DIG DEMO

- Load the data. In this case EEG measures (rows - channels, columns - observations)

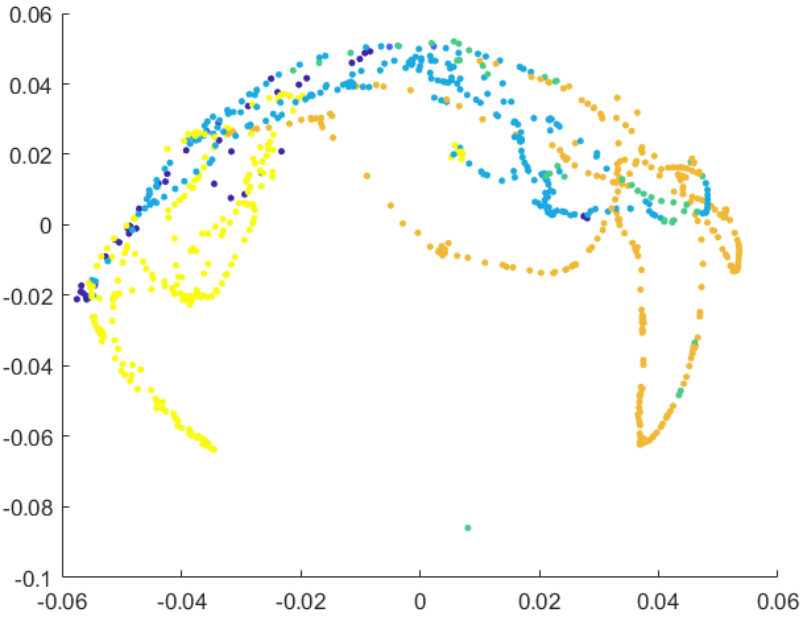
```
data = load('n10_8-12hz');
data = data.data;
labels = load('labelsn10.mat');
labels = labels.hyp;
```

DIG applied with the default parameters, in this case 'L' = 3840, since the labeling for sleep stages is given in this time lapse.

```
[Y, z_hist] = DIG(data(4:8,:), 'L',3840);
```

```
Computing distances among time-windows of data
Computing Affinity Matrix
Diffusing operator
Computing potential/gamma/inf_geometry distances
using -log(P) potential distance
MDS
```

```
scatter(Y(:,1), Y(:,2), 10, labels, 'filled');
```

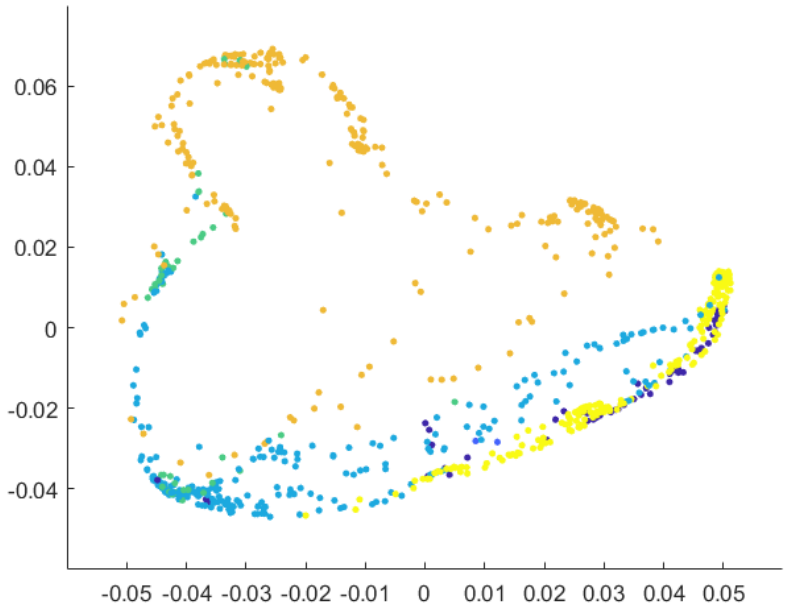


Trying different values for 'L2' to compute the covariance matrices. L2 = 5 produces a noisy embedding, while L2 = 100, smooths everything out. We are gonna stay with L2 = 20.

```
L2v = [5, 20, 40, 100];
for L2 = L2v
[Y, z_hist] = DIG(data(4:10,:), 'L',3840, 'L2', L2, 'pot_method', 'info_geometry');
figure
scatter(Y(:,1), Y(:,2), 10, labels, 'filled');
drawnow
end
```

```
Computing distances among time-windows of data
Computing Affinity Matrix
Diffusing operator
Computing potential/gamma/inf_geometry distances
```

```
using information geometry distance (arccos)
MDS
```




```
Computing distances among time-windows of data
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Diffusing operator
Computing potential/gamma/inf_geometry distances
using information geometry distance (arccos)
MDS
```

