

CS 736: Medical Image Processing

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Contents

- Loading Data
- Transforming to preShape
- Iterative calculation of mean shape
- calculation of modes of variation
- PLOTS
- Part(a) Initial point set
- Part(b) Aligned point sets with mean
- Part(c) Principal modes
- Part(d) Plot modes of variations

Loading Data

```
load('../Data/assignmentShapeAnalysis.mat');
```

Transforming to preShape

```
centroid = sum(pointSets,2) / numOfPoints;  
preShapePoints = pointSets - centroid(:, ones(1, 32), :);  
norms = sqrt(sum(sum(preShapePoints.^2, 2), 1));  
preShapePoints = preShapePoints./norms(ones(1, 2), ones(1, 32), :);
```

Iterative calculation of mean shape

initialization using sample mean

```
mean = preShapePoints(:, :, 3);  
oldMean = mean + 100;  
  
% parameters for loop  
epsilon = 0.000001;  
iteration = 0;  
  
% loop  
while sqrt(sumsqr(mean - oldMean)) > epsilon  
    % update in the loop  
    oldMean = mean;  
    iteration = iteration + 1;  
  
    % for each set find the rotation matrix  
    for i = 1 : numOfPointSets  
        % find rotation  
        Y = preShapePoints(:, :, i);  
        [U, ~, V] = svd(Y * mean');  
        RotMatrix = V * U';  
        if det(RotMatrix) == -1  
            % correcting for negation  
            t = [1, 0; 0, -1];  
        end  
    end  
end
```

```

        RotMatrix = V * t * U';
    end
    preShapePoints(:, :, i) = RotMatrix * preShapePoints(:, :, i);
end

% mean shape calculation
mean = sum(preShapePoints, 3) / numOfPointSets;

% normalization of mean
norm = sqrt(sumsqr(mean));
mean = mean ./ norm;
end

% calculation of eigen values done here
CV = 0;
for i = 1 : numOfPointSets
    CV = CV + (preShapePoints(:, :, i) - mean) * (preShapePoints(:, :, i) - mean)';
end
% normalized
CV = CV / numOfPointSets;
[V,D] = eig(CV);
eigenValues = diag(D);

```

calculation of modes of variation

```

var = zeros(size(mean, 1), size(mean, 2), 2, 2);
for j = 1 : 2
    for k = 1 : 2
        for i = 1 : 2
            sd = sqrt(eigenValues(3 - j));
            mult = 1;
            if k == 2
                mult = -1;
            end
            var(i, :, k, j) = mean(i, :) + mult * 2 * sd * V(:, 3 - j)' * mean;
        end
    end
end
end

```

PLOTS

using color scheme

```

colors = jet(numOfPointSets);

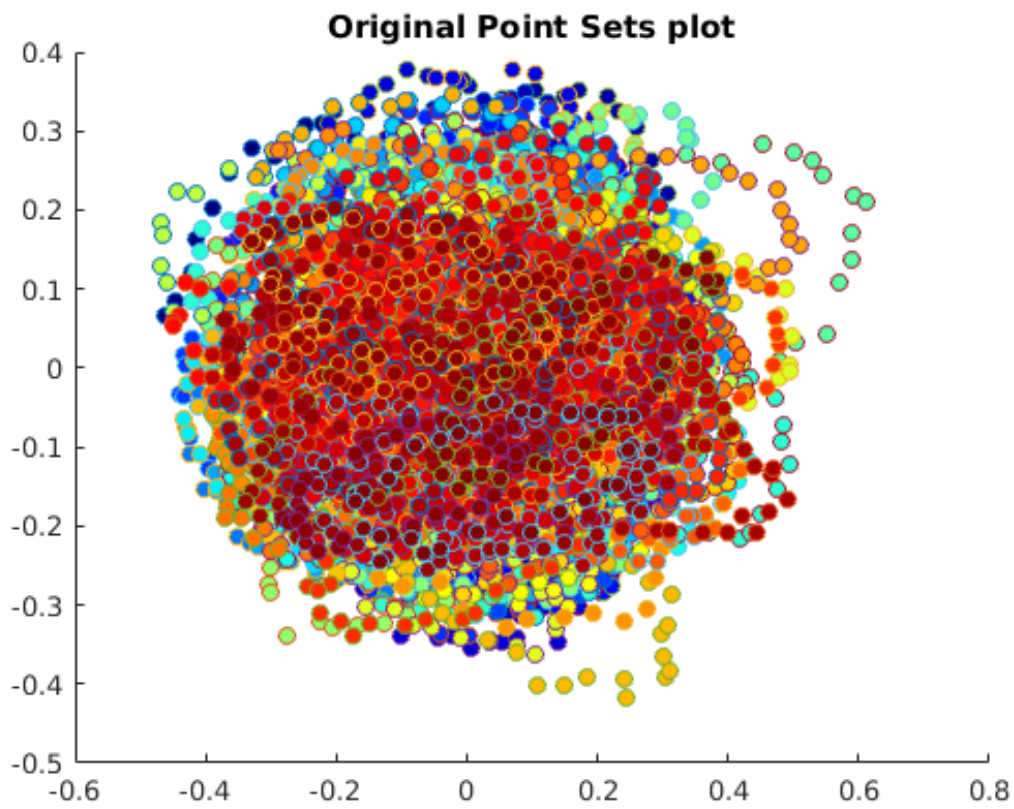
```

