Ultrasound-based Detection of Prostate Cancer Using Automatic Feature Selection with Deep Belief Networks

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Introduction

Temporal units and layers
To augment the detection for Rooij and Cancer selection likelihood of all targeted, Ultrasound shows an expensive tissue depiction in MRI. The lack of systematic approach for feature selection. The input of DBN is cancer likelihood.

Background and Objective

Data Acquisition

mp-MR imaging
MR-ultrasound fusion (UroNav)
US Imaging
Temporal ultrasound data
Taking Biopsy & Histological processing

Experiments

• Conditions of permutation:
  – Random Selection
  – Cancerous cores larger than 1.5 mm

Table 1. Validation results using testing data.

<table>
<thead>
<tr>
<th>Type</th>
<th>Benign</th>
<th>Cancerous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correctly identified</td>
<td>22</td>
<td>13</td>
</tr>
<tr>
<td>Total number</td>
<td>23</td>
<td>13</td>
</tr>
</tbody>
</table>

Table 2. Results of permutation of the training and testing data. In four out of five permutations, all cancerous cores were correctly identified.

<table>
<thead>
<tr>
<th>Cancerous</th>
<th>93%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>98%</td>
</tr>
<tr>
<td>Specificity</td>
<td>90%</td>
</tr>
</tbody>
</table>

Material and Methods

Model Overview

Figure 2. Tissue acquisition steps data obtained in collaboration with Philips research North America during MRI guided targeted TRUS biopsies performed at the National Institutes of Health (NIH), Maryland.

Figure 3. Percentage of cancerous ROIs with a Likelihood of more than 90% in the model output versus tumor in-core-length (left) and MRI grade (right). Cancerous and benign cores are shown as circles and squares, respectively.

Figure 4. Cancer probability maps overlaid on B-mode US image, showing the projected needle path in the temporal US data and correlated on the target. The ROIs for which the cancer likelihood are more than 90% are colored in red. Red boundary shows the sagittal prostate in MRI projected to TRUS coordinates.

Discussion

• Temporal ultrasound data is a promising technology to complement mp-MRI in TRUS-guided biopsy.

• Limitations:
  – Training DBN is computationally expensive.
  – All temporal ultrasound data is acquired from MR-positive tumors.

• Future work:
  – Incorporating more cores in the study
  – Prostate cancer grading

• Future applications of the approach include:
  – Reducing the need for unnecessary biopsy
  – Surveillance of patients

References