

The Model Based Behavior Driven Arithmetic Research

Song Jinbao^a, Li Junyu^b Zhang Qin^c

Information Engineering School, Communication University of China, Beijing, China

^asongjinbao@cuc.edu.cn, ^blijunyu2008@cuc.edu.cn, ^czhangqin@cuc.edu.cn

Keywords: Motion Model; Particle Filter; Behavior Driven

Abstract. This paper is based on the particle filter for discrete particle track prediction theory, analyses the motion of animation with the methods of picking key points and predicting motion trace by utilizing particle filter. The behavior model has been built for the already existing animation character. During the research, the thesis realized using existed animation motion trace model to drive a similar figure and create a new animation.

Introduction

In the recent years, digital media technology, IP network technology, the 3G mobile communication technology and cultural and creative industries develop rapidly, and more and more combine closely together. Then it triggers the people's demand for the real time and high quality multimedia data transmission, new media production methods (especially the computer animation production) and new man-machine interaction. The demand in turn puts forward higher request for media processing technology. A given model analysis of the movement is the most basic and important for the media processing. The basic action characteristics analysis of dynamic video, not only can help understand video behavior, but also can be used for similar behavior imitation between similar objects. So this paper will focus on the research of model based behavior driven related algorithm and program realization.

Motion Capture and Behavior Driven

The behavior capture and model driven emphasis is on the moving object segmentation and the analysis of the needed track of the object movement. This kind of the capture problem can be shown on Fig. 1. In the animation video target behavior tracking, the application of motion capture field and the description of status quo, video target tracking, and motion capture is a basic research. It appeared many tracking algorithm. The proposed standards and classification was different, often results were not the same. No matter how behavior capture is, it can't be inseparable from a few key points of the physical motion, center of gravity, trajectory, edge outline, problems such as object properties [1]. So the movement behavior capture so long as can solve these core problems, it can achieve model, and then similar object can be driven by the model.

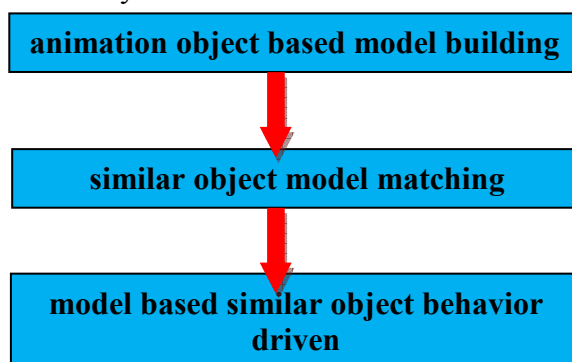


Figure1: Behavior driven flow chart

Most of the animation makers are not willing to use model driven but directly use pencil or computer lever for art, because it is very difficult to establish the animation object model and get better behavior capture. This is why the job is difficult to rise at home and abroad. Along with the development of particle filters in recent years, it simplifies the way of extracting motion point information frame by frame, greatly liberates the labor force of modeling and makes computation more intelligent. It can be get rid of that only 3D can use the model driven way. The 2 D animation also can realize the way of using motion model and can make similar animation objects driven by model become a reality [2].

Animation Object Behavior Capture. In the field of animation object capture and tracking statistical model, in recent years the Particle Filter as a kind of nonlinear filtering algorithm, has become a mainstream, object-oriented tracking algorithm because of getting rid of the restrictive condition of Gaussian distribution. Choosing particle filter as the animation object behavior capture algorithm will enhance the ability of the object tracking, make capture mode more perfect and make it easy to input data while building model. The Particle Filter performs a recursive Bayesian filtering algorithm through the Monte Carlo Sampling. The key idea is using a group of random samples with weights and signifying a Posterior Density Function PDF based on these sample estimates. When the sample is very big, the estimate will be equal to PDF [3]. The particle filter can extract motion model from the dynamic image. This model will drive other object to finish similar movement. This can greatly reduce object tedious physical attributes in motion and simple the form of image motion capture, shown as Fig. 2.

