Ultrasound-based Characterization of Prostate Cancer for Transrectal Biopsy Guidance

Shekoofeh Azizi1, Pingkun Yan2, Amir Tahmasebi3, Peter Pinto4, Bradford Wood4, Jin Tae Kwaak5, Sheng Xu4, Baris Turkbey4, Peter Choyke4, Parvin Mousavi6, Purang Abolmaesumi1

1The University of British Columbia, Vancouver, BC, CA
2Rensselaer Polytechnic Institute, Troy, NY, United States
3Philips Research North America, Cambridge, MA, USA
4National Institutes of Health, Bethesda, MD, United States
5Sejong University, Seoul, South Korea
6Queen’s University, Kingston, ON, CA

Introduction: Prostate Cancer (PCa) detection under transrectal ultrasound (TRUS) guidance is blind to intraprostatic pathology, and can miss clinically significant disease. Multi-parametric MRI and its fusion with TRUS show promising results to target potential cancer lesions. However, this technique has a high false positive rate and can miss smaller foci of aggressive lesions. Ultrasound-based tissue typing has been investigated extensively to enable more accurate targeted biopsy. A key challenge for building computer-aided diagnosis models for prostate cancer is that histopathology data is sparse and not finely annotated [1].

Methods: Here, we propose a solution to alleviate this challenge as a part of Temporal Enhanced Ultrasound (TeUS)-based prostate cancer biopsy guidance method. Specifically, we embed a prior knowledge from histopathology in developing a machine learning solution for detection of PCa [1, 2]. We then use this information to accurately detect the grade and size of cancer.

Results: In an in vivo study with 155 patients, we analyze data from 250 suspicious cancer foci obtained during fusion biopsy. We achieve an average area under the curve of 0.84 for cancer grading and mean squared error of 0.12 in the estimation of tumor length in biopsy cores.

Conclusion: The results from the fusion biopsy study suggest that our machine learning solution can be used to accurately estimate the length and grade of cancer in biopsy cores.

References
