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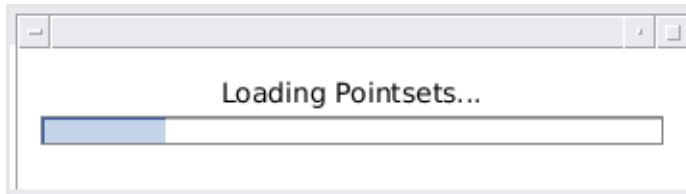
```
%Written with MATLAB 2019Rb
%Note that some functions might not work in depricated versions
```

```
tic
warning('off','all');
```

load data

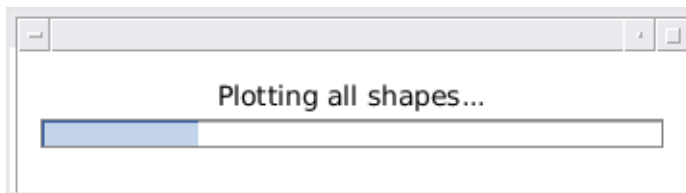
```
w = waitbar(0.2, "Loading Pointsets...",'windowstyle', 'modal' );
shapes = importdata('../data/pointset/data.mat');

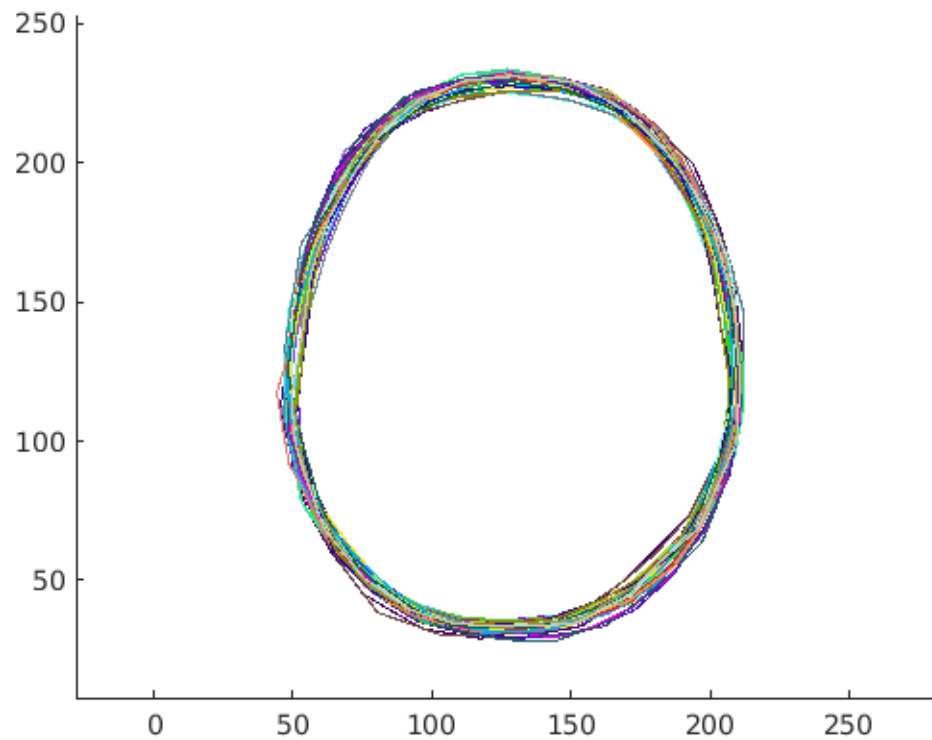
sz = size(shapes);
n = sz(3); %no of images
p = sz(2);
```



Plot all shapes

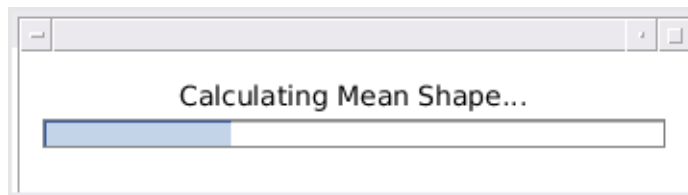
```
fig1 = figure('Name','a) Plot all shapes');
plot_all(shapes);
waitbar(0.25, w, "Plotting all shapes...");
```

