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Finding a small number of regions in an image using low-level features. (English)

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Summary: Many computer vision applications, such as object recognition, active vision, and content-based image retrieval (CBIR) could be made both more efficient and effective if the objects of most interest could be segmented easily from the background. In this paper, we discuss how to compute and process low-level features in order to obtain "reasonable" regions for the putative objects. This process is a precursor to the detection of salient objects in an image, a subject discussed in a companion report. Although considerable work has been done on image segmentation, there still does not exist an "off-the-shelf" solution applicable to all types of images. A major issue has been the lack of a good measure of quality of a particular segmentation. In this paper, three different measures are considered: the non-parametric measure (NP) proposed by Pauwels and Frederix, the modified Hubert index (MH), and a threshold-based measure with a manually selected threshold. From the experimental results, we have found that the simple threshold-based measure gave consistently better results than the other two more complex, statistically based measures. The particular image segmentation method we have employed in this study is also described in detail.

MSC:

68U99 Computing methodologies and applications

68T10 Pattern recognition, speech recognition

68T45 Machine vision and scene understanding

Keywords:

image segmentation; non-parametric clustering; cluster validity indices; threshold

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References:

- [1] A.H.F. Lau, M.D. Levine, Finding perceptually salient "objects" using low-level features, internal report, 2000.
- [2] Pauwels, E.J.; Frederix, G., Finding salient regions in images, *J. comput. vision image understand*, 75, 1/2, 73-85, (1999)
- [3] Jain, A.K.; Dubes, R.C., Algorithms for clustering data, (1988), Prentice-Hall, Inc Englewood Cliffs, NJ · [Zbl 0665.62061](#)
- [4] S. Ullman, High-level vision: object recognition and visual cognition. The MIT Press, Cambridge, MA, 1998, pp. 234-235 (Chapter 8).
- [5] D. Marr, Vision: a computational investigation into the Human presentation and processing of visual information W.H. Freeman and Company, New York, 1982, p. 270 (Chapter 4).
- [6] W.E.L Grimson, The combinatorics of object recognition in cluttered environments using constrained search, in: Proceedings of the International Conference on Computer Vision, 1988. · [Zbl 0717.68084](#)
- [7] Lades, M., Face recognition technology, (), 667-683
- [8] Christensen, H.; Bowyer, K.; Bunke, H., Active robot vision, (1993), World Scientific Press Singapore · [Zbl 0995.68530](#)
- [9] Ashley, J.; Barber, R.; Flickner, M.D.; Hafner, J.L.; Lee, D.; Niblack, W.; Petkovic, D., Automatic and semiautomatic methods for image annotation and retrieval in query by image content (qbic), *Spie*, 2420, 24-35, (1995)
- [10] H. Greenspan, S. Belongie, C. Carson, J. Malik, Recognition of images in large databases using color and texture, *CVPR'97*, 1997.
- [11] W. Osberger, A.J. Maeder, Automatic identification of perceptually important regions in an image, in: *ICPR'98*, Brisbane, Australia, August 1998, pp. 701-704.
- [12] Wertheimer, M., Experimentelle studien "uiber des sehen von bewegung, *Z. psychol.*, 61, 161-265, (1912)
- [13] Sarkar, S.; Boyer, K.L., Perceptual organization in computer vision: A review and a proposal for a classificatory structure, *IEEE trans. SMC*, 23, 2, 382-399, (1993)
- [14] Pal, N.R.; Pal, S.K., A review on image segmentation techniques, *Pattern recognition*, 26, 9, 1277-1294, (1993)

