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COMPARISON OF CLASSIFIERS AND FEATURES IN THE IDENTIFICATION OF NODULES IN ULTRASOUND IMAGES OF THE THYROID

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Abstract. *In this work we investigate the use of image processing and pattern recognition techniques to identify nodules in ultrasound images of the thyroid. Clinical material comprised 50 ultrasonic images (384 x 288 x 8bit) from 25 patients with cytological confirmed thyroid nodules of grade I and III. Images were obtained by an experienced physician on an HDI-3000 ATL digital ultrasound system (Philips Ultrasound, Bothel, WA, USA) with a wide band (5 to 12 MHz) linear probe. Various types of median filters were used to remove noise from the images. The effect of the filters was quantified by calculating the percent noise reduction in the central part of the image. A set of 15 textural features, extracted from Regions of Interest (ROIs) of the best filtered image in each case was fed to a pattern recognition system for identification of the nodules. Regions of Interest (ROIs) were delineated in image areas corresponding to both the nodule and normal tissue of the thyroid. Textural features extracted from the gray-level histogram, the gray-level co-occurrence matrices and the gray-level run-length matrices of the images were calculated for each ROI. Four classifiers (Minimum Distance, k-Nearest Neighbor, Bayesian and Probabilistic Neural Network) were used to classify the ROIs, based on the exhaustive combination of all calculated features. Each classifier was evaluated using and external cross validation procedure. Results are presented for the effect of the filters and the performance of the classifiers is discussed. The proposed system led to improved quality for diagnostic purposes (>85% percentage noise reduction) in terms of both visual appearance of US images following despeckling and automated assessment of nodules' grade (85.7% accuracy using external cross validation).*

REFERENCES

[1] Alexander, E. K., Marqusee, E., Orcutt, J. et al., (2004), ""Thyroid nodule shape and prediction of malignancy"", Thyroid, 14, 953-8.
[2] Bartolazzi, A. and Gasbarri, A., (2000), "Thyroid disease classification", Lancet, 356, 2010-1.
[3] Gonzalez, Rafael C., Woods, Richard E. and Eddins, Steven L., (2003), *Digital Image Processing Using MATLAB*, Prentice Hall, New Jersey.
[4] Gonzalez, Rafael C. and Woods, Richard E., (2002), *Digital Image Processing*, Prentice Hall, New Jersey.
[5] Pratt, William K., (2007), *Digital Image Processing*, John Wiley & Sons, Inc., New York.
[6] Theodoridis, S. and Koutroubas, K., (1999), *Pattern Recognition*, Academic Press,
[7] Haralick, Rm., Shanmugam, K. and Dinstein, I., (1973), "Textural features for image classification", IEEE Transactions on Systems, Man and Cybernetics, 3, 610-621.
[8] Galloway, M. M., (1975), "Texture Analysis Using Gray-Level Run Lengths", Computer Graphics and Image Processing, 4, 172-179.
[9] Fellow, J., Duin, R. and Mao, J., (2000), "Statistical pattern recognition: A review", IEEE Transactions on pattern analysis and machine intelligence, 22, 4-37.

[10] Andrews, H. C. I, (1972), *Introduction to mathematical techniques in pattern recognition.*, John Wiley & Sons Inc.

[11] Specht, D.F., (1990), "Probabilistic Neural Networks", Neural Networks, 3, 109-118.

[12] Ambroise, C. and Mclachlan, G. J., (2002), "Selection bias in gene extraction on the basis of microarray gene-expression data", Proceedings of the National Academy of Sciences of the United States of America, 99, 6562-6566.

[13] Kohavi, Ron, (1995), "A study of cross-validation and bootstrap for accuracy estimation and model selection", *Proceedings of the Fourteenth International Joint Conference on Artificial Intelligence, IJCAI 95*, Montréal, Québec, Canada.