REU-17 Code Document
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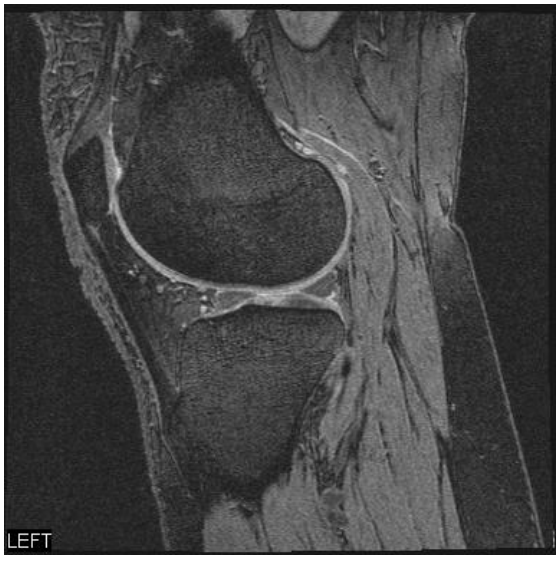
This file contains all functions and sample MRI images used to detect cartilage boundary and segment the cartilage.

1 Function Summary

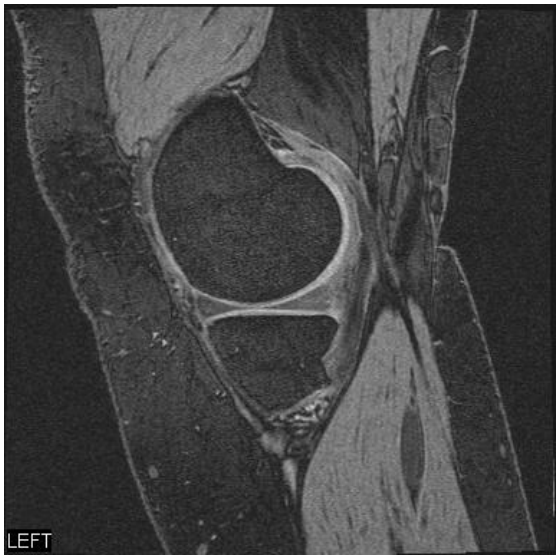
```
% function image_pre is used to pre-processing the image
function [bigBoundary, boundaries] = image_pre(img)

% function aver_intensity is used to choose the region of interest manually, calculate the center of the search, its average intensity and standard intensity
function [mean_intensity,center_x, center_y, radius, sd] = aver_intensity(img)

% function cartilage_area2 is used to detect the boundary of cartilage.
function [boundary, outer_boundary, I] = cartilage_area2(radius, center_x, center_y, I, mean_intensity, sd, boundaries, bigBoundary, coeff_x, coeff_y,s)

% function thickness_calculation is used to calculate the thickness of cartilage
function [aver_thickness] = thickness_calculation(boundary, outer_boundary);

%function segmentation_area is used to segment the cartilage and calculate its the area
function [area, cartilage] = segmentation_area(boundary, outer_boundary, test_img);

%function linear_prediction is used to train the model to predict the next boundary value (it will call training_boundary function which is pretty much like cartilage_area2 function)
```

```
17 function [coeff_x, coeff_y, X, Y] = linear_prediction(n,
       training_img)
18
19 % coeff_x and coeff_y are the coefficients used to predict
       the next value. I already trained it and save it as
       matrix in the same file.
20 load coeff_x;
21 load coeff_y;
```