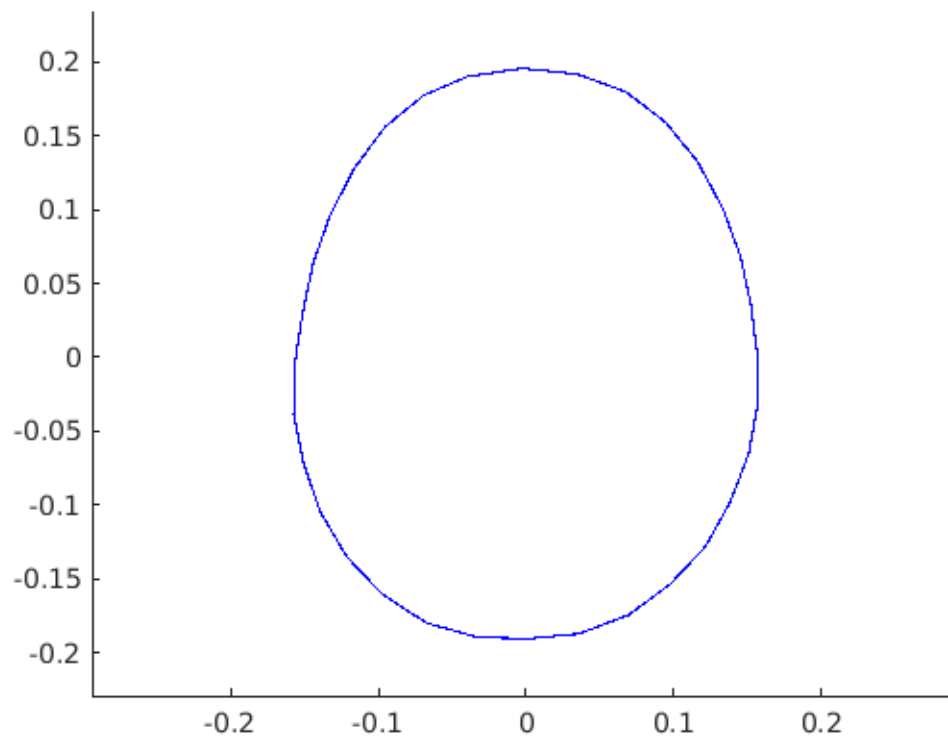




Mean Shape

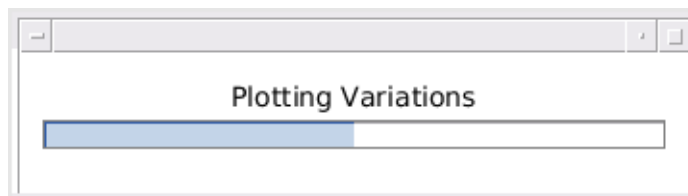
```
[mn, al_shapes, itr] = mean_img(shapes);  
fig2 = figure('Name', 'b) Plot computed shape mean');  
img_plot(mn);  
waitbar(0.3,w, "Calculating Mean Shape...");
```

