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Video Manifold Feature Extraction Based on ISOMAP

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ABSTRACT : *ISOMAP is a nonlinear dimensionality reduction method and also one of several widely used low-dimensional embedding methods. ISOMAP is one representative of isometric mapping methods,and extends metric multidimensional scaling by incorporating the geodesic distances imposed by a weighted graph. In this paper, nonlinear dimensionality reduction Isomap is introduced in context of video manifold feature extraction. According to MATLAB tests, ISOMAP algorithm is able to reduce dimensionality greatly and provide an alternate tool for video analysis.*

KEYWORDS- *Feature extraction, Images, ISOMAP, Manifold, Video.*

I. INTRODUCTION

Digital video is a technology which is most widely developed during the past few decades. The use of digital techniques in video created digital video, which allowed higher quality and, eventually, much lower cost than earlier analog technology. In simple terms video can be defined as an electronic medium for the recording, copying, playback, broadcasting, and display of moving visual and audio media. Video is a medium of communication that delivers more information than any other elements of multimedia. But there are various complexities of video data and current video processing methods have limited uses in fields of video data modeling, indexing and retrieval. One of the basic step of video analysis is feature extraction[1].Feature extraction (or dimensionality reduction) is an important research topic in computer vision, pattern recognition and machine learning fields. The curse of high dimensionality is usually a major cause of limitations of many practical technologies, while the large quantities of features may even degrade the performances of the classifiers when the size of the training set is small compared with the number of features[11].A number of feature extraction methods have been developed in past several years in which one of the basic is principle component analysis(PCA)[13],linear discriminant analysis(LDA)[13], and multidimensional scaling(MDS)[14] ,these methods come under linear dimension reduction methods and simple and easy to implement. In recent years studies shown that many biometric systems[2] and multimedia videos [3]are using elegant nonlinear dimension reduction methods for feature extraction. If the number of attributes is large, then the space of unique possible rows is exponentially large. Humans often have difficulty comprehending data in many dimensions. Thus reducing data to a small number of dimensions is useful for visualization purposes. Among the various methods, the most well known methods are isometric feature mapping(ISOMAP)[4],local linear embedding(LLE) [5]and Laplacian eigenmap, locality preserving projections(LPP)[6].These methods are quite useful for facial or digit images and other real-world data sets. However, all of these methods, either linear methods or nonlinear ones, attempt to find the low dimensionality features of single sample. The relationship between the samples has not been considered. In other words, when these collections are video sequences, these algorithms ignore the temporal coherence between frames, even though this cues provide useful information about the neighborhood structure and the local geometry of the manifold.In this paper video manifold feature is defined first and then extract the feature manifold through ISOMAP. The proposed manifold feature extraction method is applied to the frames obtained from the video. The rest of this paper is arranged as follows :The video manifold feature is defined in section 2.1;In section 2.2 ISOMAP method is described; Video manifold feature extraction using ISOMAP is provided in detail in section 2.3.Experimental results on video frames are presented in section 3;Finally ,the conclusion is given in section 4.

II. VIDEO MANIFOLD FEATURE EXTRACTION BASED ON ISOMAP

Videos can be represented by a hierarchical structure consisting of four levels(video,scene,shot,frame) from top to bottom increasing in granularity, while a shot is the basic unit of a video[9].In general a video has a multiple shot, which is an ordered set of images. The video manifold feature is a low dimension description of the video sequences, which is extracted by ISOMAP embedding.

(a).*Video Manifold Feature*
Provided the given video clip is consisting of frame sequence $(f_{1,}f_{2,....}f_k)$.All m×n pixel images frames f_i exist in the m×n dimensional space.

Definition : Given a dimensionality reduction method M,M is used to reduce the dimension of the original features to d
$M: (f_1, f_2, \dots, f_k) \to (v_{1,}v_2, \dots v_k)$
Each v_i is a d dimensional vector, and $(v_1, v_2, \dots. v_k)$ is d dimensional vector sequence, $(v_1, v_2, \dots. v_k)$ is called video manifold feature.
In general, d≤3.When d=1, $(v_1, v_2, \dots. v_k)$ is transformed into 1D vectors, so it is called video manifold feature vector

(b).*Manifold Feature Extraction using ISOMAP*

ISOMAP

Input: an n×n matrix pair wise distances with some (perhaps most) distances unknown.
Output: Point coordinates such that the pair wise distances are best approximated.
Method: Define a graph whose vertices are the set of points, and whose edges are the known pairwise distances[10]. Compute all-pairs shortest path distances
in this graph, which defines a distance between every pair of nodes. Use MDS to find point coordinates which satisfy these (now complete) distance constraints.