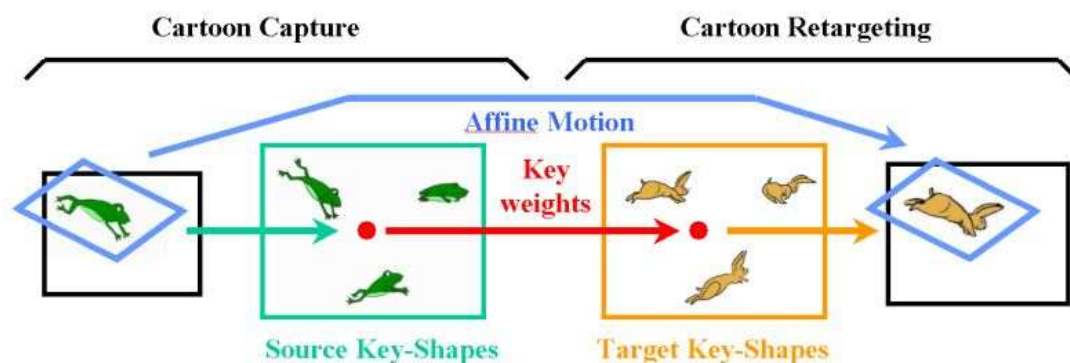


Figure 2: Model based behavior driven whole preview figure

Target Model Building. Target tracking process is random, nonlinear, the problem can be described as: in a given a set of observation condition, do the Bayesian estimation to the target motion state[4]. So you make the target tracking problem abstract for the state vector estimate. The state vector used to describe the location of the object, speed, acceleration and outline and other information. A dynamic system needs at least two reference models. One model is to describe the state which changes over time, the other is observation model which is the state related.

Because the classic particle filter is based on Bayesian tracking algorithm, using prior probability, estimate the moving targets state probability, and through the latest observation data to fixed target state distribution. The essence of estimate problem is under the premise of the acquisition of all the observed data at t moment and before t moment, to use the system state model to predict state prior probability density, to use the recent observations to update and get the posterior probability of t moment $P(X_t | Z_{1:t})$. The tracking process includes condition forecasting, data association, and state updates. The current state is related of the recent past state only, and regardless of the status of the earlier. And the first state probability density is used Gaussian distribution as the initial value[5]. So they can work out forecast position frame by frame, get motion vector, establish the model matrix and facilitate the dynamic behavior driven of the similar object[6].

Behavior Driven Of Moving Object. The driven model matrix is get after filtering based on the dynamic behavior. The similar objects, according to the same algorithm, will be tracked by similar particle filter. The data within the matrix will be used to similar object which lets objects look in the

trajectory of the model based same movement. Because after the particle filter, the matrix not only includes contour information, but also includes the next frame position vector, so it can be used for similar object, predict the trend of next frame and give effect drive to the similar object[7].

In the behavior driven of objects, it is to establish similarity between the driven object and the model object [8]. After all, in the object model, just to point trajectory to carry on the forecast, no way to change it movement way and movement form. For example a tiger can't drive a hippopotamus heavy running condition, because both the consistent physical movement and inconsistencies of volume and form can't become unity. So a tiger can drive a vigorous leopard running, this part of the form is almost unanimously similar between each other and the effect of drive is really good.

Technology Realization

Video Analysis And Looking For Contour.

Video Analysis. In the video analysis section, we think out two kind of way. The first way is automatic using the decoding information during compression for analysis; another way is using artificial way to mark the key points on the contour after video image is analytical out and analyzing video. The realize speed of the first kind of way is more quickly than the second one, but some key points selected of the outline is not ideal which influences subsequent frames analysis. Although the second method is trouble, but it can directly get the animation character key information which makes further analysis accuracy greatly improved. It is more feasible method of analysis. So in the realization of the program, we choose the second method for the video analysis.