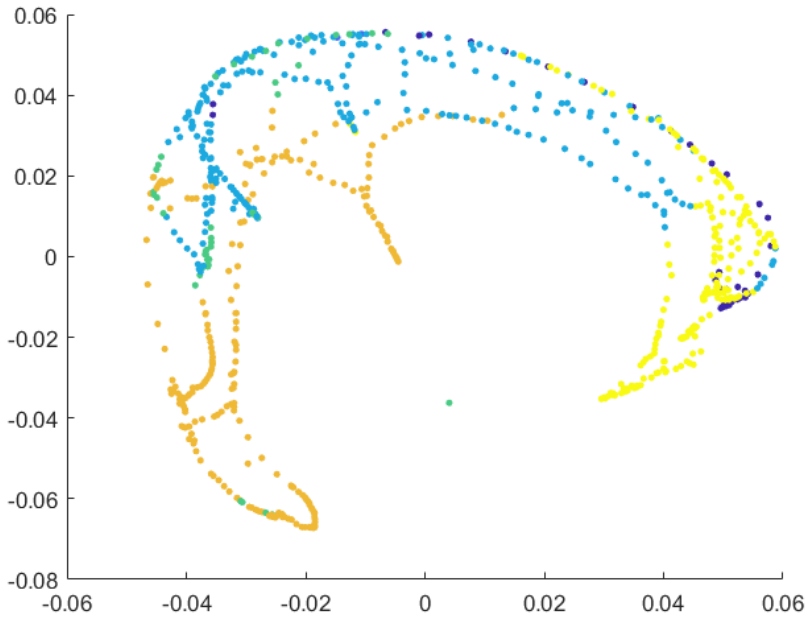


```
Computing distances among time-windows of data
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MDS
```
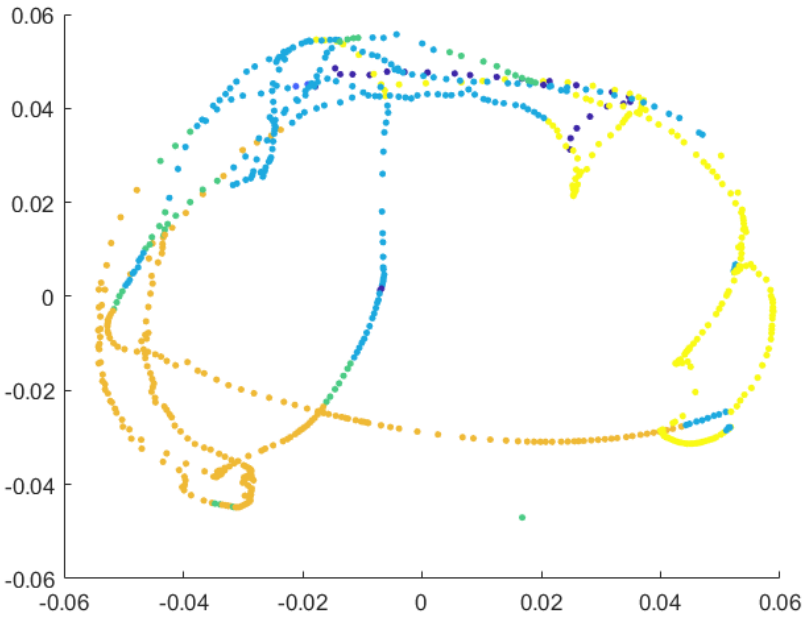
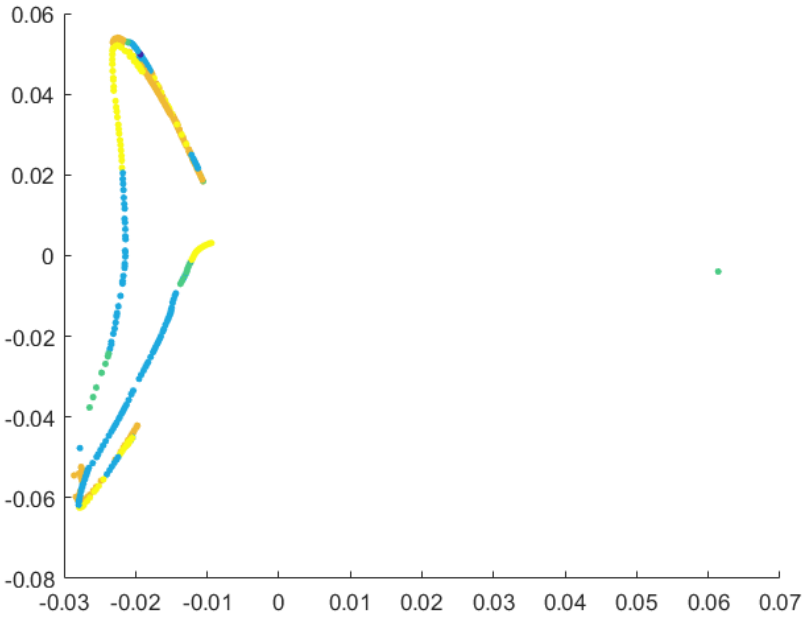




```
Computing distances among time-windows of data
Computing Affinity Matrix
Diffusing operator
Computing potential/gamma/inf_geometry distances
using information geometry distance (arccos)
MDS
```



Now let's take a look to the different distances in the potential operator, we can see that the information geometry distance is quite similar to the Hellinger distance figures 1 and 3.

```
potMethods = ["info_geometry", "none", "sqrt", "log"];
for potM = potMethods
[Y, z_hist] = DIG(data(4:10,:), 'L',3840, 'L2', 20, 'pot_method', potM);
figure
scatter(Y(:,1), Y(:,2), 10, labels, 'filled');
drawnow
end
```

```
Computing distances among time-windows of data
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Diffusing operator
Computing potential/gamma/inf_geometry distances
using information geometry distance (arccos)
MDS
```
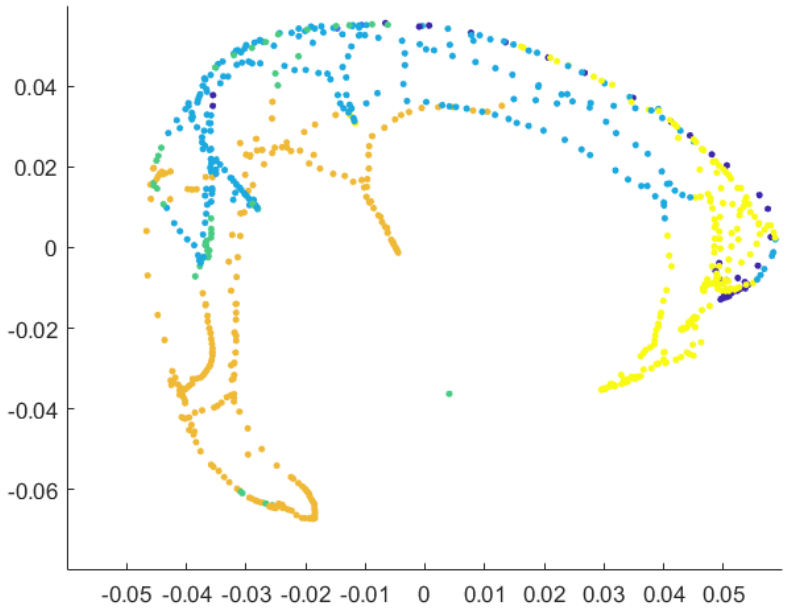
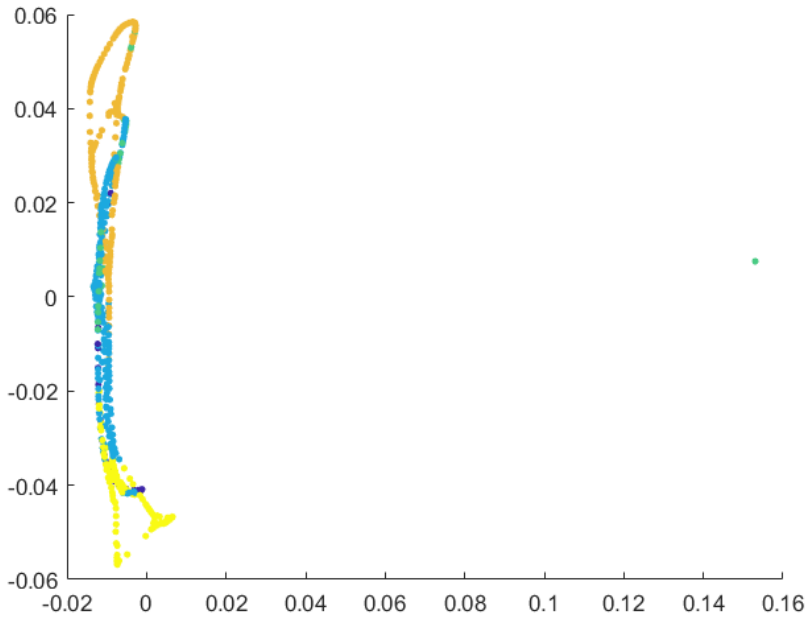
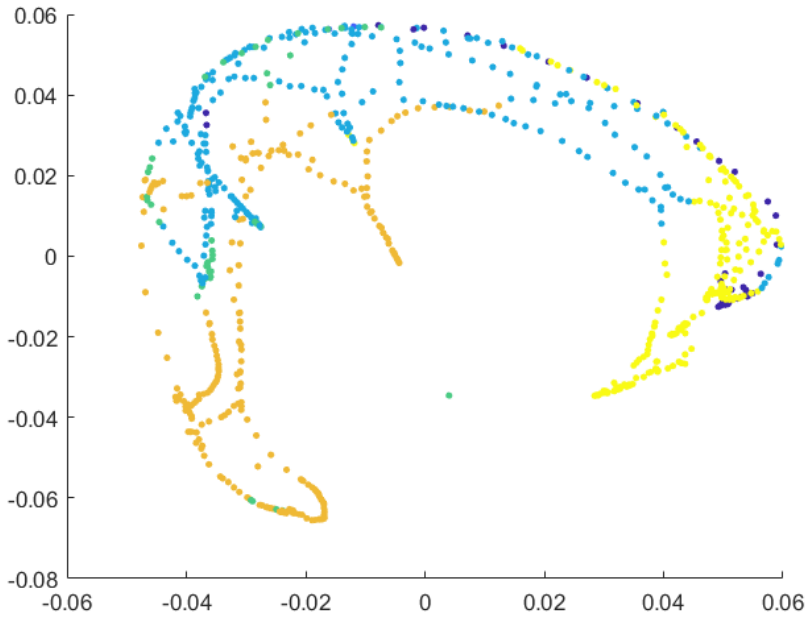