Part(a) Initial point set

```

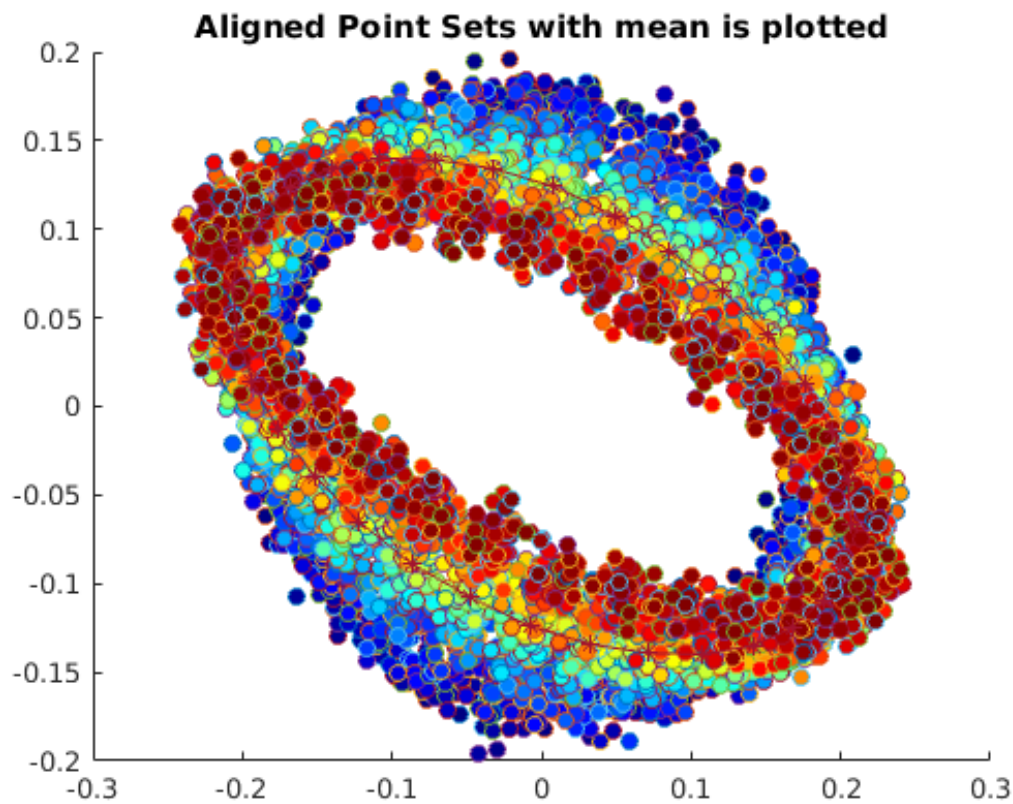
figure;
hold on;
title('Original Point Sets plot');
for i = 1 : numOfPointSets
    scatter(pointSets(1,:,i), pointSets(2,:,i), 'MarkerFaceColor', colors(i, :));
end
hold off;