The coeff_x, coeff_y is trained using this image below



The coeff_x1, coeff_y1 is trained using this image below

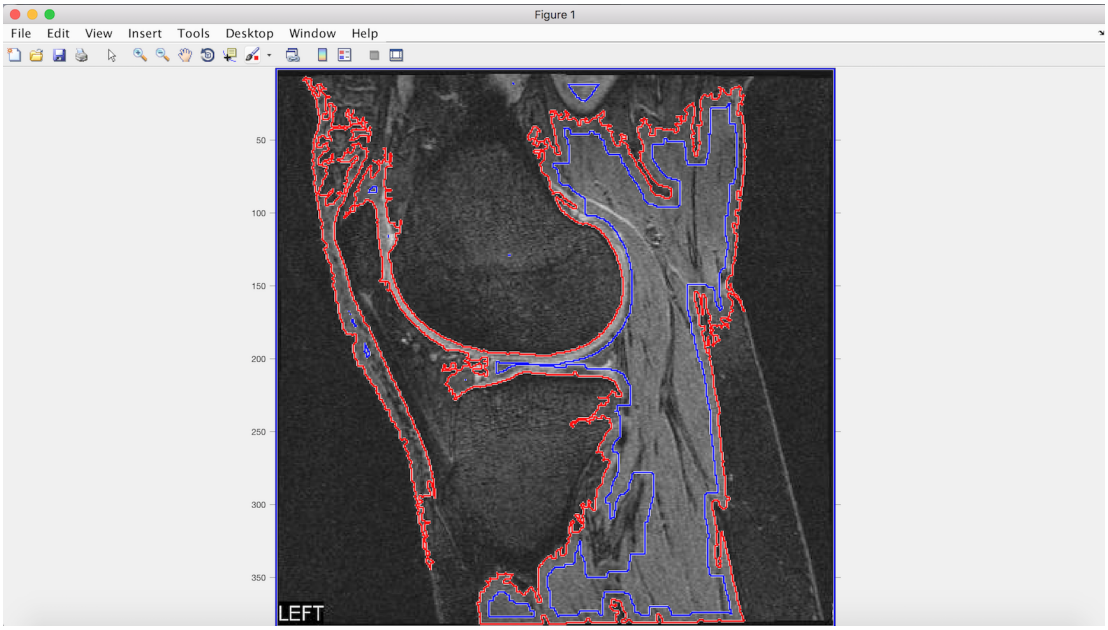


2 Run Modified Radial Search Method on 1 Image for Testing the Code

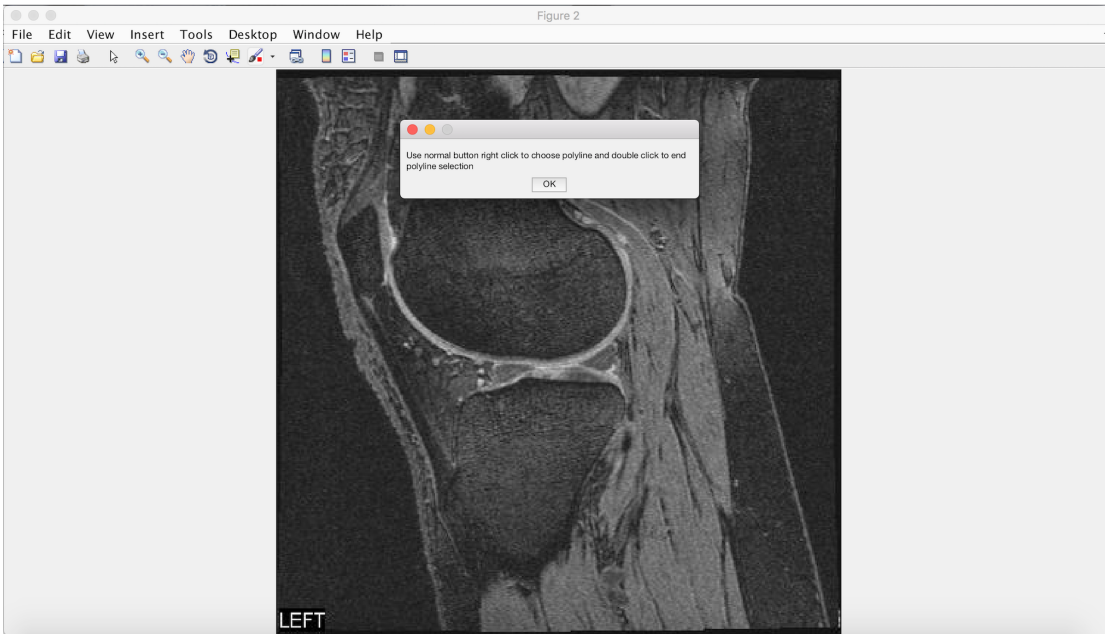
The function *main_script* can be used to run the Modified Radial Search method on 1 image. When execute the function *main_script* on the command window

```
>> [boundary, outer_boundary, I, aver_thickness, area,
cartilage]= main_script('normal_knee.jpg', 4, 'femur'
);
```