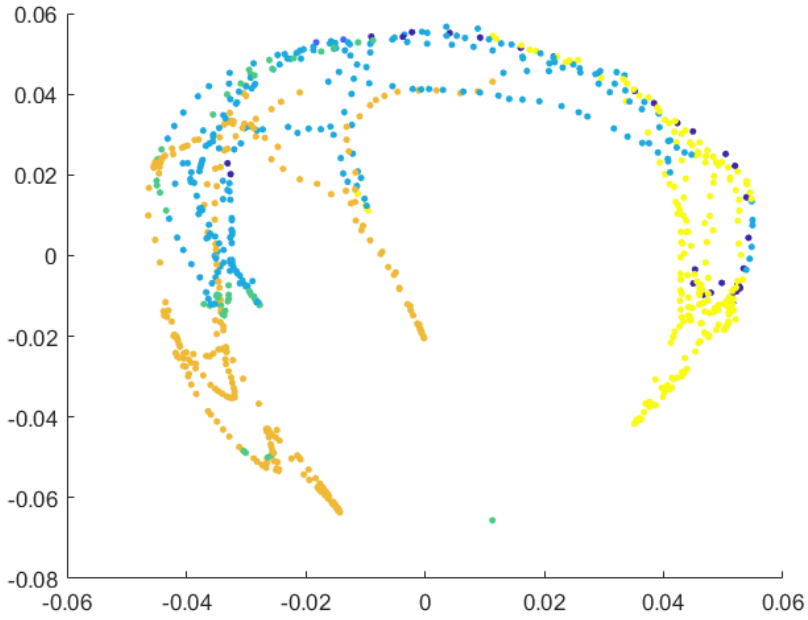

```
Computing distances among time-windows of data
Computing Affinity Matrix
Diffusing operator
Computing potential/gamma/inf_geometry distances
MDS
```




```
Computing distances among time-windows of data
Computing Affinity Matrix
Diffusing operator
Computing potential/gamma/inf_geometry distances
using sqrt(P) potential distance
MDS
```




```
Computing distances among time-windows of data
Computing Affinity Matrix
Diffusing operator
Computing potential/gamma/inf_geometry distances
using -log(P) potential distance
MDS
```