```



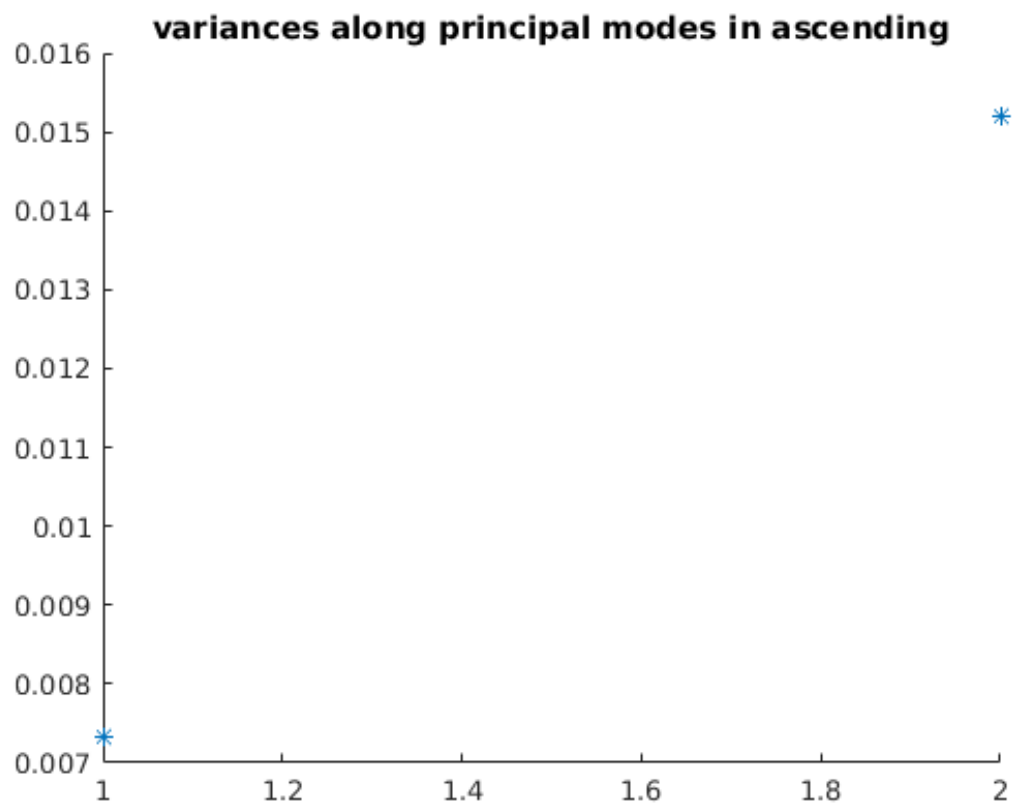
Part(b) Aligned point sets with mean

```
figure;  
hold on;  
title('Aligned Point Sets with mean is plotted');  
for i=1:numOfPointSets  
    scatter(preShapePoints(1, :, i),preShapePoints(2, :, i), 'MarkerFaceColor',colors(i, :));  
end  
plot(mean(1,:),mean(2,:), 'Marker', '*');  
hold off;
```



Part(c) Principal modes

```
figure;  
scatter(1 : size(eigenValues, 1), eigenValues, '*');  
title('variances along principal modes in ascending');
```

