THE APPLICATION RESEARCH OF MANIFOLD-LEARNING ALGORITHMS IN HUMAN ACTION RECOGNITION

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ABSTRACT

The recognition of Human Action is the key technique of the intelligent video surveillance system. Recognition of human action mainly on image sequences containing human motion analysis and processing,usually involves five processes such as moving object detection, moving object classification, moving object tracking,feature extraction,motion description and human behavior analysis. Since the formation of the video image sequence data are high dimensional data,dealing directly with the difficulties,it is necessary to use the appropriate method to reduce. Manifold-Learning Algorithms is a effective method of data dimensionality reduction,In this paper,Manifold-Learning and basic principle of typical algorithms such as PCA and LLE are explicitly introduced.Finally,simulation of human action recognition based on LLE algorithm has been carried out,the experimental results verify the effectiveness of the algorithm.

KEY WORDS: Manifold-Learning, Human Action Recognition, Local Linear Embedding(LLE)

1. INTRODUCTION

Recognition of human action is the intelligent video surveillance system for one of the key issues in recent years have achieved some success at home and abroad, such as: University of Reading, UK has carried out the tracking of vehicles and pedestrians and their interactions studies identified ; the United Kingdom, Portugal and France CAVIAR project jointly carried out by groups and individuals to analyze the behavior patterns to detect the occurrence of abnormal behavior, and thus real-time automatic alarm [1-4]; domestic start of the study in the field relatively late, but there are also Many universities and research institutions such as the Institute of Automation Chinese Academy of Sciences State Key Laboratory of Information Processing Perception, Peking University and Tsinghua University State Key Laboratory of Human Behavior Recognition for key technologies in-depth research.

Human action recognition [5] mainly on image sequences containing human motion analysis and processing, usually involving the motion detection, moving object classification, object tracking, feature extraction and motion description] and human behavior analysis of five processes. Since the formation of the video image sequence data are high dimensional data, dealing directly with the difficulties, it is necessary to use the appropriate method to reduce.

Manifold learning (manifold learning) is to effectively describe the structure of a manifold embedded in data sets and found that the data sets related to the inherent laws. Manifold learning data set in the unknown but assumed the existence of low-dimensional effect of the internal variables in the observation space will form a high-dimensional manifolds. This problem is universal, in image processing, speech, text analysis of this phenomenon exists.

This commonly used in the study based on manifold learning algorithm, select the video image sequence LLE algorithm to reduce the dimensions to be relatively rapid global profile of human characteristics, in order to further provide the basis for human behavior recognition.

2. MANIFOLD-LEARNING ALGORITHMS

Roweis, Saul, and Tenenbaum and others in "Science" magazine published three papers in 2000[6] [7] [8], discussed the manifold learning, and for the first time using manifold learning (manifold learning) the term , marking the birth of manifold learning methods.

Manifold learning goal is to effectively describe the structure of a manifold embedded in data sets and found that data sets related to the inherent laws of manifold learning algorithms can be used for high-dimensional data dimensionality reduction. And general, that the body image is a manifold structure. Recognition in human behavior, often due to the light, pose and imaging process variability and other factors identified difficulties. The essence is the reason for the difficulty caused by the so-called "curse of dimensionality", the video image sequence in the human data is a typical high-dimensional data. Manifold learning the main objective is to find high-dimensional data space of the low-dimensional observation of smooth manifold. Just to find out from the manifold body control variables such as illumination and pose, you can significantly reduce the dimension of observation space.

Manifold learning algorithms can be divided into two types of linear and nonlinear.

Linear manifold learning algorithms are Principle Component Analysis(PCA) and Locality Preserving Projects(LPP) and so on.

Principal component analysis (PCA) [9] is a linear dimension reduction by simplifying the data structure to the classical method. The basic idea of PCA is: the original large number of relevant variables into a smaller number of uncorrelated variables. The usual practice is a linear combination of original variables into a number of integrated variables, not related to these integrated variables, and as far as possible that the information contained in the original variable, select some of the largest principal component analysis, so that you can as far as possible little loss of original information, based on the data dimension reduction, improved operational efficiency.

For example, in determining the type of an image, you should consider many features, such as color histogram, texture, edges, light and shade, regional distribution and so on. To list them all, perhaps there are dozens of hundreds of features. Therefore, several integrated features with the small amount of the original place of many features is a practical significance. Principal component analysis of variance by linear transformation to retain large, containing information on more weight, remove the variance is small, with less information on the quantity of image data in order to achieve dimensionality reduction.

PCA of the ellipsoidal distribution of the sample set has good results, the main study by the ellipsoid axis direction is the direction. The algorithm is a non-supervised algorithm, we can find the best representative of the direction of all samples.

Although the PCA in many pattern recognition applications, have achieved good results, but because it is based on the best of all the samples for the purpose of reconstruction, and the PCA is an unsupervised learning method, so for the description between different types of samples differences, it is not necessarily the best description.

