chang Y. Choo and Yushu Feng, "Dynamic Finite-State Vector Quantization of Digital Images," IEEE Trans. on Communication, vol. 42, no. 5, May 1994.
[23] L. Torres and J. Huguet, "An Improvement on Codebook Search for Vector Quantization," IEEE Trans. on Communication, vol. 42, no. 2/3/4, Feb. 1994.
[24] F. G. B. De Natale, S. Fioravanti and D. D. Giusto, "DCRVQ:A New Strategy for Efficient Entropy Coding of Vector-Quantized Images," IEEE Trans. on Communication, vol. 44, no. 6, May 1996.
[25] D. E. Rumelhart, G. E. Hinton and R. J. Williams, "Learning Internal Representation by Error Propagation," in D. E. Rumelhart and J. L. McClelland, Parallel Distributed Processing, vol. I, Cambridge, Massachusetts: The MIT Press, 1986.
[26] R. P. Lippmann, "An Introduction to Computing with Neual Nets," IEEE ASSP Magazine, pp. 4-22, Apr. 1987.
[27] L. Zhang, B. Zhang and G. Chen, "Generating and Coding of Fractal Graphs by Neural Network and Mathematical Morphology Methods," IEEE Trans. on Neural Networks, vol. 7, no. 2, pp. 400-407, March 1996.
[28] C.-C. Lee and J. P. de Gyvez, "Color Image Processing in a Cellular Neural-Network Environment," IEEE Trans. on Neural Networks, vol. 7, no. 5, pp. 1086-1098, Sep. 1996.
[29] T. Kohonen, "The Self-Organizing Map," Proceedings of the IEEE, vol. 78, no. 9, pp. 1464-1480, Sep. 1990.
[30] T. Kohonen, Self-Organizing Maps, Springer, Berlin, Heidelberg, 1995.
[31] R. O. Duda and P. E. Hart, Pattern Classification and Scene Analysis, N.Y.:Wiley, 1973.
[32] C. W. Therrien, Decision Estimation and Classification. An Introduction to Pattern Recognition and Related Topics, John Wiley and Sons, Inc, 1989.
[33] E.B. Kosmatopoulos, M.M. Polycarpou, M.A. Christodoulou and P.A. Ioannou, "High-Order Neural Network Structures for Identification of Dynamical Systems," IEEE Trans. on Neural Networks, vol. 6, no. 2, pp. 422-431, March 1995.
[34] J. A. Corral, M. Guerrero and P. J. Zufiria, "Image Compression via Optimal Vector Quantization: a comparison Between SOM, LBG and K-means Algorithms," Neural Networks, 1994. IEEE World Congress on Computational Intelligence., IEEE International Conference on, vol. 6, pp. 4113-4118, 1994.
[35] J. Kangas and T. Kohonen, "Developments and Applications of the Self-Organizing Map and Related Algorithms," Mathematics and Computers in Simulation, 41(5-6):3-12, July 1996.

[36] J. Kangas, "Sample Weighting When Training Self-Organizing Maps for Image Compression," Neural Networks for Signal Processing V, Proceedings of the 1995 IEEE Workshop, pp. 343-350, 1995.
[37] O. T.-C. Chen, B. J. Sheu, and W.-C. Fang, "Image Compression Using Self-Organization Networks," IEEE Trans. Circuits Syst. Video Technol., vol. 4, pp. 480-489, Oct. 1994.
[38] E. A. Riskin, L. E. Atlas, and S. R. Lay, "Ordered Neural Maps and Their Applications to Data Compression," in Neural Network for Signal Processing, IEEE Wkshp., pp. 543-551. 1991.
[39] S. Carrato, G. L. Sicuranza, and L. Manzo, "Application of Ordered Codebooks to Image Coding," in Neural Network for Signal Processing, IEEE Wkshp., pp. 291-300. 1993.
[40] G. Burel and J.-Y. Catros, "Image Compression Using Topological Maps and MLP," in Proc. ICNN''93, Int. Conf. On Neural Networks, vol. 2, pp. 727-731, IEEE Service Center, Piscataway, NJ, 1993.