diomic features (first-order histogram (FOH), gray-level co-occurrence matrix (GLCM), run-length matrix (RLM), and Gabor filters) were calculated from mp-MRI. Statistical analysis was performed using receiver-operating-characteristic curve analysis for feature filtering, linear discriminant analysis (LDA) for feature extraction, and leave-one-out cross-validation for evaluation of the method in the differentiation of benign and malignant lesions.

Results: An accuracy of 96.6% was achieved for discriminating benign and malignant prostate lesions from a subset of texture features derived from ADC and DCE maps (radiomics-based method) with sensitivity and specificity of 100% and 85.7%, respectively.

Conclusion: A radiomic quantification method based on T2-weighted images, ADC maps, and quantitative and semiquantitative DCE maps can discriminate benign from malignant prostate lesions with promising accuracy. This method is helpful to avoid unnecessary biopsies in patients and may provide information for CAD systems for the classifications of prostate lesions as an auto-detection technique.

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## An Efficient Framework for Accurate Arterial Input Selection in DSC-MRI of Glioma Brain Tumors

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### Abstract

Background: Arterial input function (AIF) accurate extraction is an important step in the quantification of cerebral perfusion hemodynamic parameters using dynamic susceptibility contrast magnetic resonance imaging (DSC-MRI).

Objectives: In this study, using machine learning methods, an optimal automatic algorithm was developed to accurately detect AIF in DSC-MRI of glioma brain tumors with a new pre-processing method.

Methods: DSC-MR images of 43 patients with glioma brain tumors were retrieved retrospectively. Our proposed method consisted of a pre-processing step to remove non-arterial curves such as tumorous, tissue, noisy, and partial-volume affected curves and a clustering step through agglomerative hierarchical (AH) clustering method to cluster the remaining curves. The performance of automatic AIF clustering was compared with the performance of manual AIF selection by an experienced radiologist, based on curve shape parameters, i.e., maximum peak (MP), full-width-at-half-maximum (FWHM), M (= MP / (TTP × FWHM)), and root mean square error (RMSE).

Results: The mean values of AIFs shape parameters were compared with those derived from manually selected AIFs by a two-tailed Paired t-test. The results showed statistically insignificant differences in MP, FWHM, and M parameters and lower RMSE, confirming the resemblance of the selected AIF with the gold standard. The intraclass correlation coefficient and percentage coefficient of variation showed a better agreement between manual AIF and our proposed AIF selection method rather than previously proposed methods.

Conclusion: The results of the current work suggest that by using efficient preprocessing steps, the accuracy of automatic AIF selection could be improved and this method appears to be promising for efficient and accurate clinical applications.

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## Automatic Myocardial Segmentation in Four-Chamber View Echocardiography Images

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### Abstract

Background: Most quantitative features in analyzing echocardiography images are elicited from the shape of different parts of the heart. One of the challenging tasks in this area is detecting the border between the left ventricle and its wall. Segmentation that is a process to extract the shape of objects in an image is a way to have a better observation of epicardial and endocardial parts of the left ventricle. Today, manual segmentation is performed by

expert radiologists in most cases, but there is some research in the field of automatic echocardiography image segmentation by the use of image processing and computer vision methods. Automatic segmentation is desired because it is more accurate and less operator-dependent. It leads to further quantifications such as the measurement of LV volumes, ejection fraction, myocardial volumes, and thickness. It can be also used for evaluating myocardial perfusion by analyzing myocardial intensity changes over time. Due to the intrinsic limitations of echo imaging such as low image intensity, contrast traditional segmentation methods such as edge-based and region-based image processing algorithms could not be accurate enough to overcome the segmentation complexities. Deep learning that is a branch in the computer vision area has been shown to outperform the image processing methods in many tasks.

Objectives: In this study, we used a novel image segmentation neural network (Unet) first introduced in 2014 to segment the myocardium in the left ventricle in 2D four-chamber view echocardiography images.

Methods: The dataset used in this research was the public echocardiography image dataset published in CAMUS (Cardiac Acquisitions for Multi-structure Ultrasound Segmentation) Challenge. The data contained four-chamber view end-systole and end-diastole frames from 450 patients. We used Unet architecture for the segmentation task. Unet is a kind of pyramidal network with encoding and decoding paths. The encoder or contraction path was used to capture the context and features in the image. The second path was the symmetric expanding or decoder path used to enable precise localization. The whole task of the network was to classify each pixel in the image to the background or epicardium classes.

Results: Five-fold cross-validation was used to report the accuracy metrics for the automatic segmentation task. The data were split into the train and test sets several times to evaluate the performance of the neural network. The test and train sets contained 90 and 360 images, respectively. Dice coefficient, Hausdorff distance, and mean absolute distance (MAD) were used to evaluate the accuracy of the method in echocardiography images. The calculated metrics included a dice coefficient of 90%, Hausdorff distance of 5.01, and MAD of 0.91 for the training set and dice coefficient of 83.14%, Hausdorff distance of 6.55, and MAD of 1.47 for the test set.

Conclusion: We used a novel neural network architecture for the myocardial segmentation task in 2D four-chamber view echocardiography images. We showed that deep learning algorithm automated segmentation can be an accurate alternative to extract the geometric features from images. Using this method can lead the operator to better analyze for LV and myocardial measurements. An approach for future work is expanding the automation to the measurement level from the segmented part.

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## Design of Multivariate Hotelling's $T^2$ Control Chart Based on Medical Images Processing

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### Abstract

Background: In the healthcare area of cancer patients, the diagnosis procedure of cancerous tumors and metastases is a valuable and popular research subject in magnetic resonance imaging. A highly accurate diagnosis procedure can be support for doctors in interpreting and diagnosing medical data.

Methods: To address this subject, we used a two-dimensional discrete wavelet transform. First, some features of the image texture were extracted by statistical and transform methods. Then, a genetic algorithm was used for data reduction and feature selection. Afterward, to diagnose bone marrow metastatic patients, we used two methods including a fuzzy c-Means clustering algorithm and a multivariate Hotelling's T2 control chart. In this paper, we employed ADC and T1-weighted images of the pelvic region. From 204 bone marrow samples, 76 features were extracted, six of which were selected and a 204 × 6 feature vector matrix was generated. Finally, the performance of the two proposed methods was compared in terms of diagnosis and accuracy measures.

Results: The results showed that the diagnosis (100%) and accuracy (100%) of the multivariate Ho-