Looking for Contour. There is a significant change between different areas of image around the contour. Contour is formed by the lightness suddenly change. Contour is a shape of any border or shape line. In the contour looking for, because program only recognize that points, so we must extract video information of the marked points, especially the information of α channel and RGB information. This is very important for establishing the observed equation later, shown as Fig. 3.

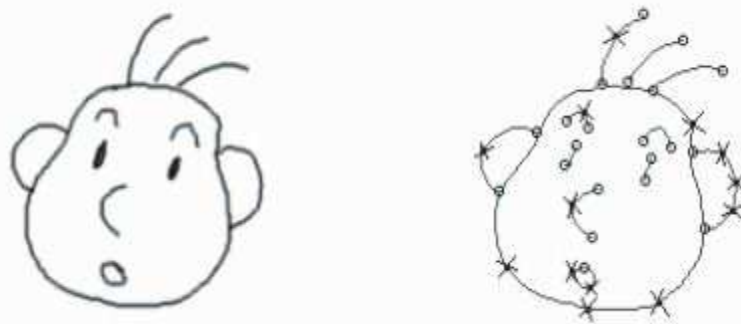


Figure 3:Extraction of contour information

Due to the contour information is formed by obvious change in some area, we must pay attention to the contrast of object and background. According to contour is visible or not, whether to have the other form, the contour is divided into the objective and subjective contour. For the objective contour, there is sudden changes to contour point lightness differential, it is visible, notably, such as Mach belt; For subjective contour, there is no sudden change to contour point lightness differential, for some reason, people will see the contour. And in a 2D graphics, the contour has the rich information. The steepest curvature changes or the biggest part of the contour is the greatest information concentration place, and direction consistent part of the contour is the place with the greatest superfluous information. So we must specially need to pay attention to RGB threshold selection of the contour. By this way, the contour will be obtained, the information of contour will be very rich, convenient for trajectory prediction.

Particle Filter Nonlinear Movement Prediction.

Motion Equation Establishment. In the particle filter, establish motion equation is very important, here we use Sequential Important Sampling (SIS) to create motion equation. Eq. 1 contains the angle and part deformation offset that a movement has, which is applicable to the cartoon movement track prediction when moving range is not a lot. In the formula, $y(t)$ is for prediction, $x(t)$ is for particle key point of motion equation, v is for process noise, w is for observation noise.

$$y(t) = x(t-1) + \frac{x(t-1)}{x(t)} + 8 \cos(3v) + w \quad (1)$$

In the movement equation, it is not difficult to see the selected formula is based on a nonlinear particle trajectory estimation. Each point motion embodied in formula is desultorily and there is no law, which accords with the nonlinear irregular movement pattern of animation movement. It is easy to see the forecast track in the realization of program, very clearly shows that there is no regularity among the various points and meets the disorder of the animation movement track.

The establishment of the observed equation. Observation equation is to point to functional relationship between observation and estimated parameters. The purpose of observation equation is to assist the motion equation and achieve the purpose of prediction. Observation is generally determined. In the author's program, observation is RGB and α channel. RGB and α channel value of the general object in moving won't have too big change, of course, possible from the sunlight place into the shadows, then threshold will have a change, but the RGB model between the overall trend will remain the same, which is convenient for observation.

In the observation equation, the chosen parameter is RGB values. When the RGB value of particle point of a frame is the same as the RGB value got in previous frame in a certain threshold, then think the two particle point is identical and the key point of a frame after a frame is the same as the key points of previous frame. Using RGB value as observation more than gray histogram is more suitable for each point observation and gets greater accuracy.

