Detecting and Staging Prostate Cancer from MR Images

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Introduction:

Prostate cancer is the second leading cause of death for men in the US, with over 30,000 deaths and 200,000 new cases diagnosed each year [1]. Early prostate cancer detection is critical for improving the treatment effectiveness and the survival rate [2]. Patients are typically screened using biopsies guided by transrectal ultrasound imaging, however, this procedure is highly invasive and has low predictive rates ranging from 20% to 50% due to certain lesions showing no contrast in ultrasound images. The second most widely used imaging modality is magnetic resonance imaging (MRI). MRI offers excellent soft-tissue contrast, and a variety of pulse sequences can be designed for screening, including T2-weighted imaging, dynamic contrast enhanced imaging, and diffusion-weighted imaging [3]. However, radiologists have difficulty distinguishing lesions due to their miniscule size, and this is especially problematic for patients with early stage prostate cancer. It is incredibly time consuming for a radiologist to screen using MR images due to the huge dataset produced by each patient as well as the challenging task of reading each image, so it would be desirable to accelerate this process using computer-assisted detection.

Proposal:

We plan to develop an algorithm for computer-assisted detection for prostate cancer using MR images. We are particularly interested in datasets that contain image sets acquired with multiple pulse sequences. For example, SPIE provides multiple sets of data (T2-weighted, dynamic contrast enhanced, diffusion-weighted) from 346 patients through the *PROSTATEx Challenge* [4]. We aim to first investigate various methods for segmenting out the prostate. Afterwards, different features will be evaluated for their ability to indicate the presence of prostate cancer, and the most effective ones will be used as inputs to a machine learning model for predicting which patients are suspected to have prostate cancer. We are interested in further segmenting out regions of suspicion from high-risk patients using these features. Litjens et al. have already developed an initial processing pipeline for computer-assisted prostate cancer diagnosis [3], but they focused primarily on detecting for just the presence of cancer. We plan on going a step further by attempting to classify the cancer based on its severity. We are also interested in exploring different segmentation methods, features, and parameters derived from MR images acquired using different pulse sequences.

References:

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[4] https://wiki.cancerimagingarchive.net/display/Public/SPIE-AAPM+PROSTATEx+Challenge