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BioImage Informatics, Image Analysis

Molecular & Computational Pathology
Segmentation of epithelial components in complex HE images of the colon

Analysis:
- Machine Learning (ML) to detect epithelium (pixel classification)
- Fast radial symmetry transform (FRST-D) to detect circular structures
- Post-processing: watershed-based post processing to split glands
1. Color normalization
2. Color deconvolution to obtain separate Haematoxylin & Eosin intensity images
Analysis workflow - FRSTD

1. Machine Learning
   - HE image
   - eosin image
   - FRST-D
   - glandular lumina
   - mucin filled vesicles

2. Large circular areas
3. Small circular areas

Final mask
Analysis workflow – Machine Learning

H&E Intensity Histograms for Machine Learning

- Stroma
- Epithelium
Analysis workflow - Postprocessing

Post Processing:
1. Watershed colorized image
2. Fill holes in objects
3. Morphological opening & closing
## Performance Measures

<table>
<thead>
<tr>
<th>Metric</th>
<th>Training set (n=85)</th>
<th>Training subset* (n=24)</th>
<th>Part A*** (n=60)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hausdorff</td>
<td>128.14±99.78</td>
<td>122.3±73</td>
<td>152.48±84.78**</td>
</tr>
<tr>
<td>Dice Coefficient</td>
<td>0.70±0.16</td>
<td>0.69±0.17</td>
<td>0.71±0.16**</td>
</tr>
<tr>
<td>F1</td>
<td>0.59±0.22</td>
<td>0.55±0.26</td>
<td>0.78 (47/60)</td>
</tr>
<tr>
<td>Jaccard Index**</td>
<td>0.67±0.17</td>
<td>0.65±0.17</td>
<td>0.57±0.17</td>
</tr>
<tr>
<td>Overlap**</td>
<td>0.73±0.19</td>
<td>0.72±0.19</td>
<td>0.65±0.21</td>
</tr>
<tr>
<td>Run Time</td>
<td>~11 minutes</td>
<td>~3.5 minutes</td>
<td>~7.5 minutes</td>
</tr>
</tbody>
</table>

* Images from the training set not used in classifier training
** Pixel-level, considering the “epithelial mask” as one object
*** On annotations made by a team member
Example Result Images (Dataset A)
References


