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Multidomain Feature Level Fusion for Classification of Lumbar Intervertebral Disc Using Spine MR Images

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Abstract

Grading of discs is essential for the assessment of degeneration progression which subsequently plays a vital role in decision making in the removal of a disc. In particular, Pfirrmann's five-scale (1–5) scoring system is widely used in MR image modality for grading the discs. In this study, we have presented a contemporary semiautomatic feature level fusion approach for the classification of inter-vertebral discs. The data of T2-weighted lumbar MR scans in sagittal plane were collected from 120 distinct subjects. In total, 1123 inter-vertebral disc images were obtained upon performing image augmentation. The experts have segregated the discs into five categories as per Pfirrmann's criteria. This segregation is utilized as ground truth label data for classification. Furthermore, two feature extraction techniques are exploited,

one from spatial domain and other follows deep learning process. A popular Local Binary Pattern (LBP) texture descriptor extracts features from spatial domain. In addition, a popular pre-trained Convolution Neural Network (CNN), which acts as a feature extractor, extracts deep features. The training procedure using SVM classifier yields a model built from post-fusion feature vectors. Furthermore, to estimate the model's performance, a 5-fold cross-validation is performed by computing principal component analysis as well as without dimensionality reduction. Experiment results obtained on our dataset indicate that after dimensionality reduction, SVM classifier with various kernel functions yields the accuracy up to 92%. A quantitative analysis of the classifier model is presented for parameters, namely – Accuracy, Area Under Curve (AUC), Specificity, Sensitivity, and F1 measure.

🔍 **KEYWORDS:**   Classification   Deep learning   Intervertebral disc degeneration   MRI images   SVM

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Additional information

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