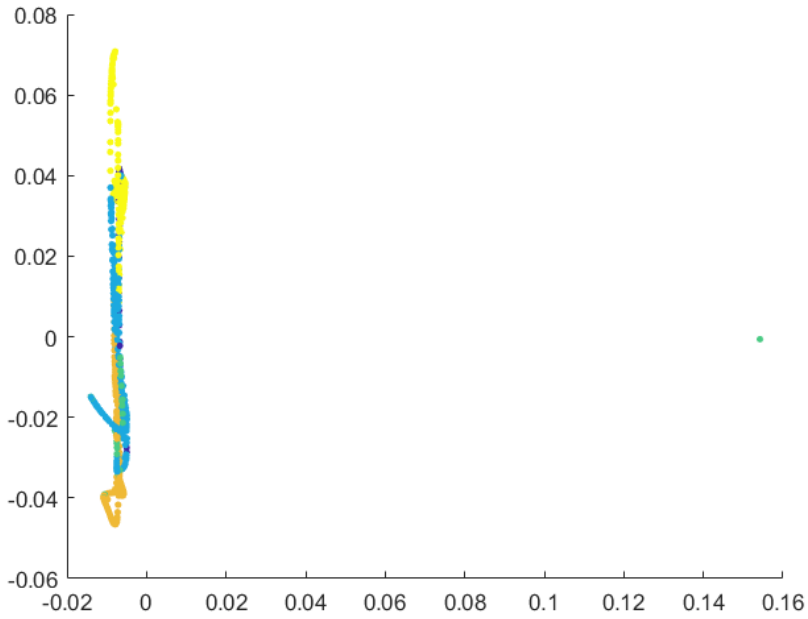


Different values of gamma

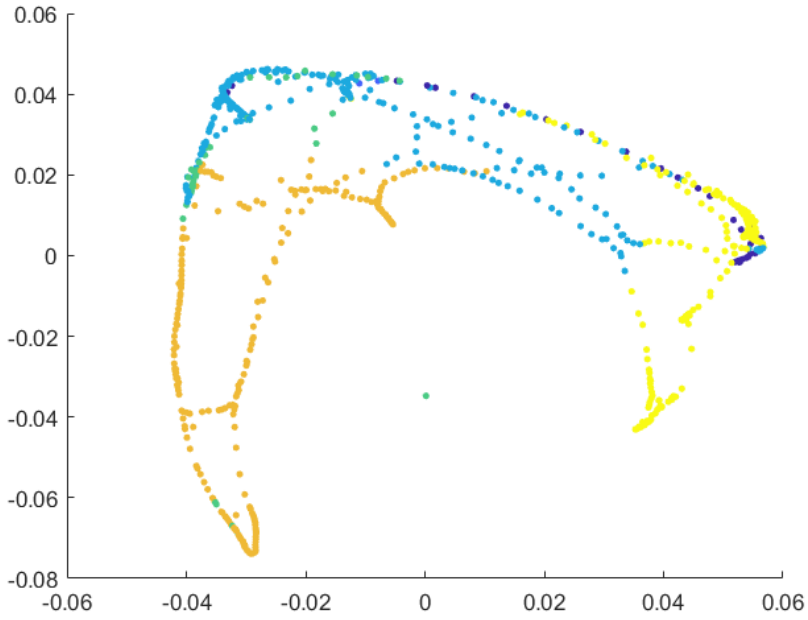
```
Gammas = [-1:0.4:1];
for gamma_v = Gammas
[Y, z_hist] = DIG(data(4:10,:), 'L',3840, 'L2', 20, 'pot_method', 'gamma', 'Gamma', gamma_v);
figure
scatter(Y(:,1), Y(:,2), 10, labels, 'filled');
drawnow
end
```

```
Computing distances among time-windows of data
Computing Affinity Matrix
```

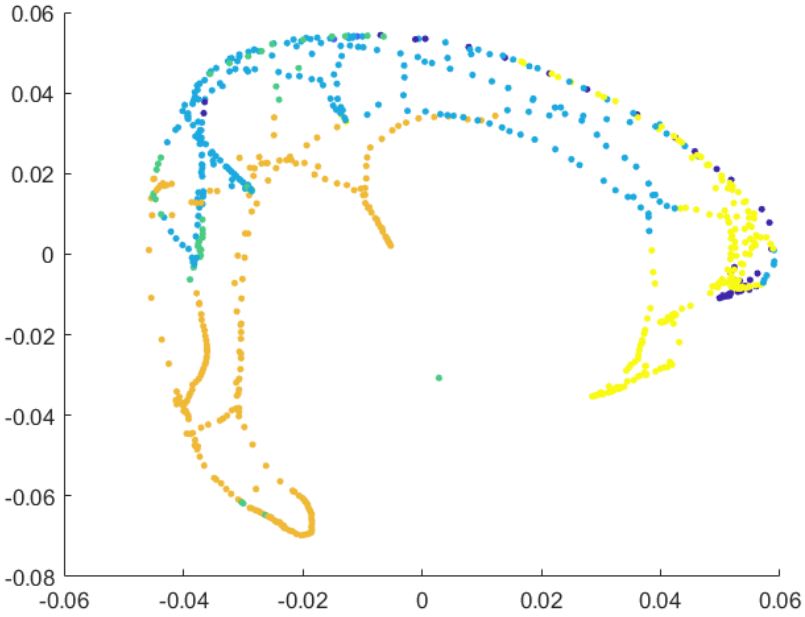
```
Diffusing operator
Computing potential/gamma/inf_geometry distances
MDS
```



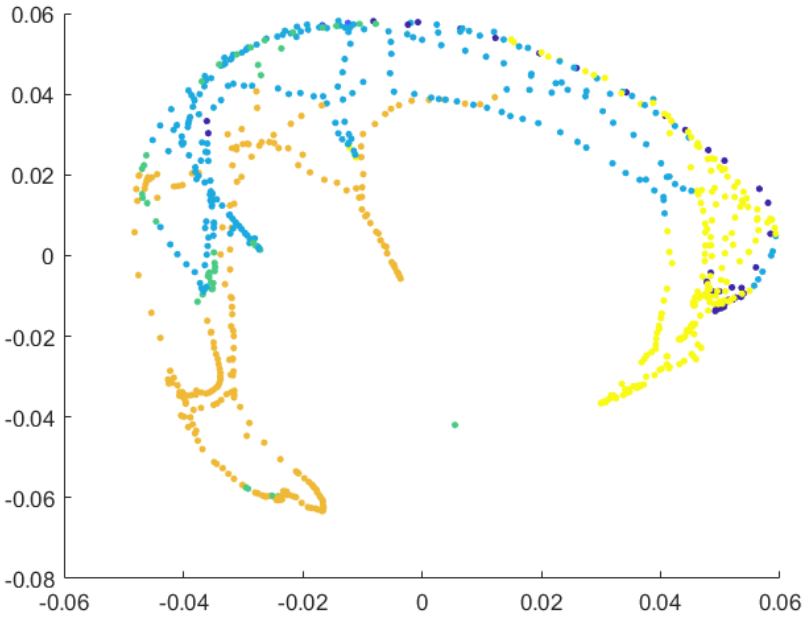

```
Computing distances among time-windows of data
Computing Affinity Matrix
Diffusing operator
Computing potential/gamma/inf_geometry distances
Pot = 2/(1-\gamma)*P^((1-\gamma)/2)
gamma = -0.6
MDS
```



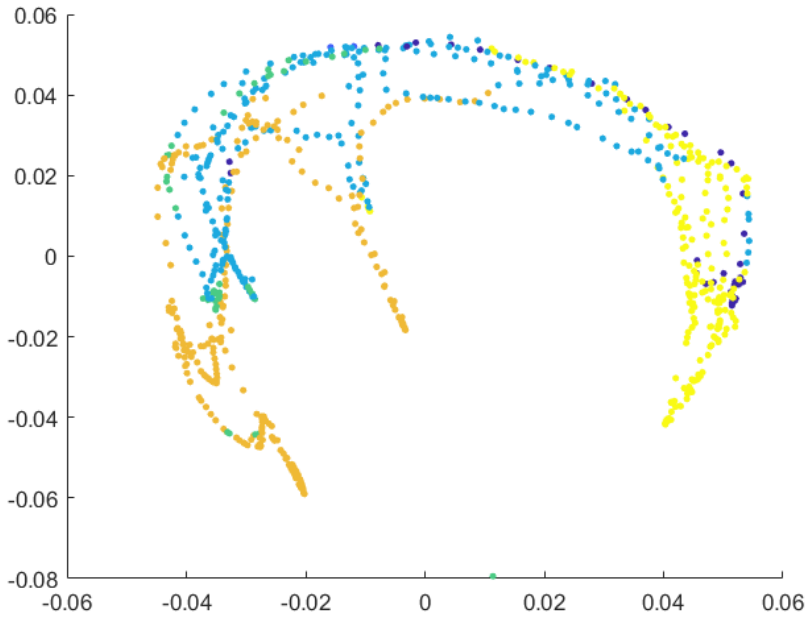

```
Computing distances among time-windows of data
Computing Affinity Matrix
Diffusing operator
Computing potential/gamma/inf_geometry distances
Pot = 2/(1-\gamma)*P^((1-\gamma)/2)
gamma = -0.2
MDS
```



