%% select file and load data

[fn, fp] = uigetfile({'\*\_res\_all\_movies\*.mat';'\*.\*'}, 'Select a file');

cd(fp)

load(fn);

%% convert pixels to nm

pts(:,4:5)=pts(:,4:5)\*80;

%% plot the figure to zoom in the cell

h = figure; plot(pts(:,4), pts(:,5), '.k')

pause

%% select the region of interest to be analysed

xmin=min(get(gca, 'XLim'));xmax=max(get(gca, 'XLim'));

ymin=min(get(gca, 'YLim'));ymax=max(get(gca, 'YLim'));

ROI = [ymin xmin; ymin xmax; ymax xmax; ymax xmin; ymin xmin];

in=inpolygon(pts(:,4), pts(:,5), ROI(:,2), ROI(:,1));

selpts=pts(in, 4:5);

% reset position to start at zero (saving computation later)

selpts(:, 1) = selpts(:, 1) - xmin +1;

selpts(:, 2) = selpts(:, 2) - ymin +1;

box = selpts(boundary(selpts(:,1),selpts(:,2)), :);

close (h)

%% Voronoi analysis

[v,c] = voronoin(selpts);

ind = find(~inpolygon(v(:,1),v(:,2),box(:,1), box(:,2))); %find index of vertices located outside the set of points

c\_ind = cellfun(@(x) ismember(ind, x), c, 'UniformOutput', false); %find polygons that have at least one vertice outside the cell

c(find(cellfun(@max, c\_ind)))=[]; %mark polygons to be deleted

clear c\_ind ind

[ar\_vor] = arrayfun(@(x) polyarea(v(c{x}, 1), v(c{x}, 2)), 1:length(c)); % calculate&plot area of each voronoi cell

%% calculate mean area for Voronoi

mean\_area = polyarea(box(:,1), box(:,2))./length(selpts);

%% group voronoi regions that have a higher density

temp\_vor = c(ar\_vor<(mean\_area/3));

sel\_vor = temp\_vor;

all={};

sel\_vor\_group={};

ar\_vor\_group=[];

ar\_vor\_group\_sum=[];

%% plot result

figure

voronoi(selpts(:,1), selpts(:,2)); hold on

tic

while ~isempty(temp\_vor)

index = find(cell2mat(cellfun(@(x) sum(ismember(temp\_vor{1},x)), temp\_vor, 'UniformOutput', false))>0); %check which other entries share the same vertice - get index values

ind\_pt = unique(cat(2, temp\_vor{index})); %merge polygon and delete repeated points

temp\_vor(index)=[];

if length(index) == 1 %no more shapes sharing the vertices

shp = alphaShape(v(ind\_pt, 1), v(ind\_pt, 2));

if sum(inShape(shp,selpts(:,1),selpts(:,2))) >= 10 %minimum number of localization

ctr=[mean(shp.Points(:,1)), mean(shp.Points(:,2))]; %center of the area

ar\_vor\_group = cat(1, ar\_vor\_group, [area(shp) ctr sum(inShape(shp,selpts(:,1),selpts(:,2)))]);

sel\_vor\_group{end+1} = boundaryFacets(shp);

plot(shp,'FaceColor','red','EdgeColor','red','FaceAlpha',0.25)

all{end+1} = ind\_pt;

end

else

temp\_vor = [{ind\_pt}; temp\_vor];

end

disp(num2str(length(temp\_vor)))

end

toc

%% save file

ar\_vor\_group(:,5)=ar\_vor\_group(:,4)./sum(ar\_vor\_group(:,4));

save([fn(1:end-4) '\_Voronoi.mat'], 'all', 'ar\_vor\_group', 'pts', 'c', 'v', 'ROI', 'sel\_vor', 'sel\_vor\_group', 'selpts');