Detection of Prostate Cancer on mpMRI Using Intensity, Gradient and Histogram Features

Carina Jensen[1], Anne Sofie Korsager[2], Lars Boesen[3], Lasse Riis Østergaard[2], Jesper Carl[1,4]

[1] Department of Medical Physics, Oncology Department, Aalborg University Hospital, Aalborg, Denmark
[2] Department of Health Science and Technology, Aalborg University, Aalborg, Denmark
[3]Department of Urology, Herlev University Hospital, Herlev, Denmark
[4] Department of Clinical Medicine, Aalborg University Hospital, Aalborg, Denmark

INTRODUCTION

Prostate cancer (PCa) is one of the most common cancers in men and second most common cause of cancer death [1]. Current diagnostic tool for PCa is systematic transrectal guided biopsies (TRUSP+B) [2]. TRUSP+B has a risk of missing tumors that are not visible on ultrasound scanning of the prostate and the chance of finding PCa from the first TRUSP+B is only 30-40%. [3,4]

Multiparametric MRI (mpMRI) guided biopsies can improve the PCa detection rate, help reduce the number of unnecessary biopsies and allow better assessment of the cancer aggressiveness. [5]

Screening mpMRI for PCa is time consuming, requires a high level of expertise and is affected by significant interobserver variation. [6], [7]

The aim of this study was to develop an algorithm for detection of PCa in the prostate gland based on 3T T2W, ADC and DWI mpMRI.

MATERIALS AND METHODS

Data

Data consisted of 3T mpMRI series (T2W, DWI and ADC) from 18 PCa confirmed patients with a total of 22 tumors.

Images were cropped, N3 corrected and made isotropic.
For one patient the DWI and ADC were manually co-registered to T2W.

Prostate and tumor contours were delineated on T2W images by an expert for all patients.

Feature Extraction and Classification

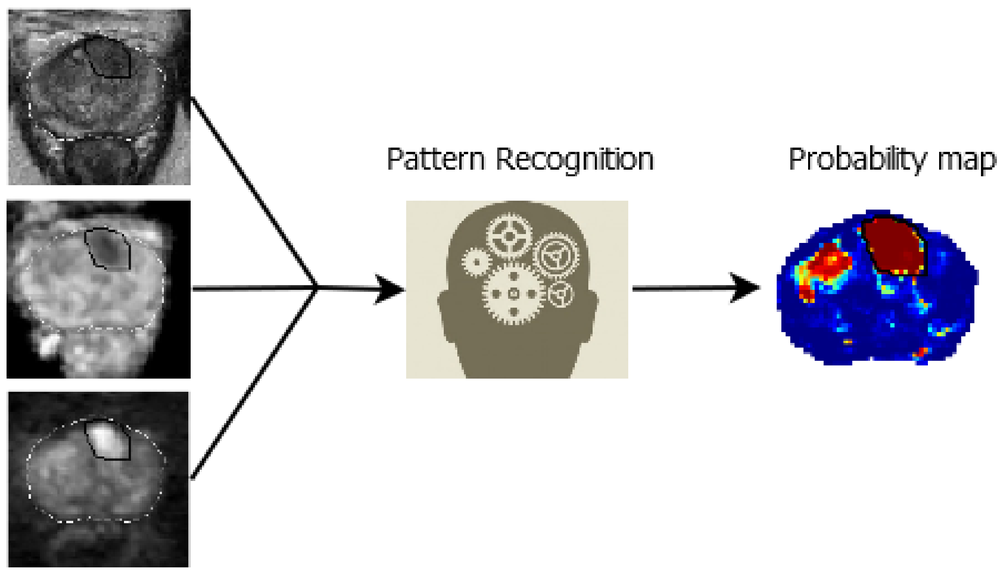
Intensity, gradient and histogram based features were used for classification.

Before classification, all features were normalized to zero mean and unit variance.

Classification was done using a naïve Bayes model using leave-one-out cross-validation.