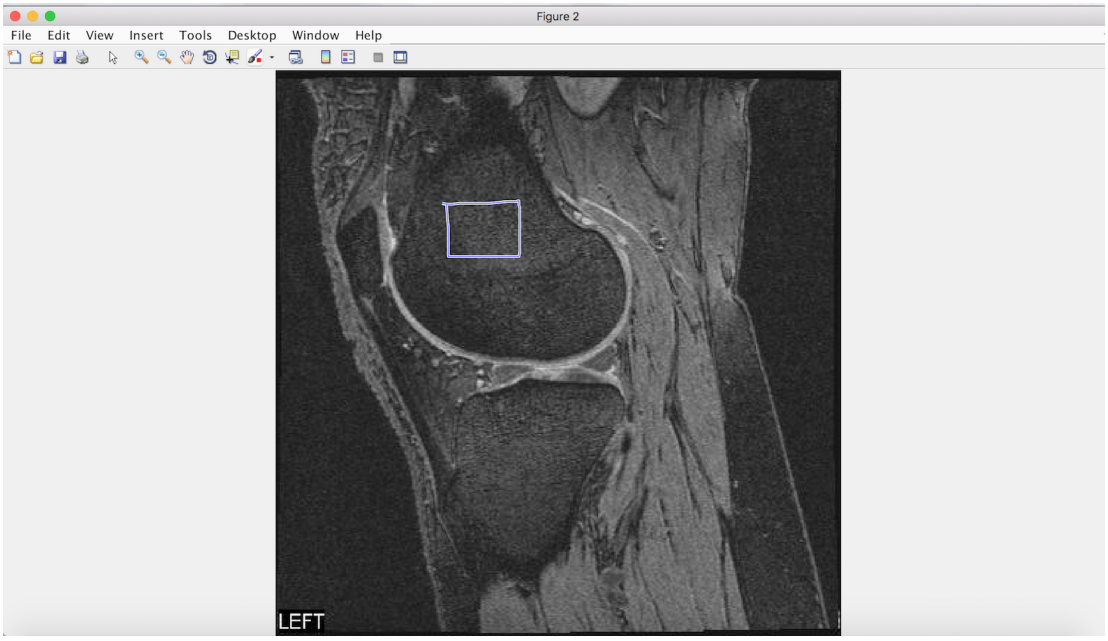
The first image to be seen is in figure 1.



The program then displays the image and asks to choose a region of interest. This is the only manual step in this method. Click OK and start drawing the region, don't remove our figure of the mouse until the drawing is finishing. It is one-line drawing without stopping. Fig.2 shows a simple animation of this step.



The region is usually drawn in rectangular shape with the center approximately in-line with the top of the cartilage.



After this step, the program will run automatically.

Figure 3 shows the images which will be displayed when the program ends.

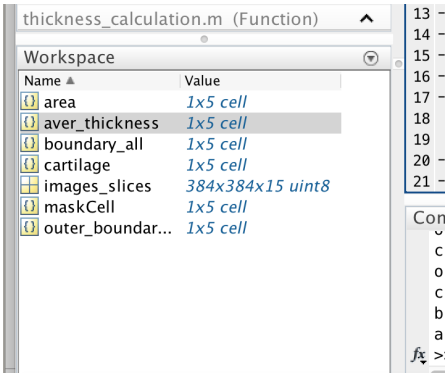
3 Run Modified Radial Search on Multiple Images

The function *segmentation_all* can be used to run Modified Radial Search method on multiple MR image in a file. Please make sure to change the directory on line 15 before run the function. When execute the function *segmentation_all* on the command window

```
1  >> [boundary_all, outer_boundary_all, maskCell,
       aver_thickness, area, cartilage, images_slices] =
       segmentation_all(4, 'femur');
```

The images will be displayed in the same order as running Modified Radial Search method on 1 image.

All the output will be stored in cells.



For example, the output *maskCell* is a cell of images which contains marked boundary values. Hence, executing

```
>> imshow(maskCell{1})
```

gives

The example above are only for femur bone, the same procedure can also be applied to tibia region.