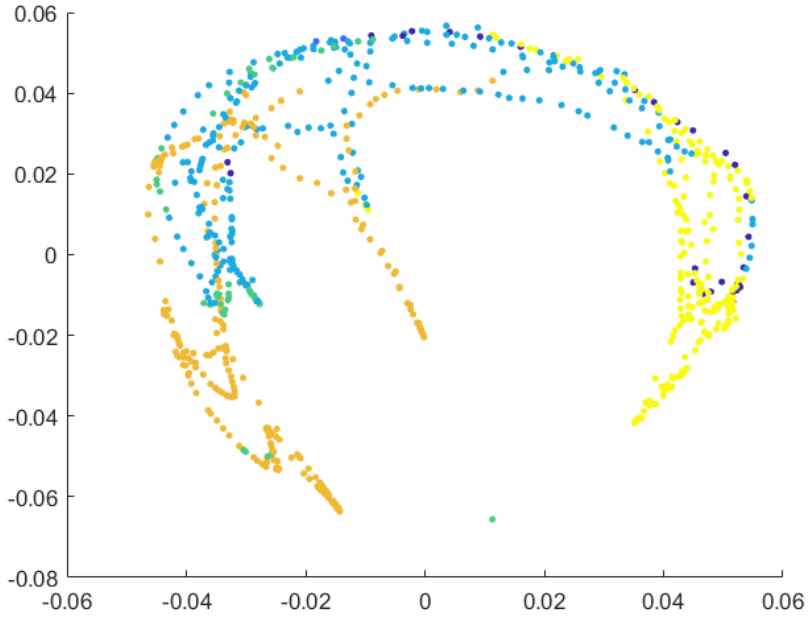

```
Computing distances among time-windows of data
Computing Affinity Matrix
Diffusing operator
Computing potential/gamma/inf_geometry distances
Pot = 2/(1-\gamma)*P^((1-\gamma)/2)
gamma = 0.2
MDS
```




```
Computing distances among time-windows of data
Computing Affinity Matrix
Diffusing operator
Computing potential/gamma/inf_geometry distances
Pot = 2/(1-\gamma)*P^((1-\gamma)/2)
gamma = 0.6
MDS
```



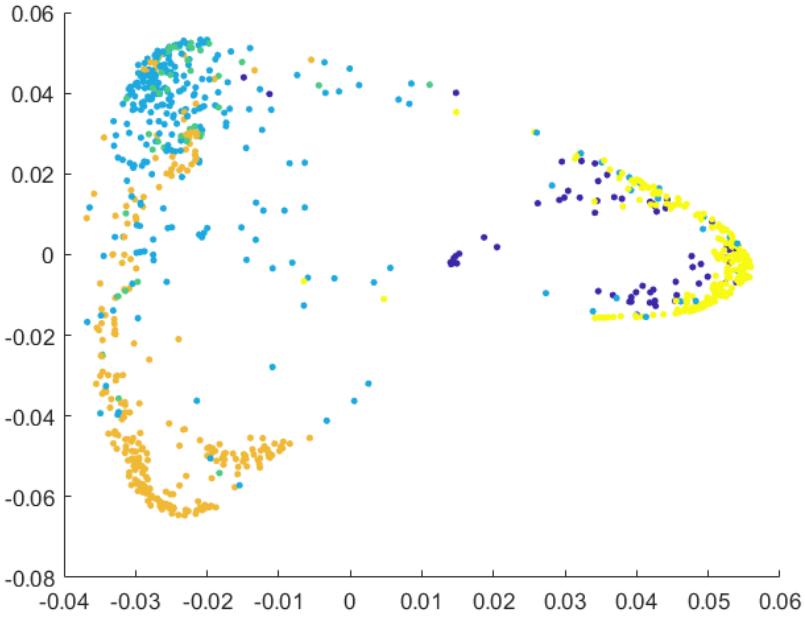

```
Computing distances among time-windows of data
Computing Affinity Matrix
Diffusing operator
Computing potential/gamma/inf_geometry distances
MDS
```



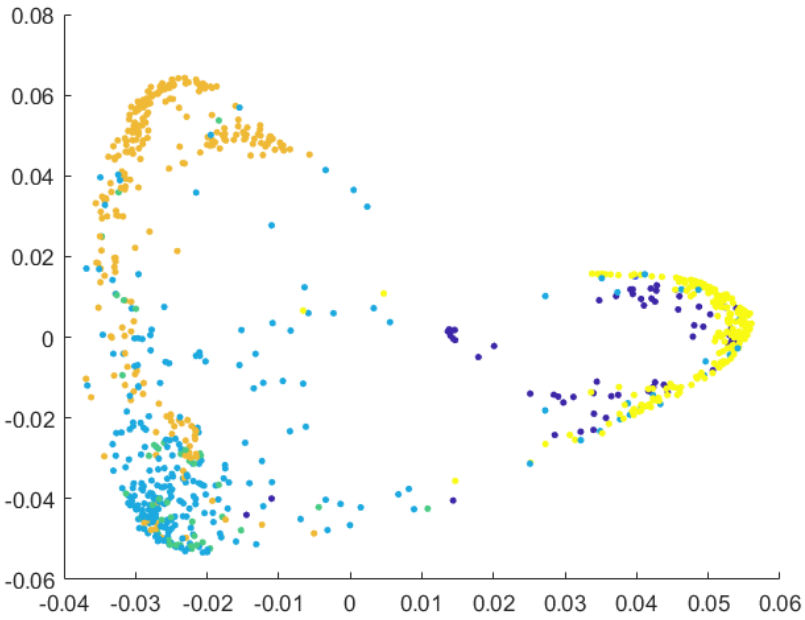
Instead of computing the EIG distance, we can also compute the KL divergence or the infomarion geometry distances between time windows of data, assuming a multivariate normal distribution. We can see that altough we can distingish between different sleep stages, the embeddings are noisier than for the EIG distance.

```
sD_v = ["InfGeo","KL"];
for sD = sD_v
[Y, z_hist] = DIG(data(4:10,:), 'L',3840, 'L2', 20, 'pot_method', 'gamma', 'Gamma', 0, 'series_distance', sD);
figure
scatter(Y(:,1), Y(:,2), 10, labels, 'filled');
drawnow
end
```

```
Computing distances among time-windows of data
Using information geometry distance, make sure the data is approximatly Mul. Gaussian with 0 mean
Computing Affinity Matrix
Diffusing operator
Computing potential/gamma/inf_geometry distances
Pot = 2/(1-\gamma)*P^((1-\gamma)/2)
gamma = 0
MDS
```