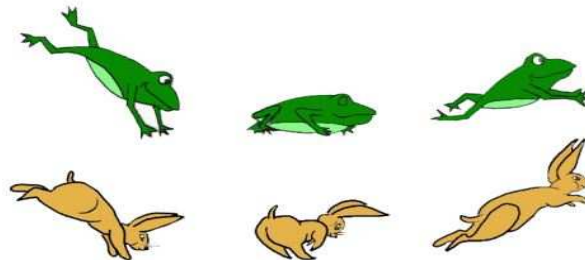


Figure 4: Motion model based behavior driven

Model based behavior driven. Behavior driven part is the last part of the whole program realization. The first is to select a similar object, which will achieve a good result. Secondly, the selected similar object also needs to take key point with the contour. In this case the application of the motion equation can be much better for one-to-one match. As Fig. 5 shows, it is the corresponding relation of the movement model, the more accurate corresponding points are, the clearer the corresponding relations are, the more perfect the drive effect is.

When motion equation matrix is got, motion matrix X can be used as a template to drive a new similar object. Assume that all the points of the new object in motion are one-to-one matching motion matrix X , we can get the first frame key point set Y , and drive first frame corresponding key points in the matrix X operation to get transition matrix P . This can come to drive equation Eq. 2. Using the drive equation can work out the motion matrix of the new object. After getting motion matrix, we can use contour and key points to reply color and then get the new image. Drive process effect is shown as Fig. 4 and the same movement driven completion of the new animation is shown as Fig. 5.

$$Y = P * X \quad (2)$$

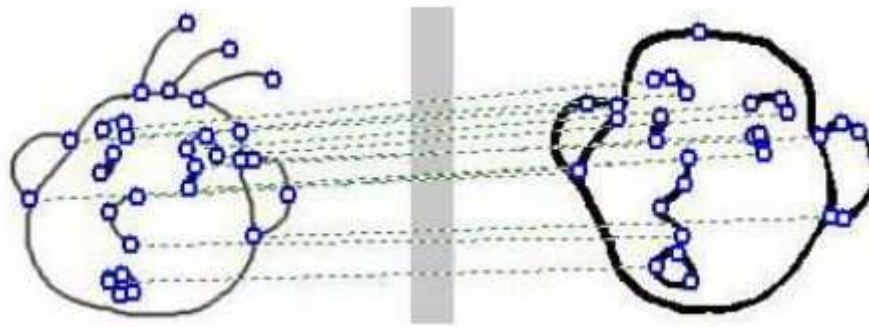


Figure 5: Similar object movement model driven diagram

Program Flow Chart Analysis.

