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Classification of microcalcifications in digital mammograms for the diagnosis of breast cancer

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Abstract

We are developing a computer program for automated classification of clustered microcalcifications associated with benign and malignant processes in mammograms. Accurate classification of microcalcifications into benign and malignant groups would help improve diagnosis sensitivity as well as reduce the number of unnecessary biopsies. In this study we investigate the effectiveness of several image features and the proposed neural network, the Trend-Oriented Radial Basis Function (TRBF). Our database is composed of 47 benign and 81 malignant region of interest (ROI) images, a total of 128 ROIs, which are selected from 50 micron by 50 micron digitized whole mammograms manually. Each 256 by 256 pixel ROI image contains clustered microcalcifications. First we extract 16 image features which are calculated from a binarized microcalcifications image and its two morphological dilation images. These features are based on 3 morphological criteria: (1) size and/or shape of the calcifications, (2) size or shape of the 'cluster,' and (3) number of microcalcifications. Secondly, we apply Karhunen-Loeve (K-L) expansion to 16 dimension feature space in order to reduce the dimension of the problem. Next we select two dimensional K-L features, which are outcomes of K-L expansion, through a calculation of the Euclidean distance measure. Finally we classify them based on two dimensional K-L features using the proposed neural network. The proposed TRBF neural network has three layers and a new learning algorithm. Its cost function for the learning process consists of a sum of squares error and a sum of inverse RBFs width. Through the learning process, the center and the width of each RBF and the weights between hidden and output layers are decided. The performances of the K-L features and the TRBF neural network are evaluated through the round-robin method in which one sample is tested after learning based on the rest of 127 samples. The two dimensional K-L features are more distinguishable than the raw two dimensional feature combination. The proposed TRBF network is able to define the trend of the distribution better than former RBF networks. According to the receiver operating characteristic (ROC) curve, this system indicates a better performance than one trained radiologist.

Citation

Osamu Tsujii (/profile/notfound?author=Osamu_Tsujii), Akira Hasegawa (/profile/notfound?author=Akira_Hasegawa), Chris Yuzheng Wu (/profile/notfound?author=Chris_Wu), Shih-Chung Benedict Lo (/profile/Shih-Chung.Lo-6594), Matthew T. Freedman M.D. (/profile/Matthew.Freedman-10074), and Seong Ki Mun (/profile/notfound?author=Seong_Mun) "Classification of microcalcifications in digital mammograms for the diagnosis of breast cancer", Proc. SPIE 2710, Medical Imaging 1996: Image Processing, (16 April 1996); https://doi.org/10.1117/12.237985 (https://doi.org/10.1117/12.237985)

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