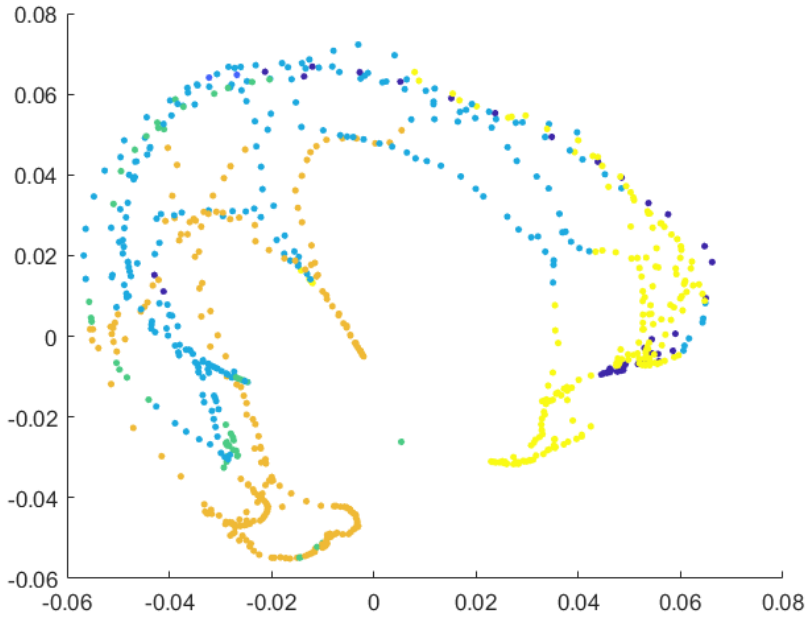

```
Computing distances among time-windows of data
Using Kullback-Liebler divergence, make sure the data is approximatly Mul. Gaussian with 0 mean
Computing Affinity Matrix
Diffusing operator
Computing potential/gamma/inf_geometry distances
Pot = 2/(1-\gamma)*P^((1-\gamma)/2)
gamma = 0
MDS
```



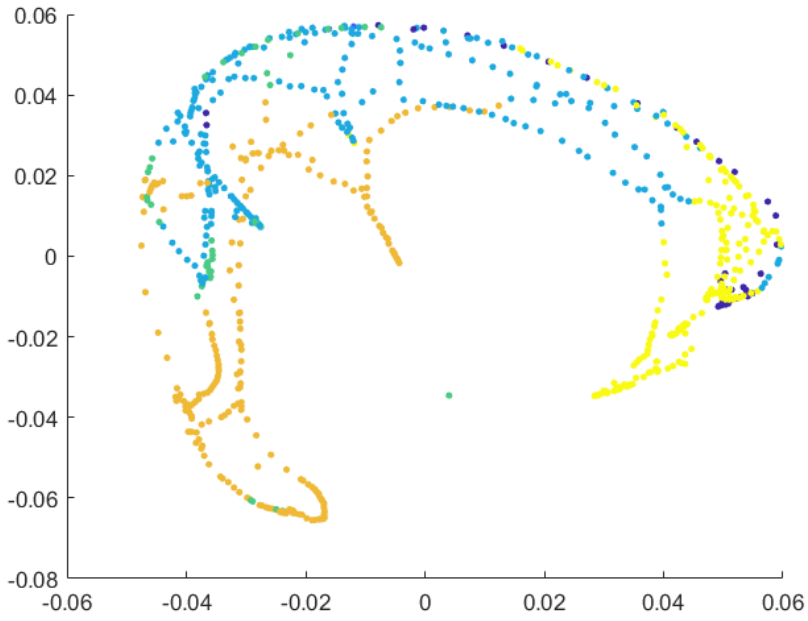
Finally we can choose different values of t and alpha.

```
t_v = [5, 10, 20, 30, 40];
for tv = t_v
[Y, z_hist] = DIG(data(4:10,:), 'L',3840, 'L2', 20, 'pot_method', 'gamma', 'Gamma', 0, 't', tv);
figure
scatter(Y(:,1), Y(:,2), 10, labels, 'filled');
drawnow
end
```

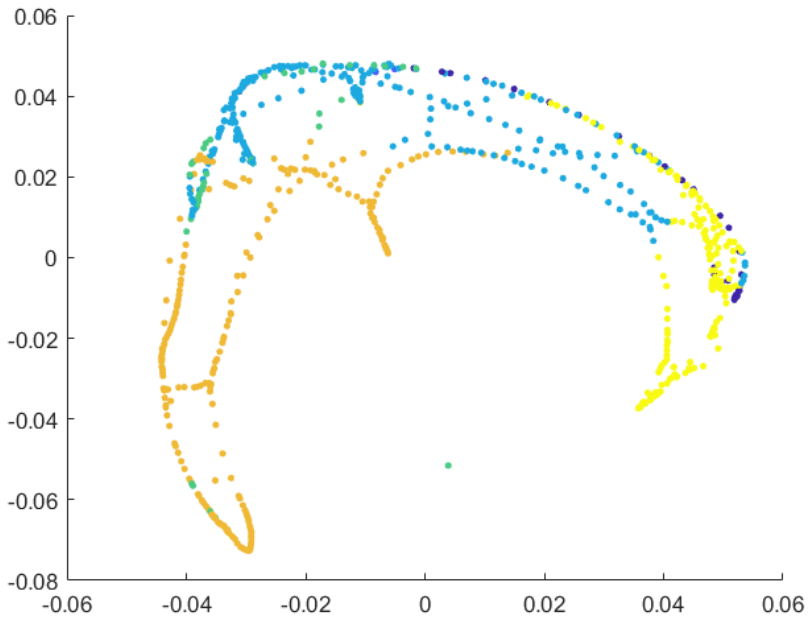
```
Computing distances among time-windows of data
Computing Affinity Matrix
Diffusing operator
Computing potential/gamma/inf_geometry distances
Pot = 2/(1-\gamma)*P^((1-\gamma)/2)
gamma = 0
MDS
```