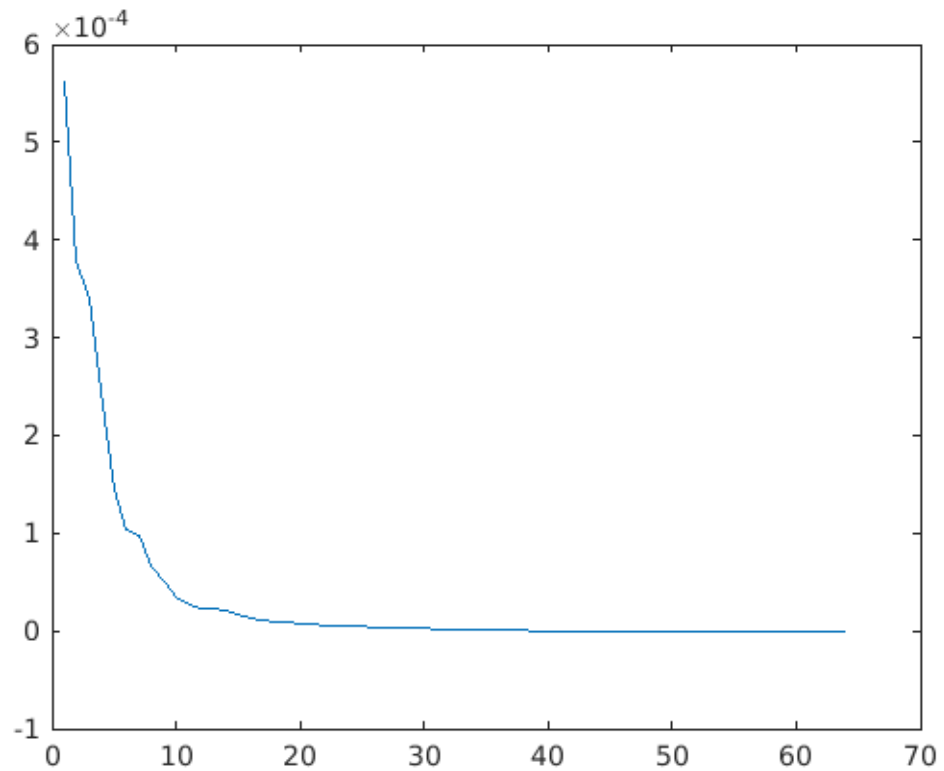




Modes of variation

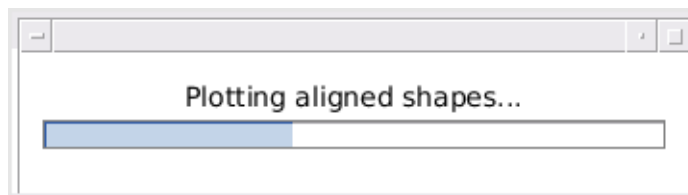
```
waitbar(0.35,w,"Finding Modes of Variation...");  
[vec, val] = variation_modes(al_shapes);  
waitbar(0.5,w,"Plotting Variations");  
fig3 = figure('Name', 'c) Plot variations');  
plot(val);  
snapnow
```

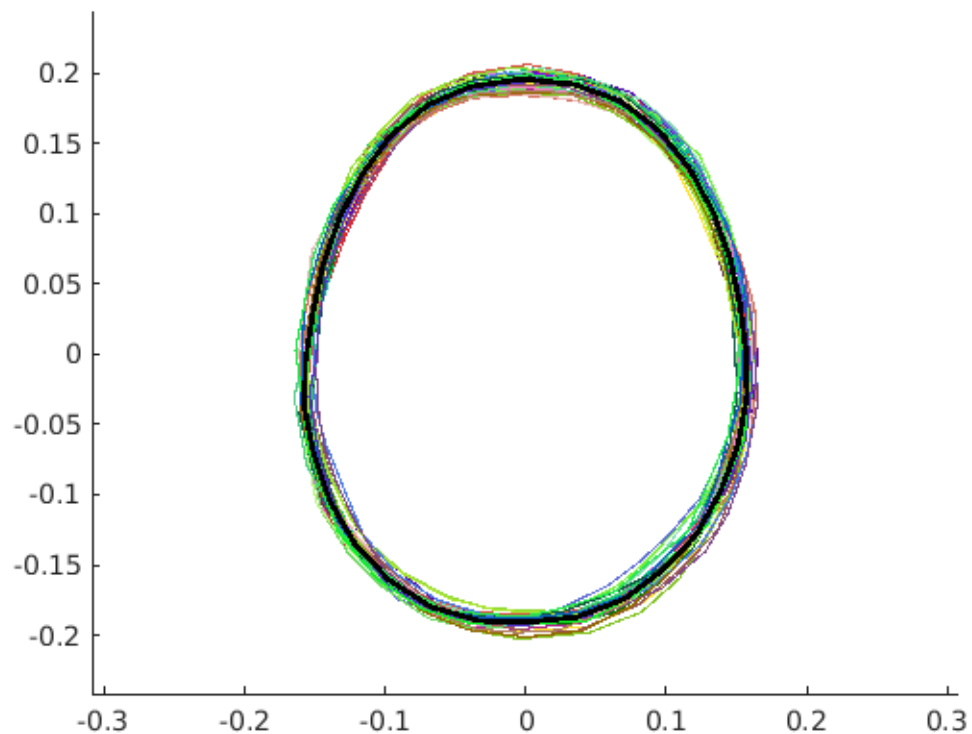




Aligned shapes

```
waitbar(0.4,w,"Plotting aligned shapes...");  
fig4 = figure('Name','Aligned Shapes and Mean');  
plot_all(al_shapes);  
hold on  
plt = img_plot(mn);  
plt.EdgeColor = 'Black';  
plt.LineWidth = 2;
```