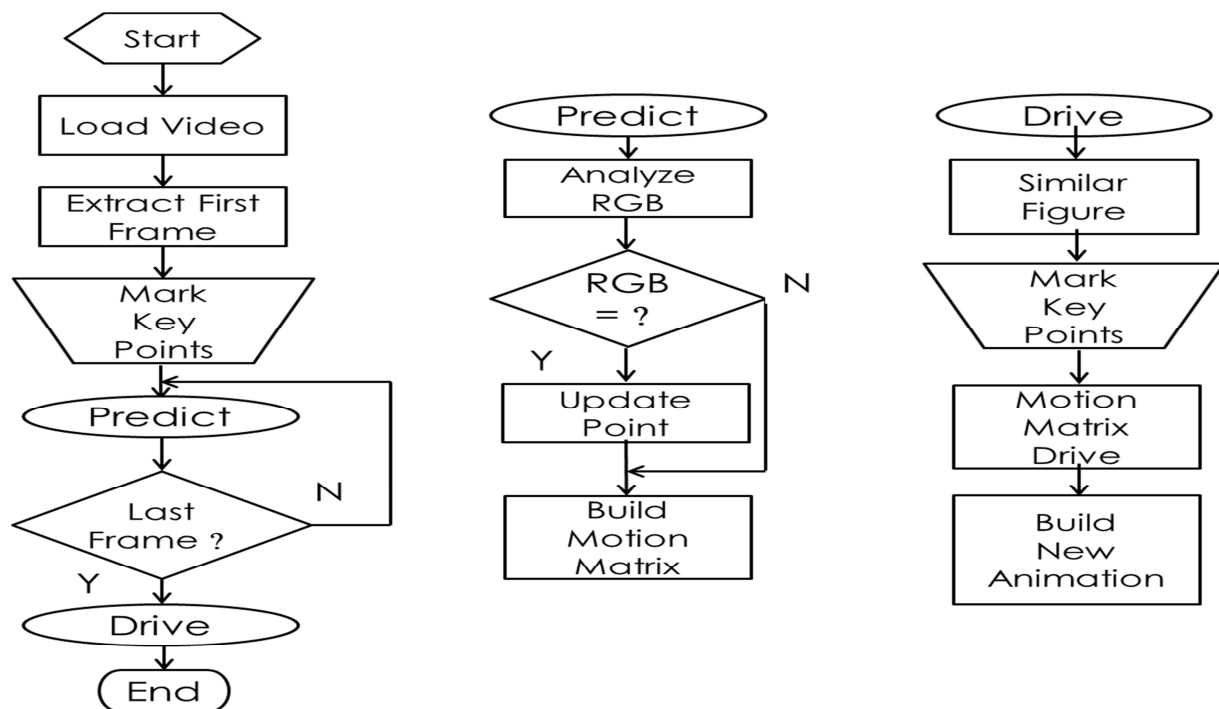


Figure 6: Final program flow chart

- 1) selection of the needed video;
- 2) the elected video analysis;
- 3) extract the first frame of the video;
- 4) find the movement capture key object of the first frame ;
- 5) mark the key points of selected key object ;
- 6) use prediction formula, use the particle filter algorithm and predict the position of the key point in next frame;
- 7) obtain the trajectory by matching each point 's RGB information of each frame;
- 8) obtain the track matrix of movement;
- 9) select a similar object;
- 10) use drive equation to drive the new object motion state, forming the new animation.

Summary

This paper firstly introduces how to read video information and the choice of key points; Secondly, we choose particle filter as the algorithm of prediction trajectory. It can obtain the accurate animation trajectory; Finally we realize to the extraction of the new animation character and similar behavior driven. It is not difficult to see that use this theory of the model based behavior driven to complete movement driven can be realized. This not only can improve the speed of animation, but also can accomplish a lot of repeatability labor, which brings more think of traditional 2D animation from the new angle of view.

References

- [1] C. Bregler, L. Loeb, E. Chuang, H. Deshpande. Turning to the masters: motion capturing cartoons[J]. ACM Transactions on Graphics (TOG), Volume 21, Issue 3 (July 2002), Proceedings of ACM SIGGRAPH 2002, SESSION: Character animation, pp. 399 - 407.
- [2] Mohammad Rastegari, Niloofar Gheissari, Multi-scale Cartoon Motion Capture and Retargeting without Shape Matching[J]. Proceedings of the 2008 Digital Image Computing: Techniques and Applications (DICTA), 2008, Australia, Canberra, pp:320-326.
- [3] Hu Shiqiang, Jing ZhongLiang. The particle filter principle and application [M]. Beijing: science press, 2010.
- [4] Fumio Sumi, Masayuki Nakajima, A Production Method of Reusing Existing 2D Animation Sequences [J]. In Proceedings of Computer Graphics International 2003 (CGI), July, 2003, Tokyo, Japan, pp:282—287.
- [5] Zhu Zhiyu. The particle filter algorithm application[M]. Beijing: science press, 2010.
- [6] Mohammad Rastegari, Mohammad Rouhani, Niloofar Gheissari, Mir Mohsen Pedram, Cartoon Motion Capturing and Retargeting by Rigid Shape Manipulation[J]. Digital Image Computing: Techniques and Applications (DICTA), 2009, 498-504.
- [7] Wang Hongbin, Li Hua. Cartoon Motion Capture by Shape Matching[J]. In Journal of Computer-aided Design & computer Graphics, Vol.15, No.19, Sep, 2003.
- [8] Chui Haili, Rangarajan A. A new algorithm for non-rigid point matching[J]. In Proceedings of IEEE Computer Society Conference on Computer Vision and Pattern Recognition, Hilton Head Island, 2001, pp: 44-51.