Nolinear manifold learning algorithms are Isometric Mapping (ISOMAP) and Local Linear Embedding(LLE) and so on.

Local linear embedding (LLE) algorithm is a nonlinear unsupervised learning algorithm. The algorithm that the local significance, the data structure of the linear, or local in the sense of the points in a hyperplane. So take any point, you can use it around the point (known as points in the neighborhood) that a linear combination. Map consists of a symmetric local linear reconstruction derived from the actual embedded computing for the sake of simplifying the problem of a sparse feature functions.

LLE algorithm can be divided into three steps:

step1:Find k-points for each sample points in the neighborhood;

step2:Each sample point from the point of the neighborhood of sample points to calculate the partial reconstruction of the weight matrix;

step3:The sample point by the weight of the local reconstruction of its points in the neighborhood matrix and calculate the output value of the sample points.

Specific algorithm flow shown in Figure 1:

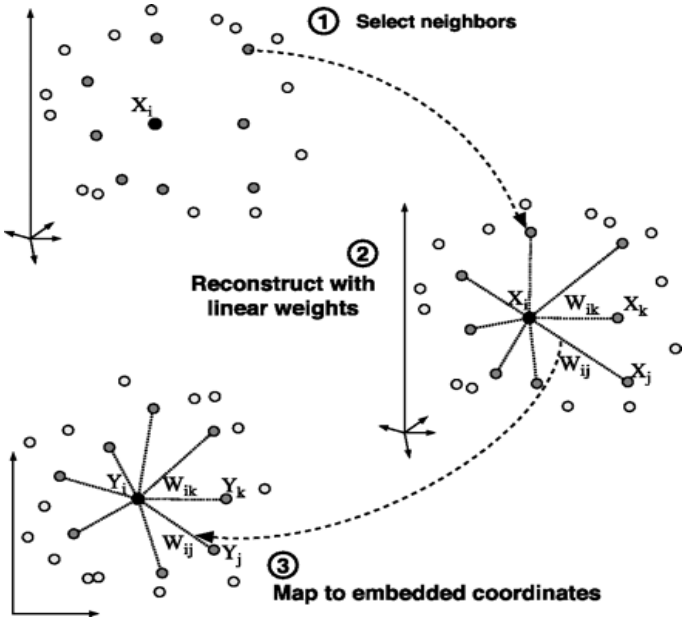

Fig.1 LLE algorithm flow

Isomap algorithm with the global geodesic distance to keep the same idea in different, LLE algorithm is obtained by local linear fitting to the inherent global linear structure. So when the local manifold is approximately linear when the LLE algorithm can achieve a satisfactory low-dimensional embedding. LLE algorithm provides additional arbitrary dimension can learn low-dimensional local linear manifold capabilities. However, LLE algorithm is only applicable to non-closed manifold learning and called for the full sample and smooth samples, in addition to the algorithm is sensitive to noise.

3. HUMAN ACTION RECOGNITION EXPERIMENTAL BASED ON LLE

LLE algorithm for high dimensional data visualization and statistical description is very effective, and less of its parameters, this paper select the LLE algorithm to manifold learning algorithms in the recognition of human behavior research. To prove the effectiveness of the algorithm, we conduct a simulation experiment.

This experiment uses its own sample database. Database, a total of 1500 valid image sequence, image acquisition and after the indoor normalization, each frame 75 × 100, to grayscale. Image sequence recorded human motion in several directions, and each movement has 4 cycles.

In this simulation experiment system, each frame into a one-dimensional vector drawing, then the whole body contour image sequence can be expressed as a two-dimensional matrix, each row represents an observation value, high-dimensional data of each column represents the one-dimensional.

LLE algorithm is less input parameters, mainly the number of data points for the neighborhood and low-dimensional space dimension. Through observation, low-dimensional space dimension is 3 better, but the number of data points in the neighborhood can be selected in 5,10,15,20,30,40. Experiments by clustering the sample database, found that the number of data points the neighborhood when the clustering effect in the 15 or so good and stable.

LLE data by dimensionality reduction algorithm to the original three-dimensional space, any two can calculate the distance between low-dimensional data points, you can use Euclidean distance, or distance from the popular hausdorff way classification of human behavior.

Because the algorithm uses the contours of the overall characteristics of human motion and contour between frames in the sequence similarity, so the recognition performance directly affected by the effect of data preprocessing, the pretreated sequence of the human body contours under ideal the algorithm the recognition rate of over 90%, with the effect of the extracted silhouette becomes worse, the recognition rate will be seriously affected.

4. SUMMARIES

Manifold learning algorithms is an effective method of dimensionality reduction, and human behavior recognition in image sequence processing is a typical high-dimensional data processing tasks, therefore, of manifold learning algorithm in the field of human behavior recognition application is very Significance. This paper describes the common manifold learning algorithms, select one of the LLE algorithm simulation of human behavior recognition experiment results

show that the effectiveness of the algorithm. With the manifold learning algorithms that further research in human behavior recognition and other pattern recognition results achieved in the field will be more and more.

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