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A Comprehensive Non-invasive Framework for Diagnosing Prostate Cancer

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Abstract

Early detection of prostate cancer increases chances of patients' survival. Our automated non-invasive system for computer-aided diagnosis (CAD) of prostate cancer segments the prostate on diffusion-weighted magnetic resonance images (DW-MRI) acquired at different b-values, estimates its apparent diffusion coefficients (ADC), and classifies their descriptors – empirical cumulative distribution functions (CDF) – with a trained deep learning network. To segment the prostate, an evolving geometric (level-set-based) deformable model is guided by a speed function depending on intensity attributes extracted from the DW-MRI with nonnegative matrix factorization (NMF). For a more robust evolution, the attributes are fused with a probabilistic shape prior and estimated spatial dependencies between prostate voxels. To preserve continuity, the ADCs of the segmented prostate volume at different b-values are normalized and refined using a generalized Gauss-Markov random field image model. The CDFs of the refined ADCs at different *b*-values are considered global water diffusion features and used to distinguish between benign and malignant prostates. A deep learning network of stacked non-negativity-constrained auto-encoders (SNCAE) is

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