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Comparison of the Effectiveness of Tree Algorithms in Classification of Spongy Tissue Texture

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Abstract : Analysis of the texture of medical images consists of determining the parameters and characteristics of the examined tissue. The main goal is to assign the analyzed area to one of two basic groups: as a healthy tissue or a tissue with pathological changes. The CT images of the thoracic lumbar spine from 15 healthy patients and 15 with confirmed osteoporosis were used for the analysis. As a result, 120 samples with dimensions of 50x50 pixels were obtained. The set of features has been obtained based on the histogram, gradient, run-length matrix, co-occurrence matrix, autoregressive model, and Haar wavelet. As a result of the image analysis, 290 descriptors of textural features were obtained. The dimension of the space of features was reduced by the use of three selection methods: Fisher coefficient (FC), mutual information (MI), minimization of the classification error probability and average correlation coefficients between the chosen features minimization of classification error probability (POE) and average correlation coefficients (ACC). Each of them returned ten features occupying the initial place in the ranking devised according to its own coefficient. As a result of the Fisher coefficient and mutual information selections, the same features arranged in a different order were obtained. In both rankings, the 50% percentile (Perc.50%) was found in the first place. The next selected features come from the co-occurrence matrix. The sets of features selected in the selection process were evaluated using six classification tree methods. These were: decision stump (DS), Hoeffding tree (HT), logistic model trees (LMT), random forest (RF), random tree (RT) and reduced error pruning tree (REPT). In order to assess the accuracy of classifiers, the following parameters were used: overall classification accuracy (ACC), true positive rate (TPR, classification sensitivity), true negative rate (TNR, classification specificity), positive predictive value (PPV) and negative predictive value (NPV). Taking into account the classification results, it should be stated that the best results were obtained for the Hoeffding tree and logistic model trees classifiers, using the set of features selected by the POE + ACC method. In the case of the Hoeffding tree classifier, the highest values of three parameters were obtained: ACC = 90%, TPR = 93.3% and PPV = 93.3%. Additionally, the values of the other two parameters, i.e., TNR = 86.7% and NPV = 86.6% were close to the maximum values obtained for the LMT classifier. In the case of logistic model trees classifier, the same ACC value was obtained ACC=90% and the highest values for TNR=88.3% and NPV= 88.3%. The values of the other two parameters remained at a level close to the highest TPR = 91.7% and PPV = 91.6%. The results obtained in the experiment show that the use of classification trees is an effective method of classification of texture features. This allows identifying the conditions of the spongy tissue for healthy cases and those with the porosis.

Keywords : classification, feature selection, texture analysis, tree algorithms
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