first three modes of variation

```
fig5 = figure('Name','first 3 modes of variation');
t=tilayout(3,3);

names = ["1st" "2nd" "3rd"];

for r = 1:3

waitbar(0.45+(r-1)*0.05, w,"Plotting " + names(r) + " Mode...");
v1 = vec(:,r);
v1 = reshape(v1,2,[]);
vall = sqrt(val(r));

t1 = nexttile;
plt=img_plot(mn- v1*3*vall);
title(t1,'mode2 -3*sd');
plt.FaceColor = 'blue';
plt.FaceAlpha = 0.1;

t1=nexttile;
plt=img_plot(mn);
title(t1,'mean');
plt.FaceColor = 'blue';
plt.FaceAlpha = 0.1;
```

```

tl=nexttile;
plt=img_plot(mn+ v1*3*vall);
title(tl,'mode2 +3*sd');
plt.FaceColor = 'blue';
plt.FaceAlpha = 0.1;
end

```

```

t.Padding='compact';
t.TileSpacing = 'compact';

```

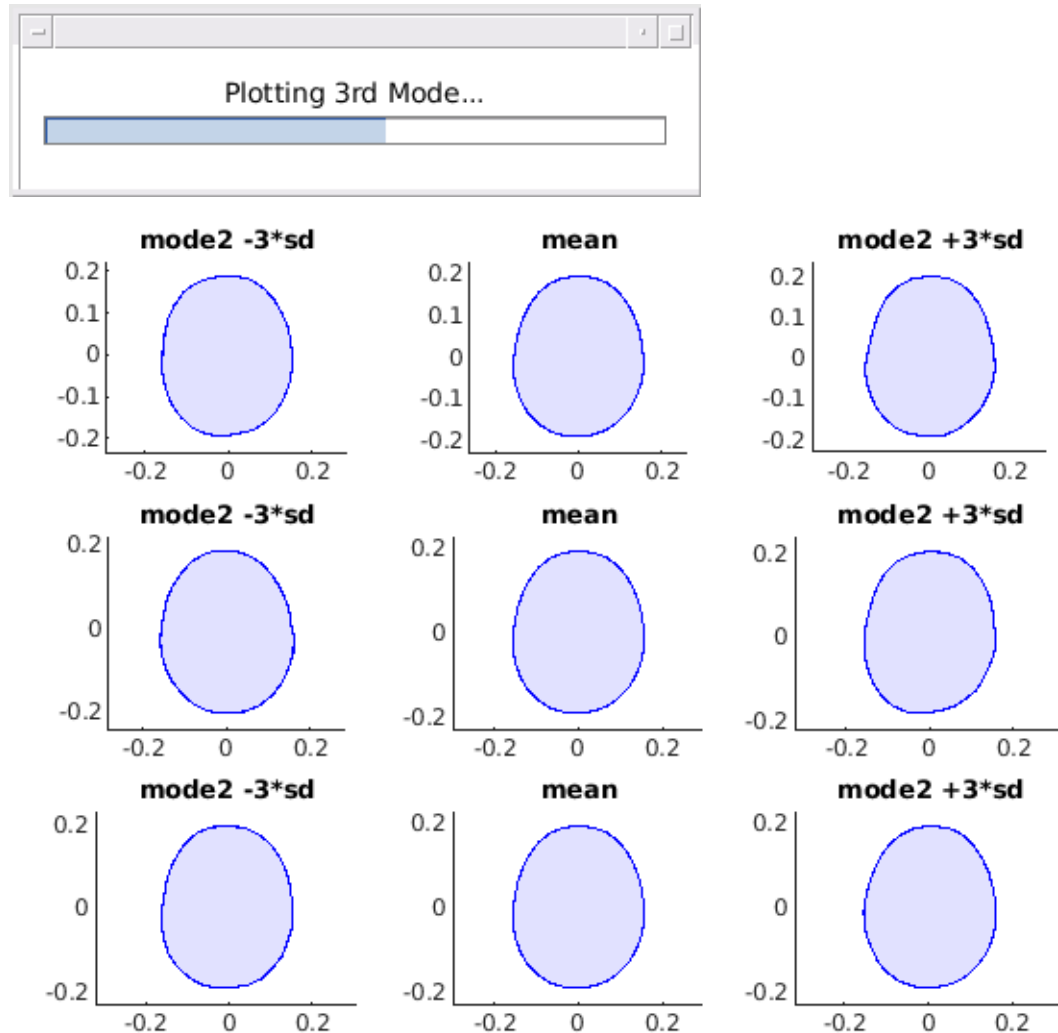


Figure 6

```

v2 = vec(:,1);
v2 = reshape(v2,2,[]);
val2 = sqrt(val(1));

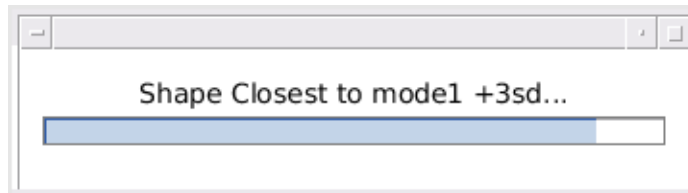
fig6 = figure('Name','e) Closest shapes');