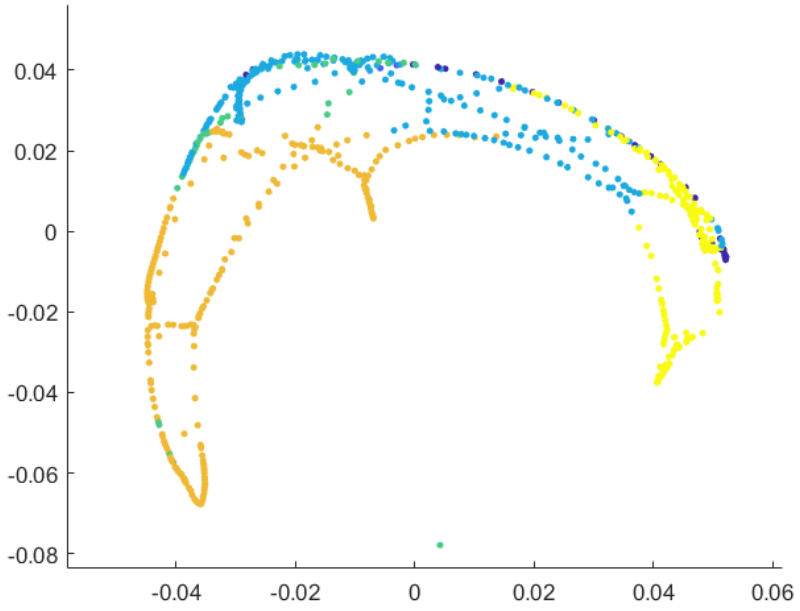

```
Computing distances among time-windows of data
Computing Affinity Matrix
Diffusing operator
Computing potential/gamma/inf_geometry distances
Pot = 2/(1-\gamma)*P^((1-\gamma)/2)
gamma = 0
MDS
```




```
Computing distances among time-windows of data
Computing Affinity Matrix
Diffusing operator
Computing potential/gamma/inf_geometry distances
Pot = 2/(1-\gamma)*P^((1-\gamma)/2)
gamma = 0
MDS
```




```
Computing distances among time-windows of data
Computing Affinity Matrix
Diffusing operator
Computing potential/gamma/inf_geometry distances
Pot = 2/(1-\gamma)*P^((1-\gamma)/2)
gamma = 0
MDS
```




```
Computing distances among time-windows of data
Computing Affinity Matrix
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Computing potential/gamma/inf_geometry distances
Pot = 2/(1-\gamma)*P^((1-\gamma)/2)
gamma = 0
MDS
```
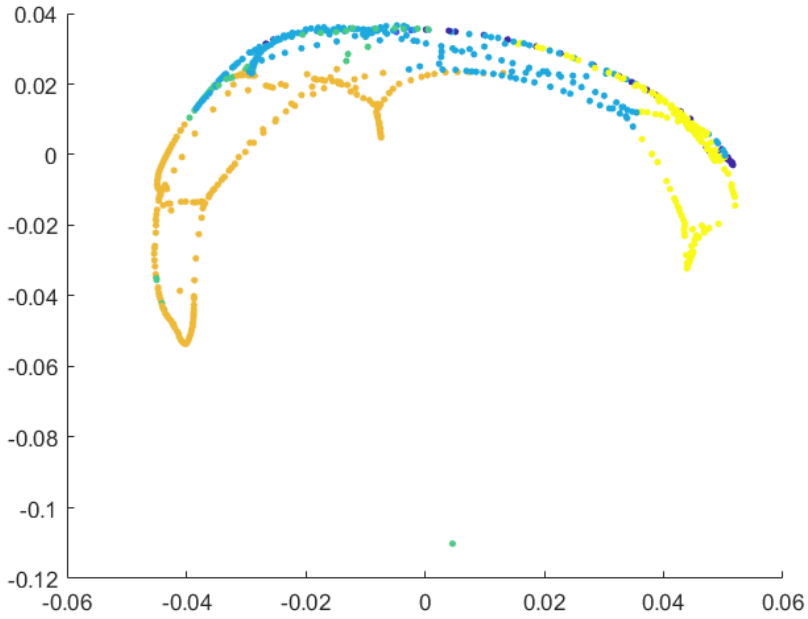
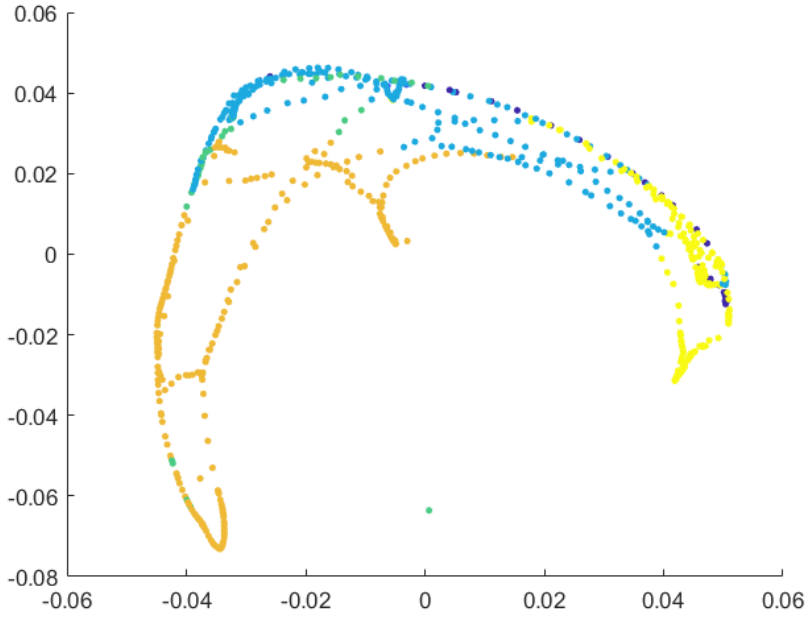




```
a_v = [2, 5, 15, 30, 40];
for av = a_v
[Y, z_hist] = DIG(data(4:10,:), 'L',3840, 'L2', 20, 'pot_method', 'gamma', 'Gamma', 0, 't', 20, 'a', av);
figure
scatter(Y(:,1), Y(:,2), 10, labels, 'filled');
drawnow
end
```

```
Computing distances among time-windows of data
Computing Affinity Matrix
Diffusing operator
```

```
Computing potential/gamma/inf_geometry distances
Pot = 2/(1-\gamma)*P^((1-\gamma)/2)
gamma = 0
MDS
```




```
Computing distances among time-windows of data
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Pot = 2/(1-\gamma)*P^((1-\gamma)/2)
gamma = 0
MDS
```