We can regard video sequence as the high-dimensional Euclidean space Rf^{N+1}, where N is pixel number of each frame. Each frame of video can be seen as a point in Rf^{N+1} space, these points have a local relevance[1]. The given the video is consisted of frame sequences ($f_{1,}f_{2,....}f_n$).The methods in detail are as follows :
(1).Transforming frame sequence $f_i(i = 1, \dots. k)$ into a one-dimensional vector F_i with size M*N (M,N for the number of frame rows and columns respectively).
(2).Define a sparse matrix M whose i,j entry is $f(image_i, image_j)$ .Resizing the images by converting the images into gray scale and then by making an array of images.
(3).Compute ISOMAP embedding using the algorithm of "Tenenbaum,de silva and Langford(2000)" where parameters are given as

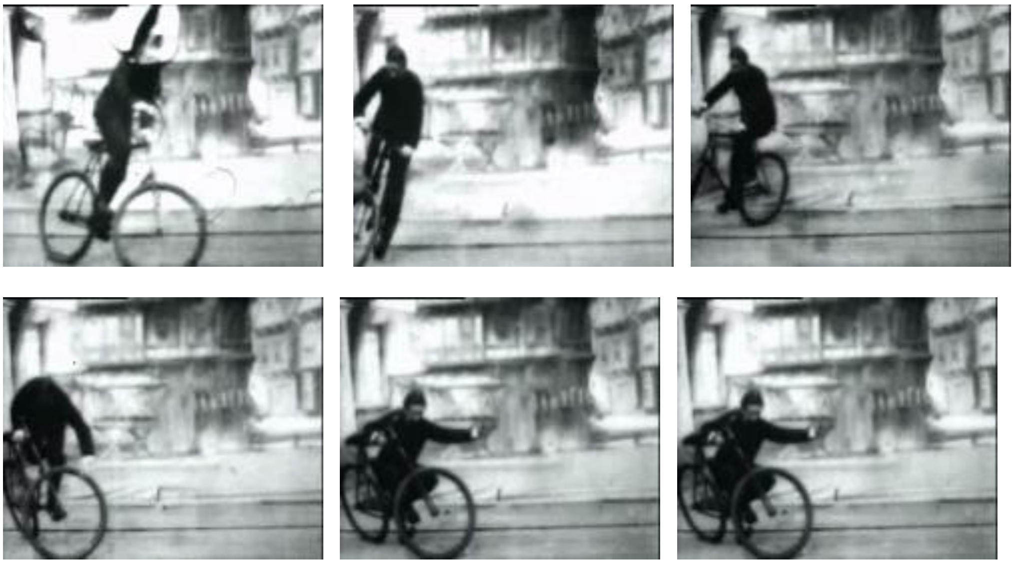
[Y,R,E] = isomap(D,n_fcn,n_size) (1)
Input :
D= N×N matrix of distances(where N is the number of data point)
n_fcn=neighborhood function(epsilon or 'k')
n_size=neighborhood size(value for epsilon or 'k')
Output;
Y= Y.coords is a cell array with coordinates for d-dimensional embedding in Y.coords{d}
R= residual for embedding in Y
E= edge matrix for neighborhood graph
(4).Showing the output manifold images with data and image set.

TABLE 1. VIDEO MANIFOLD FEATURE EXTRACTION BASED ON ISOMAP

Input : video clip
Output : d-dimensional manifold feature
1.Transform frame sequences $f_i(i = 1,2, \dots k)$ into a one dimensional vector F_i
2.Compute Isomap embedding by using equation (1).
3.showing data and image manifold for several combinations of vertical and horizontal dimensions.

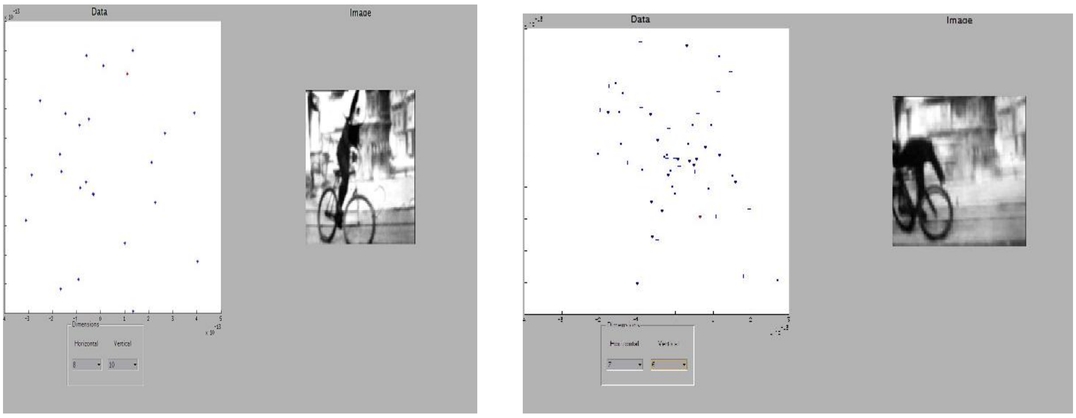
III. EXPERIMENTS AND RESULTS

The video experimented here is a clip from 'Bicycle trick riding,no.2.mpeg'[15].The clip opens with a man riding a bicycle in a forward circle, pausing and balancing for a moment, then continuing in a forward circle. Some images sample from the clip in Fig.1(a).