Evaluation

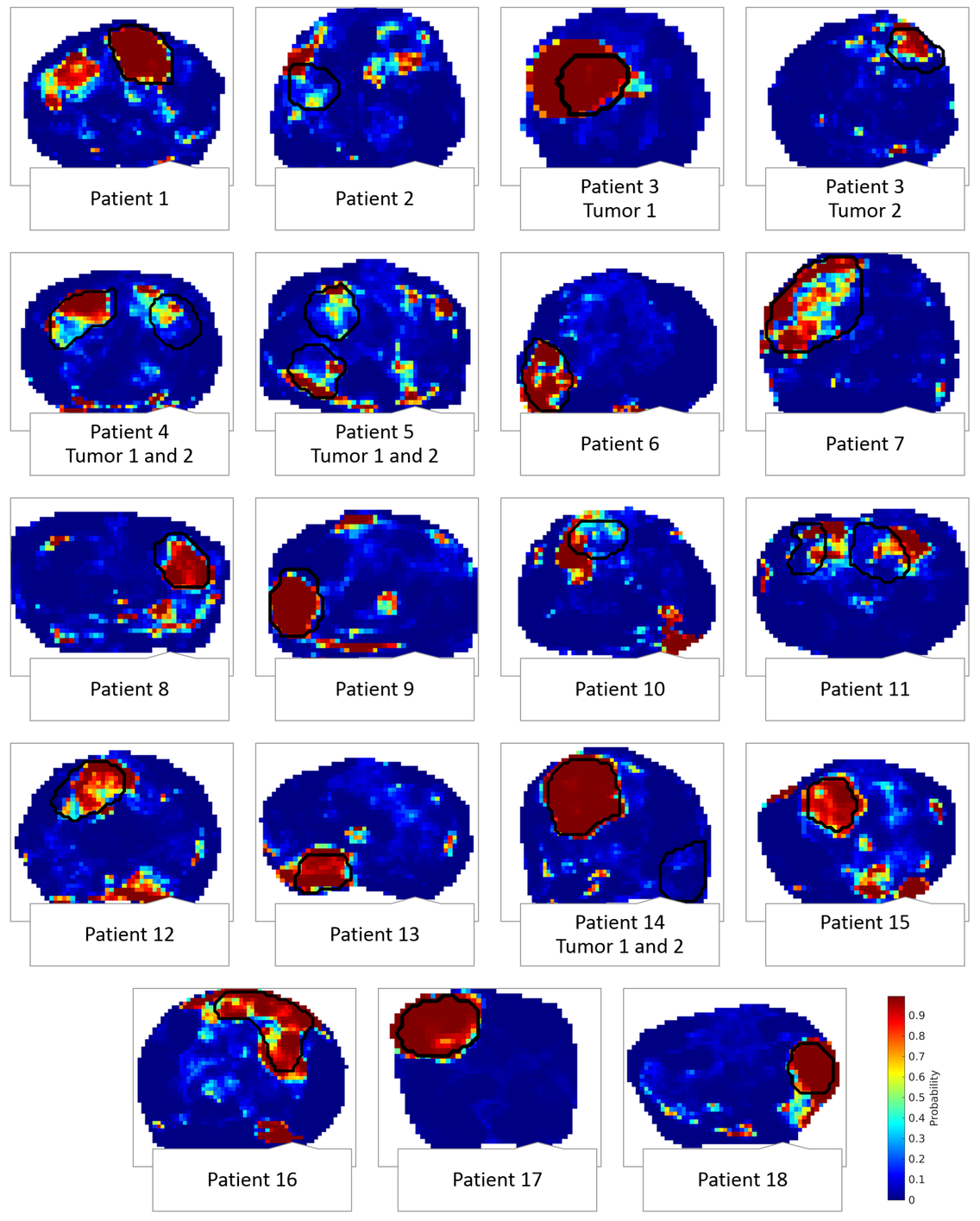
The result of the classifier is a probability map per-voxel-basis for each 3d prostate volume with values between 0 and 1, 1 indicating highest suspicion of PCa.



RESULTS

The probability maps presented below show a slice from each tumor region annotated by the expert (black contour).

- For several patient (e.g. 1, 3, 9, 13 17 and 18) the highest tumor probability corresponds well with the expert annotated area.
- Some patients (e.g. patient 3 (tumor 2), 6, 7 and 12) show high tumor probability within the expert annotation but with under estimation of the area.
- Patient 2, 10 and 11 show a detected area near the expert annotation.
- Some patients (e.g. one tumor in patient 4, 5 and 14) show no areas with high tumor probability within the expert annotation, or only a small area .



DISCUSSION

Visual assessment of the probability maps shows that the majority of tumors can be successfully located by the algorithm.

The tumors where the detected area is displaced from the expert annotation might be the result of patient movement or prostate deformation during the MRI examination, which might be resolved by including registration of the image series.

Including more/other features might lead to improvement of the algorithm and thereby detection of the remaining tumors.

Limitations of the study:

- Small number of patients
- Visual assessment of the results

Conclusion

mpMRI shows useful for detecting of PCa suspicious areas in the prostate gland, however, the algorithm must be improved and validated in a larger dataset before it can be used clinically.

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