- [15] S. Belongie, J. Malik, Finding boundaries in natural images: a new method using point descriptors and area completion, in: Fifth European Conference on Computer Vision, Freiburg, Germany, June 1998.
- [16] Y. Deng, B.S. Manjunath, H. Shin, Color image segmentation, in: Proceedings of IEEE Conference on Computer Vision and Pattern Recognition, 1999.
- [17] J. Shi, J. Malik, Self inducing relational distance and its application to image segmentation. in: Fifth European Conference on Computer Vision, June 1998.
- [18] Lambert, P.; Carron, T., Symbolic fusion of luminance-hue-chroma features for region segmentation, *Pattern recognition*, 32, 1857-1872, (1999)
- [19] T. Leung, J. Malik, Detecting, localizing and grouping repeated scene elements from an image, in: Fourth European Conference on Computer Vision, Cambridge, England, April 1996.
- [20] J. Shi, J. Malik, Normalized cuts and image segmentation, in: Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, San Juan, Puerto Rico, June 1997.
- [21] D. Comaniciu, P. Meer, Robust analysis of feature space: color image segmentation, in: Proceedings of Computer Vision and Pattern Recognition, 1997.
- [22] Park, S.H.; Yun, I.D.; Lee, S.U., Color image segmentation based on 3-d clustering: morphological approach, *Pattern recognition*, 31, 8, 1061-1076, (1998)
- [23] Eriksen, C.W.; James, J.D.S.T., Visual attention within and around the field of focal attention: a zoom Lens model, *Perception and psychophysics*, 40, 4, 225-240, (1986)
- [24] Pham, D.L.; Prince, J.L., An adaptive fuzzy c -means algorithm for image segmentation in the presence of intensity inhomogeneities, *Pattern recognition lett.*, 20, 1, 57-68, (1999) · [Zbl 0920.68148](#)
- [25] W.Y. Ma, B.S. Manjunath, Edge flow: a frame work of boundary detection and image segmentation, Technical Report 97-02, University of California, Santa Barbara, CA, 1997.
- [26] Zhu, S.C.; Yuille, A., Region competition: unifying snakes, region growing, and Bayes/mdl for multiband image segmentation, *IEEE trans. pattern anal. Mach. intell.*, 19, 9, 884-900, (1996)
- [27] Ojale, T.; Pietikainen, M., Unsupervised texture segmentation using feature distributions, *Pattern recognition*, 32, 477-486, (1999)
- [28] C. Carson, S. Belongie, H. Greenspan, J. Malik, Blobworld: image segmentation using expectation-maximization and its application to image querying, in: Proceedings of the IEEE International Conference on Computer Vision, Piscataway, NJ, USA, 1998, pp. 675-682.
- [29] M. Stokes, M. Anderson, S. Chandrasekar, R. Motta, A standard default color space for the internet-srgb. <http://www.w3.org/Graphics/Color/sRGB> 1999.
- [30] Stalmeier, P.F.M.; de Weert, M.M., Large color differences and selective attention, *J. opt. soc. am. A*, 8, 1, 237-247, (1991)
- [31] Chang, K.I.; Bowyer, K.W., Sivagurunath munish, evaluation of texture segmentation algorithms, *IEEE comput. vision pattern recognition*, 1, 294-299, (1999)
- [32] Randen, T.; Husøy, J., Filtering for texture classification: a comparative study, *IEEE trans. pattern anal. Mach. intell.*, 21, 4, 291-310, (1999)
- [33] Liu, F.; Picard, R.W., Periodicity, directionality, and randomness: world features for image modeling and retrieval, *IEEE trans. pattern anal. Mach. intell.*, 18, 7, 722-733, (1996)
- [34] P.S. Williams, M.D. Alder, Segmentation of natural images using hierarchical and syntactic methods, in: Second International Workshop on Statistical Techniques in Pattern Recognition, August 1998.
- [35] Manjunath, B.S.; Ma, W.Y., Texture features for browsing and retrieval of image data, *IEEE trans. pattern anal. Mach. intell.*, 18, 8, 837-842, (1996)
- [36] Jain, A.K.; Farrokhnia, F., Unsupervised texture segmentation using Gabor filters, *Pattern recognition*, 24, 12, 1167-1186, (1991)
- [37] G.M. Smith, Image texture analysis using zero crossings information, Ph.D. Thesis, The University of Queensland, 1998.
- [38] Jain, A.; Healey, G., A multiscale representation including opponent color features for texture recognition, *IEEE trans. image process.*, 7, 1, 124-128, (1998)
- [39] J.R. Smith, Integrated spatial and feature image system: retrieval, analysis, and compression. Ph.D. Thesis, Columbia University, February 1997.
- [40] Rao, A.R.; Lohse, G.L., Identifying high level features of texture perception, *CVGIP: graph. models image process.*, 55, 3, 218-233, (1993)
- [41] Borsott, M.; Campadelli, P.; Schettini, R., Quantitative evaluation of color image segmentation results, *Pattern recognition lett.*, 19, 741-747, (1998) · [Zbl 0908.68204](#)
- [42] Zhang, Y.J., A survey of evaluation methods for image segmentation, *Pattern recognition*, 29, 8, 1335-1349, (1996)

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