Image processing For Biological Cell Segmentation

Main Script

```
%% Clear console and variables
clc, clear, close all;


%% Variables
fps = 3.0;
inputFolder='dataset/';
imagesExtension='*.tif';
outputFolder= 'videos/';


%% Load an image
image = imread("dataset/t000.tif");


%% Display image histogram
figure, imhist(image),title('Original image histogram');


%% Converting image from NDG to BW
% Using Otsu's method
imageOtsu = imbinarize(image);

% Using pixels' median
imageMedian = im2bw_median(image);

% Using pixels' mean
imageMean = im2bw_mean(image);

% Plot to screen
figure;
subplot(2,2,1), imshow(image), title('Original image (Grayscale)');
subplot(2,2,2), imshow(imageOtsu), title("Image BW (Otsu's
threshold)");
subplot(2,2,3), imshow(imageMedian), title('Image BW (Median
threshold)');
subplot(2,2,4), imshow(imageMean), title('Image BW (Mean
threshold)');

%histogram
imageMyThreshold = image > 1;
figure, imshow(imageMyThreshold),title('Image BW');
```

```
%% Choosing the thresholding method
im2bwSelected=@imbinarize;
im2bwSelected=@im2bw_median;
im2bwSelected=@im2bw_mean;
im2bwSelectedFunc=@im2bw_my_version;

imageBW = im2bwSelectedFunc(image);


%% Create video from dataset images
create_video_from_images(fps, inputFolder, imagesExtension,
outputFolder, 'cells-1-bw.avi', {im2bwSelectedFunc});
%% Image processing
imageBwProcessed=image_processing(imageBW);
figure, imshow(imageBwProcessed), title('Image BW processed')


%% Create video with processed images
create_video_from_images(fps, inputFolder, imagesExtension,
outputFolder, 'cells-2-bw-processed.avi', {im2bwSelectedFunc,
@image_processing});


%% Find regions in image
figure, image_regions(imageBwProcessed);


%% Create video with images' regions
create_video_from_images(fps, inputFolder, imagesExtension,
outputFolder, 'cells-3-bw-processed-regions.avi',
{im2bwSelectedFunc, @image_processing,@image_regions});


%% Segment all cells for one image
figure, imageBwProcessedSegmented =
image_segmentation(imageBwProcessed);


%% Create videos with segmented cells
create_video_from_images(fps, inputFolder, imagesExtension,
outputFolder, 'cells-4-bw-processed-segmented.avi',
{im2bwSelectedFunc, @image_processing,@image_segmentation});
```

Image Processing

```
function imageMyThresholdFinal = image_processing(image)
    % Delete noises and try to re-create complete cells from set of
points by
    % using opening, closing images processing methods and median
filter.

    % Median filter to correct noise (Salt-and-pepper noise)
    imageMyThreshold= medfilt2(image);
    %figure, imshow(imageMyThreshold), title('My Image median
filtered')

    % Opening and closing operation
    SE = strel('disk', 8);
    imageMyThreshold= imerode(imageMyThreshold, SE);

    SE = strel('disk', 12);
    imageMyThreshold= imdilate(imageMyThreshold, SE);

    SE = strel('disk', 4);
    imageMyThreshold= imerode(imageMyThreshold, SE);

    % Fills holes in image
    imageMyThresholdFinal= imfill(imageMyThreshold, 'holes');
end
```

Image Segmentation

```
function imageSegmented = image_segmentation(image)
    imageLabeled = bwlabel(image); % Label the cells
    nombreCells = max(max(imageLabeled)); % Calculate the number of
cells (number of connected spaces)
    imagesc(imageLabeled);
    B = bwboundaries(image);
    imlabel = bwlabel(image);
    imshow(image); hold on
    for k = 1 : max(max(imlabel))
        b = B{k};
        plot(b(:,2),b(:,1),'g','linewidth',2);
    end
    title(['Image segmented, number of cells ',
num2str(nombreCells)]);
    imageSegmented = getframe(gcf).cdata;
end
```

Image Regions

```
function imageRegions = image_regions(image)
    imageLabeled = bwlabel(image); % Label the cells
    nombreCells = max(max(imageLabeled)); % Calculate the number of
cells (number of connected spaces)
    imagesc(imageLabeled), title(['Image regions, number of cells ',
num2str(nombreCells)]);
    axis off
    imageRegions = getframe(gcf).cdata;
end
```