t=tildeLayout(2,2);

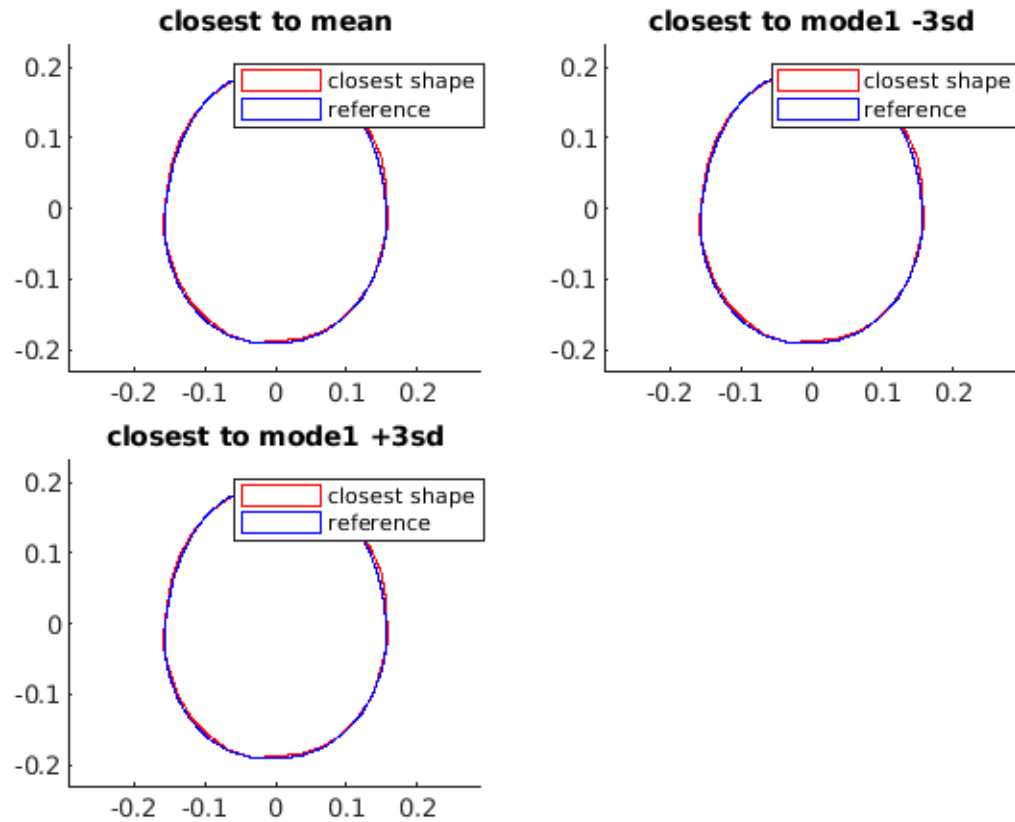
```

```
names = ["mean" "model -3sd" "model +3sd"];

for r = 1:3
waitbar(0.7 + (r-1)*0.1,w,"Shape Closest to " + names(r) + "...");
tl = nexttile;
hold on
plt=img_plot(find_closest(al_shapes , mn));
plt.EdgeColor = 'red';
plt.FaceAlpha = 0.3;
plt = img_plot(mn);
plt.EdgeColor = 'blue';
plt.FaceAlpha = 0;
title(tl, "closest to "+names(r) );
axis equal
legend('closest shape','reference')
hold off

end
t.TileSpacing = 'compact';
t.Padding = 'compact';
```





Finshing and Saving Plots

```
waitbar(1,w,"Finishing and saving plots...");
%{
figures = [fig1 fig2 fig3 fig4 fig5 fig6];
k=0;
for j = figures
    k=k+1;
    saveas(j,"../report/fig" + k + ".jpg");
end
%}
doc publish
close(w);
toc
```

Elapsed time is 7.336908 seconds.

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