

# A segmentation approach for mammographic images and its clinical value

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## Abstract

© 2017 IEEE. We developed the nested contour algorithm (NCA) - a segmentation method for X-ray mammography images and tested it on a set of 1532 images of 356 women with morphologically proven breast cancer of various characteristics located on different density background. As a result NCA correctly marked 48 of 52 (92.31 %) star-like lesions, 12 of 14 (85.71 %) architectural distortions, 51 of 58 (87.93 %) lesions with irregular shape and unclear margin, all 18 lobular and round lesions, 17 of 18 (94.4 %) partially visualized lesions, 13 of 18 (72.2 %) asymmetric areas and 7 of 16 (43.8 %) unclearly visible or invisible lesions. Overall sensitivity of NCA in our set was 90.73 % (323 of 356 cases). The mean rate of false-positive marks was 1.3 per image - for ACR A-B mammograms and 1.8 - for ACR C-D mammograms.

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## Keywords

Breast cancer, Computer-aided detection, Image analysis, Mammography, Segmentation

## References

- [1] J. Ferlay, I. Soerjomataram, M. Ervik, R. Dikshit, S. Eser, C. Mathers, M. Rebelo, D. M. Parkin, D. Forman, and F. Bray, GLOBOCAN 2012 v1.1, Cancer Incidence and Mortality Worldwide: IARC CancerBase, no. 11, [Internet]. Lyon, France: International Agency for Research on Cancer, 2014. Available from: <http://globocan.iarc.fr>, accessed on 16/01/2015.
- [2] United States Preventive Services Task Force. Screening for breast cancer: U.S. Preventive Services Task Force recommendation statement, *Annals of Internal Medicine*, vol. 151, pp. 716-726, 2009.
- [3] C. T. Brekelmans, C. Seynaeve, C. C. Bartels, et al., "Rotterdam Committee for Medical and Genetic Counseling. Effectiveness of breast cancer surveillance in BRCA1/2 gene mutation carriers and women with high familial risk," *Journal of Clinical Oncology*, vol. 19, pp. 924-930, 2001.
- [4] K. Kerlikowske, D. Grady, J. Barclay, S. E. Sickles, and V. Ernster, "Effect of age, breast density, and family history on the sensitivity of first screening mammography," *JAMA*, vol. 276, pp. 33-38, 1996.
- [5] C. L. Robertson, "A private breast imaging practice: medical audit of 25, 788 screening and 1, 077 diagnostic examinations," *Radiology*, vol. 187, pp. 75-79, 1993.
- [6] R. L. Bennett, S. J. Sellars, and S. M. Moss, "Interval cancers in the NHS breast cancer screening programme in England, Wales and Northern Ireland," *British Journal of Cancer*, vol. 104, no. 4, pp. 571-577, 2011.
- [7] T. M. Kolb, J. Lichy, and J. H. Newhouse, "Comparison of the performance of screening mammography, physical examination, and breast US and evaluation of factors that influence them: an analysis of 27, 825 patient evaluations," *Radiology*, vol. 225, pp. 165-175, 2002.
- [8] M. T. Mandelson, N. Oestreicher, P. L. Porter, D. White, C. A. Finder, S. H. Taplin, et al., "Breast density as a predictor of mammographic detection: comparison of interval- and screendetected cancers," *J. Natl. Cancer Inst.*, vol. 92, pp. 1081- 1087, 2000.

- [9] D. E. Henson, K. C. Chu, and P. H. Levine, "Histologic grade, stage, and survival in breast carcinoma: comparison of African American and Caucasian women, " *Cancer*, vol. 98, pp. 908- 917, 2003.
- [10] P. Wingo, "Population-based statistics for women with inflammatory breast cancer (United States), " *Cancer Causes and Control*, vol. 15, pp. 321-328, 2004.
- [11] A. Venkatesan, P. Chu, K. Kerlikowske, E. A. Sickles, and R. Smith-Bindman, "Positive Predictive Value of Specific Mammographic Findings according to Reader and Patient Variables, " *Radiology*, vol. 250, no. 3, pp. 648-657, March 2009.
- [12] P. C. Stomper, "Breast imaging. In: *Atlas of Breast Cancer*, Hayes DF (Ed), " Mosby, Philadelphia, p. 54, 2000.
- [13] C. Sohns, B. Angic, S. Sossalla, et al., "Computer-assisted diagnosis in full-field digital mammography - results in dependence of readers experiences, " *Breast J.*, vol. 16, pp. 490-497, 2010.
- [14] M. G. B. Calas, B. Gutfilen, and W. C. A. Pereira, "CAD and mammography: why use this tool?, " *Radiol. Bras.*, vol. 45, no. 1, pp. 25-29, 2012.
- [15] H. Freeman, "On the Encoding of Arbitrary Geometric Configurations, " *IRE Trans. Elec. Computer*, vol. EC-10, pp. 260-268, 1961.
- [16] H. Freeman, "Computer Processing of Line-Drawing Images, " *ACM Computing Surveys*, vol. 6, pp. 57-97, 1974.
- [17] Dhadma Balachandran, and R. Lavanya, "Mass characterization in mammograms using an optimal ensemble classifier, " 2016 IEEE Region 10 Conference (TENCON) - Proceedings of the International Conference, pp. 2567-2570, 2016.
- [18] Min Dong, Xiangyu Lu, Yide Ma, Yanan Guo, and Yurun Ma, Keju Wang, "An Efficient Approach for Automated Mass Segmentation and Classification in Mammograms, " *Journal of Digital Imaging*, vol. 28, is. 5, pp. 613-625, October 2015.
- [19] B. Surendiran, Y. Sundaraiah, and A. Vadivel, "Classifying Digital Mammogram Masses Using Univariate ANOVA Discriminant Analysis, " *Proceedings of the 2009 International Conference on Advances in Recent Technologies in Communication and Computing*, Kottayam, India, pp. 175- 177, October 2009.
- [20] J. Flusser, B. Zitova, and T. Suk, *Moments and Moment Invariants in Pattern Recognition*, New York: John Wiley & Sons, 2009.
- [21] M. K. Hu, "Visual Pattern Recognition by Moment Invariants, " *IRE Trans. Info. Theory*, vol. IT-8, pp. 179-187, 1962.
- [22] S. A. Ostanin, A. M. Shayduk, D. Yu. Kozlov, et al., "Entropy method for estimating the complexity of edge medical images, " *The News of Altai State University*, 1/2(77), pp. 177-180, 2013.
- [23] L. M. Foxcroft, E. B. Evans, H. K. Joshua, and C. Hirst, "Breast cancers invisible on mammography, " *ANZ Journal of Surgery*, vol. 70, no. 3, pp. 162-167, March 2000.
- [24] J. Q. Cao, R. A. Olson, and S. K. Tyldesley, "Comparison of recurrence and survival rates after breast-conserving therapy and mastectomy in young women with breast cancer, " *Current Oncology*, vol. 20, no. 6, pp. 593-601, 2013.