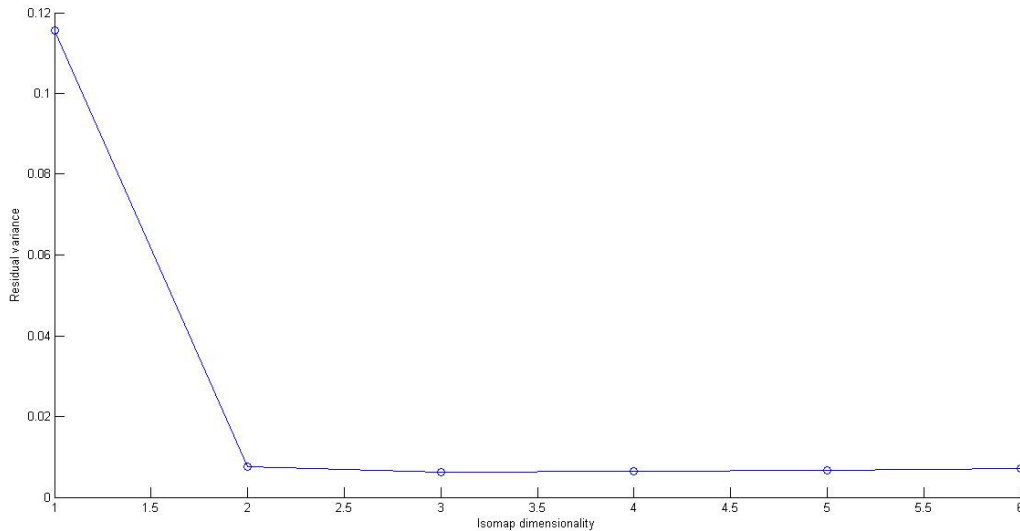


1) Isomaps

a) Graph of residual errors v/s dimensions:-



b) Discuss the result you find:-

It can be seen that the maximum reduction in error is up to the case when we reduce the data to 2 dimensions, which can be interpreted as two variables which can characterize the whole data. On increasing the dimension to greater than 2, the change in residual error is very less.

c) In the 2-D mapping, a graph is generated. Label some of the points in this mapping with the theta1, theta2 in the text file. Are the boundary thetas at the boundaries of the 2D-patch?

Some of the boundary points from the text file were 10, 16, 17, 38, and 59. These data points were found to lie on the boundary of the 2-D mapping as well.

d) When we compute this graph on the images in randomMotion1K.zip, how do the residual errors change?

The Comparative study of the residual errors in the 2 cases is as follows:-

Dimension	Residual Error in randomMotion100.zip	Residual Error in randomMotion1k.zip
1	0.11567	0.092076
2	0.0075598	0.0021925
3	0.0063086	0.0018417
4	0.0065472	0.001772
5	0.0066643	0.0017997
6	0.0070606	0.0020052

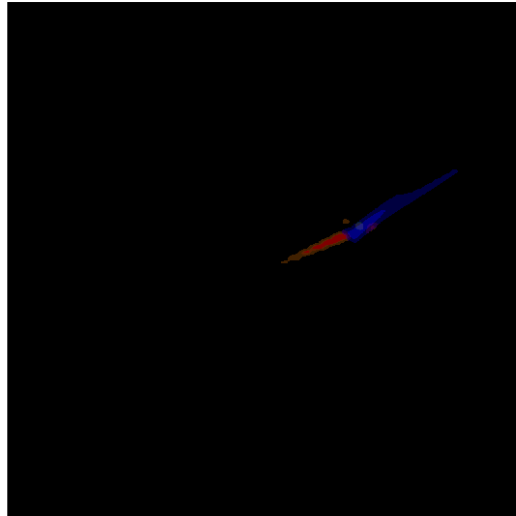
e) Give a table of the first 20 theta1 theta2 vs. y1 y2 (Isomap). What can you say about mapping these ys to theta1 and theta2 of the arm?

Data Point	Theta 1	Y1	Theta 2	Y2
1	21.70828	-969	23.28976	-1705
2	20.96372	-321	26.44559	-1917
3	25.77304	2059	19.94295	-486
4	26.92194	-407.8	10.45338	722.8
5	28.73904	3223	16.16286	826
6	24.46046	-1683	12.61411	223.7
7	27.3252	-836.7	7.879244	1008
8	23.94294	936.7	21.59286	-845.8
9	28.45035	1804	13.06541	732.9
10	27.15539	-1865	4.504699	1372
11	24.55825	-2989	7.640685	705.7
12	25.45228	-1018	12.36145	389.6
13	25.68585	3064	23.49548	-1104
14	28.67719	-1106	4.586599	1420
15	22.75509	-3374	12.45213	-196.5
16	29.24095	1752	9.477505	1258
17	27.89461	-1224	4.657732	1395
18	20.82206	-	27.99078	-
19	20.25575	-4930	12.82847	-431.2
20	23.82182	-3216	9.27291	442

It can be seen from the table that the Y1 and Y2 are not exactly the theta1 and theta 2, but are an interpolation of the same. The exact expression can be obtained from regression analysis.

2) Linear Mapping and Reconstruction

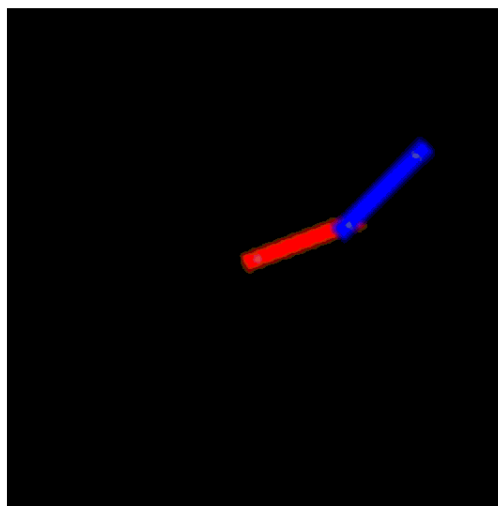
The reconstructed image is given below:-



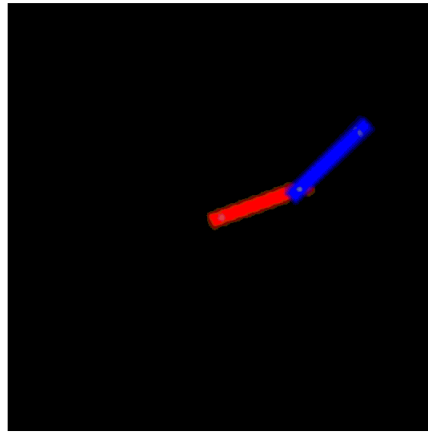
P.S: The code used for getting this image is attached on the webpage

3) Non Linear Mapping and Reconstruction

a) LLE



b) Isomap



c) As can be clearly seen, the quality of the reconstructed image is greater in the Isomap than in the LLE case than in the PCA case.

The system is able to reconstruct the multidimensional image back from 2D because of the fact that the 2 dimensions i.e. theta 1 and theta 2 are the parameters which affect the image the most.

4) For 2000 images

Description	Isomap	PCA
Reconstructed Image		
Remarks	Image Quality is good	Image Quality is poor

Thus it can be seen that the non linear methods work better than the linear one.