Fully automated segmentation of prostate zones on DW-MR images using the U-Net model

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**Background**: Prostate cancer is the most detected cancer in men and the second most common cause of cancer-related mortality for men worldwide. Radiologists usually interpret prostate Magnetic Resonance Imaging (MRI) by first separating the prostate into the Peripheral Zone (PZ), Transition Zone (TZ), fibromuscular stroma, and urethra manually. However, this is a tedious, time-consuming, and reader opinion-dependent method. To help facilitate this process, various computer-assisted techniques, including the one using Convolutional Neural Networks (CNNs), have been suggested.

**Aim of the study**: Based on the U-Net model and the DWI images, this study proposes a technique for automated segmentation of prostate zones.

**Materials and Methods:** A public dataset called “The Cancer Imaging Archive (TCIA) was reviewed and screened for acquiring relevant data for this study. This retrospective study was used DW-MR images of 92 prostate cancer patients to train and test models. Here, we assigned 65 patients to the training set and 27 patients o the testing set according to a ratio of 7:3. The images were in two sizes, 384× 384 and 512× 512. Hence, to achieve a common image size and reduce the computation time with redundant pixels, image cropping was performed using a bounding box (being equal to160×160×160 mm3). Of note, to ensure comparable voxel intensities across images, image normalization was performed and the maximum intensity of each slice was normalized between 0 and 1. The performance of U-Net for segmentation of prostate zones is evaluated by Dice Similarity Coefficient (DSC) and Intersection Over Union (IoU) metrics using 10-fold cross-validation. Of note, model DSC and IoU were compared in both the training and test sets.

**Results:** The DSC score and IoU average for 10-fold in each class for segmentation volume were achieved 0.986 and 0.972 for the PZ, 0.994 and 0.976 for the TZ, 0.989 and 0.983 for the fibromuscular stroma, and 0. 991 and 0.916 for the urethra, respectively.

**Conclusions:**The results of this work show the feasibility of a U-Net-based approach to detect and segment prostate zones in DW-MR images accurately.

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***Keywords: deep learning, segmentation, prostate, zones, DW-MR, U-Net***