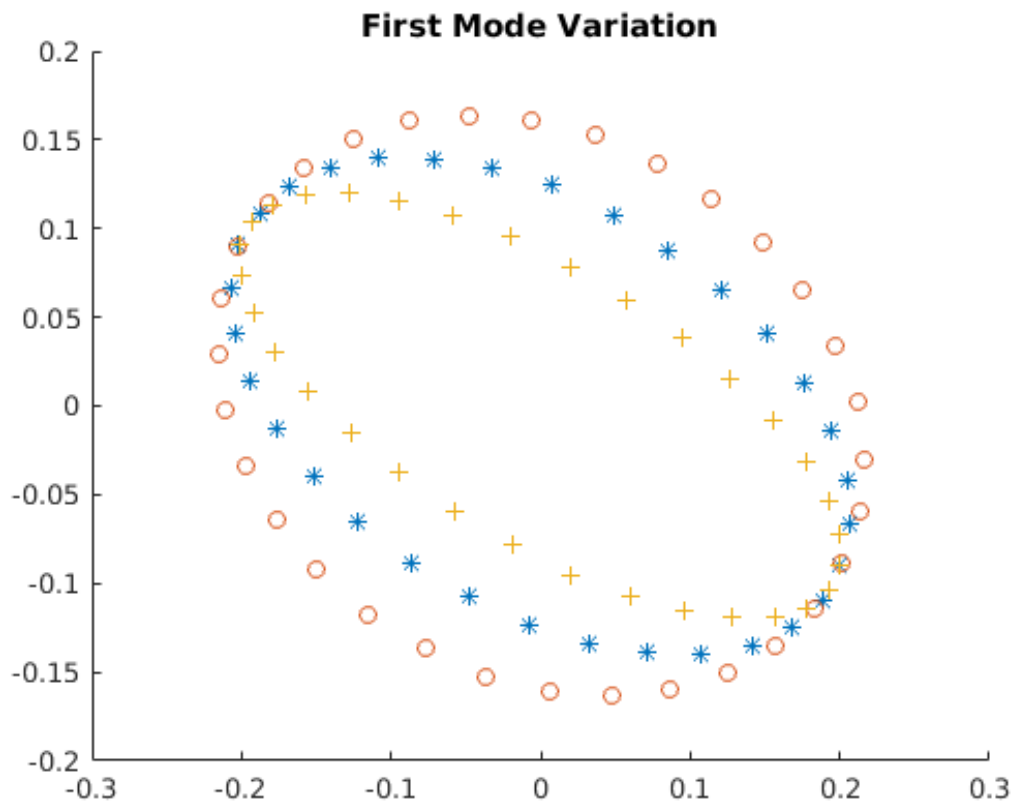


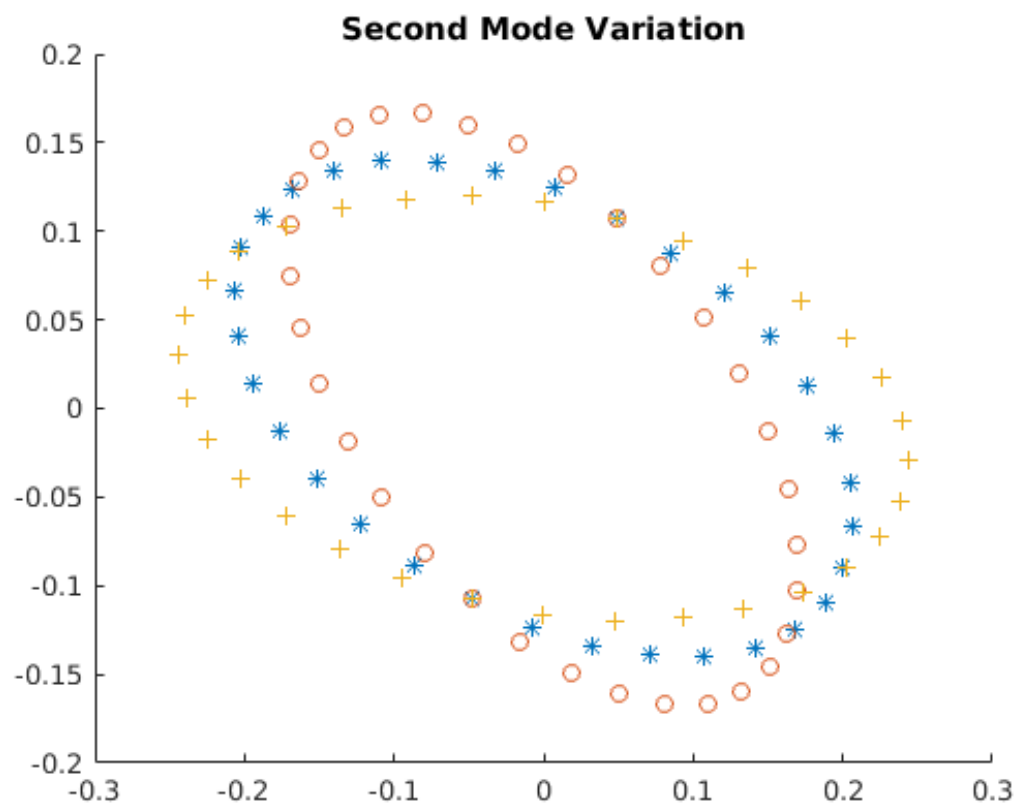
Part(d) Plot modes of variations

plot first mode of variation

```
figure;
title('First Mode Variation');
hold on;
scatter(mean(1, :), mean(2, :), '*');
scatter(var(1, :, 1, 1), var(2, :, 1, 1), 'o');
scatter(var(1, :, 2, 1), var(2, :, 2, 1), '+');
hold off;

% plot second mode of variation
figure;
title('Second Mode Variation');
hold on;
scatter(mean(1, :), mean(2, :), '*');
scatter(var(1, :, 1, 2), var(2, :, 1, 2), 'o');
scatter(var(1, :, 2, 2), var(2, :, 2, 2), '+');
hold off;
```





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