Color and Contrast

Imaging Lab 2 - May, 2017

Kamyar Nazeri
Student ID: 100633486

Cancer cells detection mask

To produce a detection mask, we apply RGB color thresholding on the reference image. To find the color thresholds, we need to know the location and color of the cancer cells. We can extract the cancer cells from the reference image by multiplying it with the provided "true mask". We can then use the "thresh" GUI tool to find the color threshold required for the detection mask. The color thresholds are at their best, when changing the Original Image from "tissue" to "cancer only cells" would not change the produced Mask.

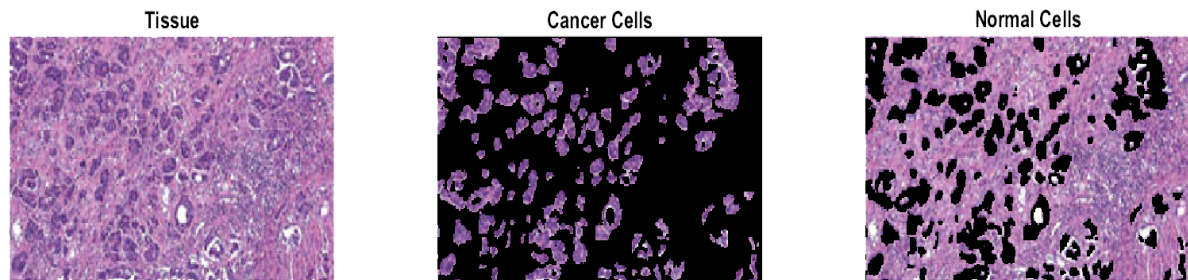*Figure 1* shows the reference image, along side the extracted cancer cells, and normal cells:

Figure 1: Extract cancer/normal cells from the reference image using the provided mask

To enhance the quality of the detection mask, we apply "binary image operations" on the detection mask. We use ***Dilation*** to grow the blobs, ***Fill***, to fill the black regions surrounded by white pixels and ***Area Open***, to remove all blobs having small areas. The followings are the color thresholds and binary operations we use to produce the detection mask:

Red: 0 - 129
Green: 0 - 79
Blue: 116 - 255
Dilation: A disk with radius of 2
Area Open: Remove all blobs that have an area smaller than 50
Fill: Fill in black regions that are completely surrounded by white pixels

Figure 2 shows the detection mask produced by color thresholding, alongside the mask after performing binary image operations:
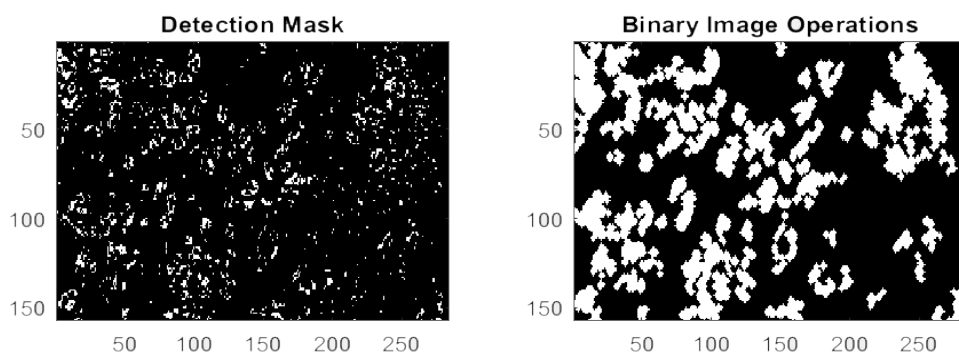

Figure 2: The detection mask produced by color thresholding / performing binary image operations

To measure the quality of our binary detection mask, we use *Matthews correlation coefficient* (MCC) and compare our detection mask with one provided. In our simulation, we reached the value of **0.6063**.

The following table displays the 5 statistics used to evaluate the detection result:

	TP	**TN**	**FP**	**FN**	**MCC**
Detection Mask	2319	33035	576	8658	0.3394
Binary Image Operation	8461	29161	4450	2516	0.6063

Classification categories, from left to right: True Positive (TP), True Negative (TN), False Positive (FP), False Negative (FN) and the Matthews Correlation Coefficient (MCC)

Figure 3 qualitatively compares our detection mask to the provided mask by displaying the detection mask next to "true mask":
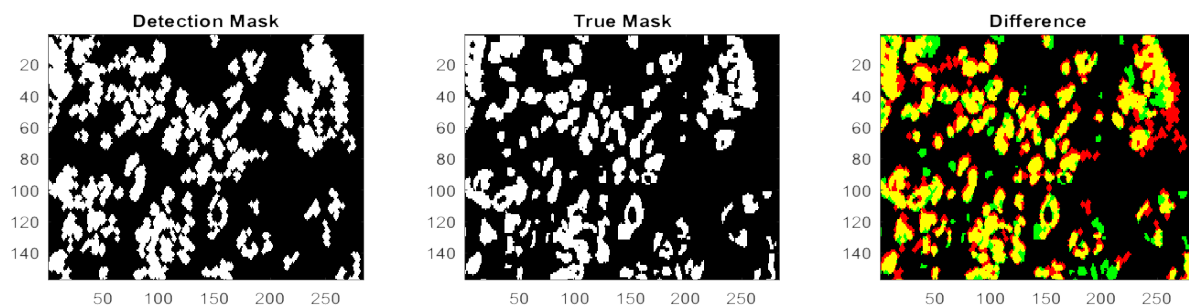

Figure 3: Visualization of the difference between the detection mask and the "true mask"

Histogram equalization / HSV thresholding.

We can improve our detection mask using, histogram equalization (Lab2_3.m) and HSV thresholding (Lab2_2.m). The following table demonstrates the statistics for RGB thresholding and the improved versions:

	TP	**TN**	**FP**	**FN**	**MCC**
RGB thresholding	2319	33035	576	8658	0.3394
HSV thresholding	7543	25547	8064	3434	0.4039
Histogram equalization	7543	25547	8064	3434	0.4193