(a)

Fig.1(b) shows some manifold output for several combinations of vertical and horizontal dimensions :



(b)

Figure1.(a) Some frames (b) manifold output for (x=8,y=10 and x=7,y=6)
Fig.2 shows a combined output of several positions of the person on the manifold embedded output plane

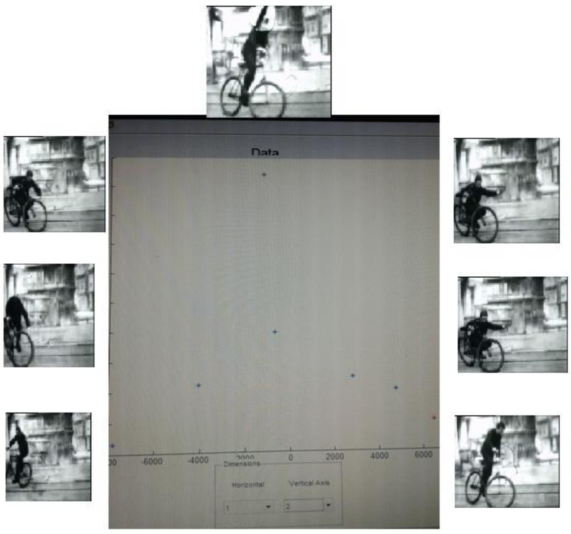


Figure 2. showing combined output of frame positions on the manifold embedding.

IV. CONCLUSIONS

This paper first gets a video into frame sequences and defines a novel video feature ,called video manifold feature, then we extract the manifold feature using ISOMAP embedding. When we compare this ISOMAP embedding with LLE we find that LLE tends to handle non-uniform sample densities poorly because there is no fixed unit to prevent the weights from drifting as various regions differ in sample densities.

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REFRENCES

Journal Papers

[1]. 1 2 Maosheng Fu , Qin Xu,Min Kong and Bin Luo,Manifold "*Feature Extraction for Video Based on Local Linear Embedding" , The 5th International Conference on Computer Science & Education,Hefei,China.*August 24-27,2010.

[2]. Ryazard Schoras," *Image Feature Extraction Techniques and Their Applications for CBIR and Biometrics Systems",International Journal of Biology and Biomedical Engineering.*

[3]. Sen-ching S. Cheung and Avideh Zakhor*," Fast Similarity Search and Clustering of Video Sequences on the World-Wide-Web",,IEEE Tranactions on Multimedia,Vol 7.No.3*,June 2005

[4]. J.B.Tenenbaum,V.de Silva,J.C.Langford,"*A global geometric framework for nonlinear dimensionality reduction",Science 290(2000) 2319-2323.*

[5]. S.T. Roweis, L.K. Saul, *"Nonlinear dimension reduction by locally linear embedding", Science 290 (2000) 2323–2326.*

[6]. M. Belkin, P. Niyogi*," Laplacian eigenmaps for dimensionality reduction and data representation", Neural Computation 15 (6) (2003) 1373–1396.*

[7]. X. He, S. Yan, Y. Hu, H. Zhang*," Learning a locality preserving subspace for visual recognition', in: Proceedings of the Ninth International Conference on Computer Vision, France, October 2003, pp. 385–392.*

[8]. Saul, L., Roweis, S.: *"Think Globally, Fit Locally: Unsupervised Learning of Nonlinear Manifolds". Technical Report MS CIS-02-18, University of Pennsylvania. (2002).*

[9]. Y.Rui,T.S.Huang, S.Mehrotra, *"Constructing Table-of-Content for Videos", ACM Multimedia Systems Journal, Special Issue Multimedia Systems on Video Libraries, Vol.7, No.5, pp. 359-368,* Sept. 1999

[10]. .Robert Pless," Image Spaces and Video Trajectories: Using Isomap to Explore Video Sequences", Department of Computer Science and Engineering, Washington University in St. Louis.

Books:

[11]. A.K Jain,B.Chandrasekaran,*Dimensionality and smaple size considerations in pattern recognition practice,in :Handbook of Statistics,(*North Holland,Amesterdam,1982)

[12] .R.O.Duda,P.E.Hart,*Pattern Classification and Scene Analysis(*,Wiley,New York,1973).

[13]. I.T.Jolliffe,*Principal Component Analysis*,(1989,Springer-Verlag,New York).

[14]. T.Cox and M.Cox. *Multidimensional Scaling*,(1994,Chapman & Hall,London).

[15]. http://www.open-video.org/details.php?videoid=4750