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PII: S0010-4825(16)30330-4
DOI: http://dx.doi.org/10.1016/j.compbiomed.2016.12.010
Reference: CBM2565

To appear in: *Computers in Biology and Medicine*

Received date: 21 September 2016
Revised date: 16 December 2016
Accepted date: 17 December 2016

Cite this article as: Islam Reda, Ahmed Shalaby, Mohammed Elmogy, Ahmed Abou Elfotouh, Fahmi Khalifa, Mohamed Abou El-Ghar, Ehsan Hosseini-Asl Georgy Gimel'farb, Naoufel Werghi and Ayman El-Baz, A Comprehensive Non-invasive Framework for Diagnosing Prostate Cancer, *Computers in Biology and Medicine,* http://dx.doi.org/10.1016/j.compbiomed.2016.12.010

A Comprehensive Non-invasive Framework for Diagnosing Prostate Cancer

Islam Reda[a,b], Ahmed Shalaby[b], Mohammed Elmogy[a,b], Ahmed Abou Elfotouh[a], Fahmi Khalifa[b], Mohamed Abou El-Ghar[c], Ehsan Hosseini-Asl[d], Georgy Gimel'farb[e], Naoufel Werghi[f], Ayman El-Baz[b,*]

[a] *Faculty of Computers and Information, Mansoura University, Mansoura 35516, Egypt*
[b] *Bioengineering Department, University of Louisville, Louisville, KY 40292, USA*
[c] *Radiology Department, Urology and Nephrology Center, University of Mansoura*
[d] *Electrical and Computer Engineering, University of Louisville, Louisville, KY 40292, USA*
[e] *Department of Computer Science, University of Auckland, Auckland, New Zealand*
[f] *Khalifa University of Science Technology and Research, Abu Dhabi, UAE*

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

*Corresponding author
Email address: aselba01@louisville.edu (Ayman El-Baz)