

```

1 %Part I
2 clear all;
3 close all;
4 %define functions
5 n=100;
6 m=100;
7 xx1=(0:n)/n;
8 xx2=(0:m)/m;
9 f=normpdf(xx1,0.3,0.02)+normpdf(xx1,0.5,0.02);
10 g=normpdf(xx2,0.3,0.02)+normpdf(xx2,0.6,0.02);
11
12 %Smooth x1 and x2 by splines
13 smthpara=1;
14 fs=fit(xx1', f', 'smoothingspline', 'SmoothingParam', smthpara);
15 gs=fit(xx2', g', 'smoothingspline', 'SmoothingParam', smthpara);
16 %Generate q1 from f and q2 from g
17
18 %x2=0:1/m:1;
19 for i = 1:length(xx1)
20     q1(i)=sign((fs(xx1(i)+0.0001)-fs(xx1(i)-0.0001))/(2*0.0001)).*sqrt(abs((fs(xx1(i)+0.0001)-fs(xx1(i)-0.0001))/(2*0.0001)));
21 end
22 for i=1:length(xx2)
23     q2(i)=sign((gs(xx2(i)+0.0001)-gs(xx2(i)-0.0001))/(2*0.0001)).*sqrt(abs((gs(xx2(i)+0.0001)-gs(xx2(i)-0.0001))/(2*0.0001)));
24 end
25
26 [path, E]=sldpSRSF2(q1,q2);
27
28 close all;
29 fig=figure();
30 set(fig,'Position', [200 200 1600 450]);
31 subplot(131);plot(f);hold on;plot(g((1:n)*m/n));title('before registration');
32 set(gca,'XTickLabel',[],'YTickLabel',[]);
33 subplot(132);imagesc(E);colormap(gray);hold on;plot(path(:,1),path(:,2));axis xy;
34 axis equal;set(gca,'XTickLabel',[],'YTickLabel',[]);
35 title('Warping function');
36 subplot(133);plot(f);hold on;
37 plot((1:n),g(round(interp1(path(:,1),path(:,2),1:n)*(m+1)/(n+1))));title('after registered');
38 set(gca,'XTickLabel',[],'YTickLabel',[]);
39
40 %Calculate da and dp
41 %da is E
42 da=E(n+1,n+1)
43 %plot(path(:,1),path(:,2));
44 pathd=slderi(path,1,1);
45 %plot(pathd(:,1),pathd(:,2));
46 dp=acos(sum(sqrt(pathd(:,2)))/n)
47
48
49 %%%Part2, Growth data.
50 close all, clear all;
51 dat=csvread('bgd.csv',1,0);
52 age=dat(:,1);
53 boy=dat(:,2:40);
54 girl=dat(:,41:length(dat));
55 %Visualization of data
56 fig1=figure();
57 set(fig1,'Position', [200 200 1100 450]);
58 subplot(121);plot(age,boy);title('Heights of Boys');xlabel('age');ylabel('Heights in cm');
59 subplot(122);plot(age,girl);title('Heights of Girls');xlabel('age');ylabel('Heights in cm');
60 %Derivatives(Growth rates)
61 %Smooth function and find growth rates.
62 %Pick two curve.
63 c1=girl(:,29);
64 c2=girl(:,28);
65 smthpara=1;
66 c1s=fit(age,c1, 'smoothingspline', 'SmoothingParam', smthpara);
67 c2s=fit(age,c2, 'smoothingspline', 'SmoothingParam', smthpara);
68 %Generate new functions gr1 and gr2 for derivative
69 x=1:0.2:18;
70 for i = 1:length(x)
71     gr1(i)=(c1s(x(i)+0.02)-c1s(x(i)-0.02))/(2*0.02);
72 end
73 for i=1:length(x)
74     gr2(i)=(c2s(x(i)+0.02)-c2s(x(i)-0.02))/(2*0.02);
75 end
76 %plot the functions of growth rate to be registered
77 close all;
78 plot(x,gr1);hold on;plot(x,gr2);title('Growth rates');xlabel('age');ylabel('Growth rate');
79
80 %Now lets calculate Q
81 %Smooth x1 and x2 by splines and scale the curve to between 0 and 1
82 smthpara=1;
83 fs=fit(((x-1)/max(x-1))', gr1', 'smoothingspline', 'SmoothingParam', smthpara);
84 gs=fit(((x-1)/max(x-1))', gr2', 'smoothingspline', 'SmoothingParam', smthpara);
85 close all;
86 fig1=figure();
87 set(fig1,'Position', [200 200 1100 450]);
88 subplot(121);plot(fs);hold on; plot(gs, 'b');title('Growth rate');
89 %Generate q1 from f and q2 from g
90 %x2=0:1/m:1;
91 n=100;
92 m=1000;
93 xx1=(0:n)/n;
94 xx2=(0:m)/m;
95
96 for i = 1:length(xx1)
97     q1(i)=sign((fs(xx1(i)+0.0001)-fs(xx1(i)-0.0001))/(2*0.0001)).*sqrt(abs((fs(xx1(i)+0.0001)-fs(xx1(i)-0.0001))/(2*0.0001)));
98 end

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99  for i=1:length(xx2)
100      q2(i)=sign((gs(xx2(i))+0.0001)-gs(xx2(i)-0.0001))/(2*0.0001)).*sqrt(abs((gs(xx2(i))+0.0001)-gs(xx2(i)-0.0001))/(2*0.0001)));
101  end
102  subplot(122);plot(xx1,q1);hold on; plot(xx2,q2);title('Functions q1 and q2');
103
104  % Ready to register
105  [path, E]=sldpSRSF2(q1,q2);
106
107  close all;
108  f=fs(xx1);
109  g=gs(xx2);
110  fig=figure();
111  set(fig,'Position',[200 200 1600 450]);
112  subplot(131);plot(f);hold on;plot(g((1:n)*m/n));title('before registration');
113  set(gca,'XTickLabel',[],'YTickLabel',[]);
114  subplot(132);imagesc(E);colormap(gray);hold on;plot(path(:,1),path(:,2));axis xy;
115  axis equal;set(gca,'XTickLabel',[],'YTickLabel',[]);
116  title('Warping function');
117  subplot(133);plot(f);hold on;
118  plot((1:n),g(round(interp1(path(:,1),path(:,2),1:n)*(m+1)/(n+1))));title('after registered');
119  set(gca,'XTickLabel',[],'YTickLabel',[]);
120
121  da=E(n+1,n+1)
122  pathd=slder1(path,1,1);
123  dp=acos(sum(sqrt(pathd(:,2)))/n)

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