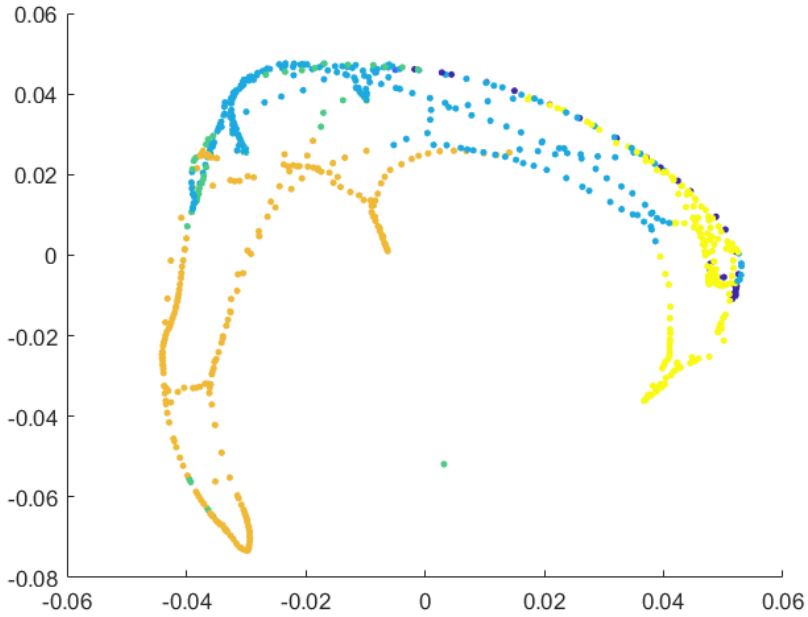


```
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Pot = 2/(1-\gamma)*P^((1-\gamma)/2)
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MDS
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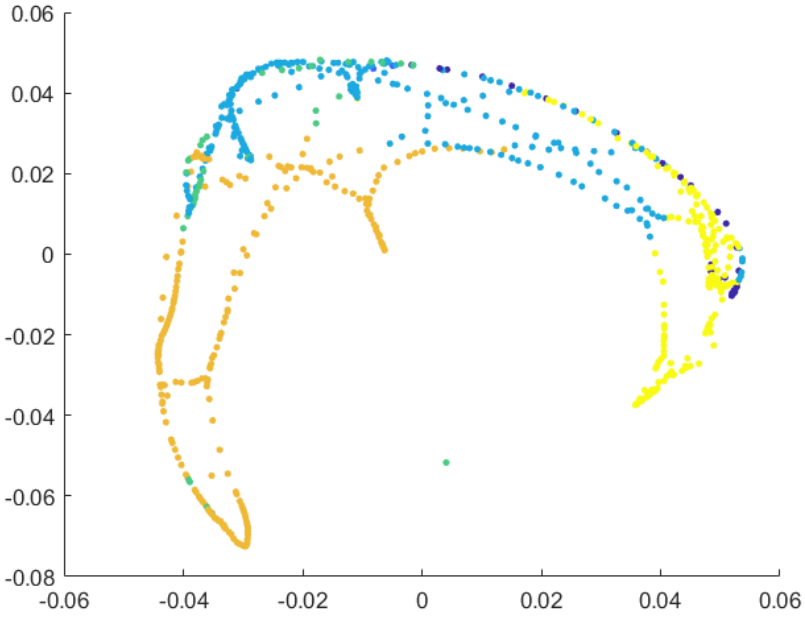


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Computing potential/gamma/inf_geometry distances
Pot = 2/(1-\gamma)*P^((1-\gamma)/2)
gamma = 0
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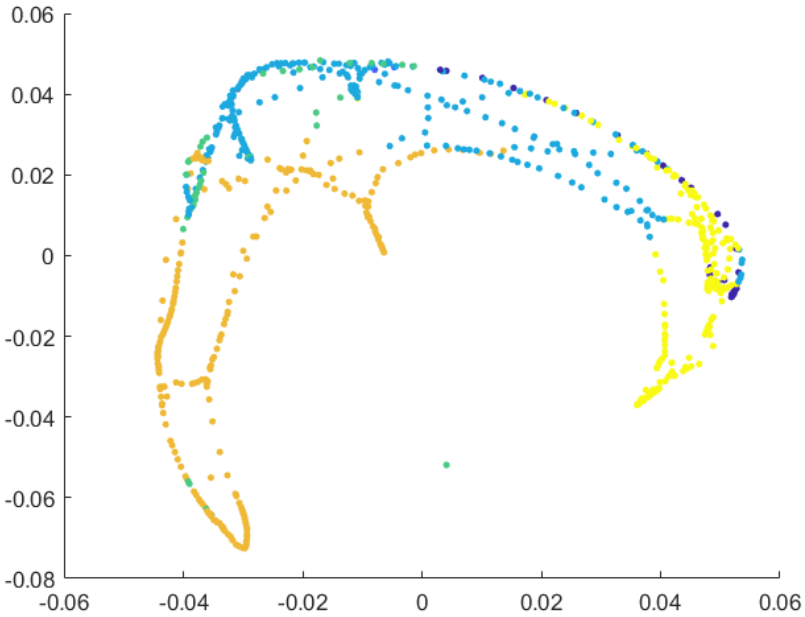


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Pot = 2/(1-\gamma)*P^((1-\gamma)/2)
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```

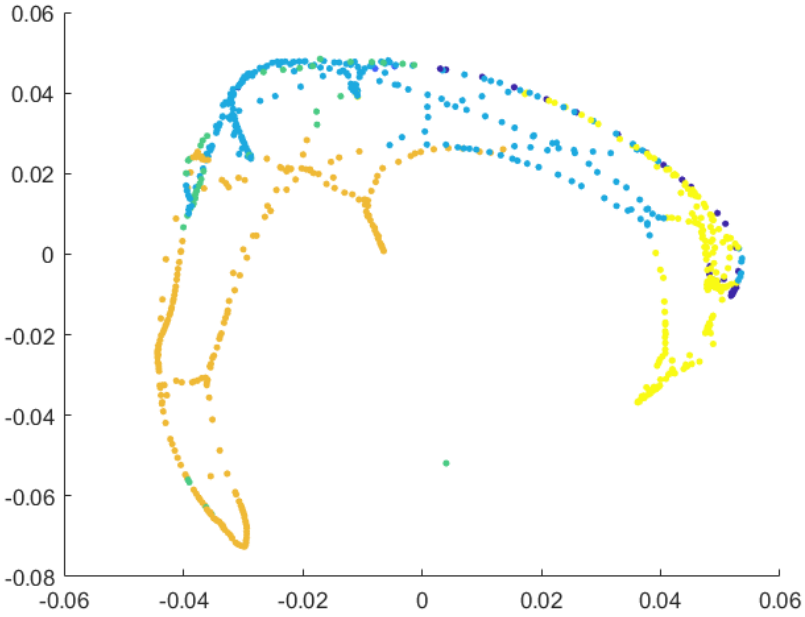
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.06
-0.04
-0.02
0
0.02
0.04
0.06