Dual Model Particle Filter for Irregular Moving Object Tracking in Sports Scenes

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I. Introduction

By superimposing some additional information(e.g. ball trajectory in baseball game and visualization of offside line in soccer game), a sports broadcast has become much attractive for audiences. For creating such additional information for many sports, it's necessary to track the objects (e.g. players or balls) steadily. Particle filter [1] based on prediction with many distributed particles is well known as a robust object tracking algorithm and can be a promising tool for it. However, since conventional methods use one state transition model, the tracking accuracy is decreased for the objects with irregular motion which is often seen in many sports.

This paper proposes a dual model particle filter based on two state transition models which targets for irregular moving object tracking. By using two state transition models which have different properties each of them, the proposed method makes it possible to track stably even if the target suddenly change its direction.

II. Dual Model Particle Filter

Prediction step (PS) and Measurement step (MS) are important in the particle filter algorithm. Particles are translated in PS, and likelihood of each particle is measured in MS. In these steps, PS is especially critical for improving tracking accuracy. In order to make possible to apply the best state transition model for different the objects' movement in a sport scene, the proposed algorithm employs dual models: second-order auto regressive dynamical model (2ARDM) and Gaussian window model (GWM) as shown in Fig. 1. Both of them are applied simultaneously in PS. 2ARDM is used for temporal analysis, and suitable for tracking fast moving objects due to predict with prior its position. On the other hand, GWM is robust against sudden change of direction because of translating particles around the objects in prior frame based on Gaussian distribution. Also in MS, the combination of two histograms, HSV histogram and gradient orientation histogram, is used in order to make robust for both color and shape.

III. Experimental Results

Fig. 2 shows evaluation results for applying 2ARDM algorithms and the proposed method to a pass scene (VGA: 640 × 480, 30 fps). This scene contains a irregular moving object like suddenly ball direction changes due to the rapid passing which is a kind of typical scene in sports. The total number of particles is one hundred, where fifty particles are assigned

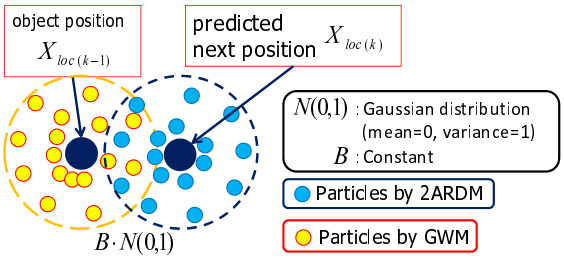

Fig. 1. Concept of dual models.

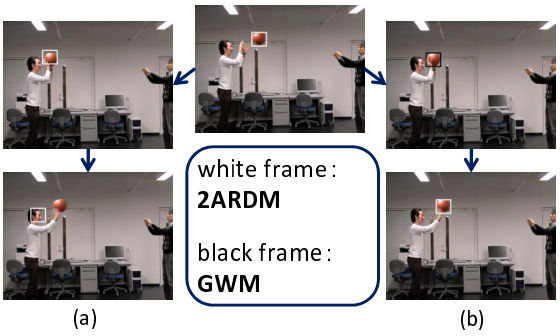

Fig. 2. Tracking results of (a) the only 2ARDM and (b) the proposed method.

to each models. As shown in Fig. 2 (a), tracking fails because 2ARDM can't generate appropriate particles when the ball changes its direction suddenly. On the other hand, as shown in Fig. 2 (b), the proposed method succeeds the tracking thanks to particles generated by GWM when the ball is pushed by hands.

IV. Conclusions

This paper proposes a dual model particle filter and showed usefulness for tracking irregular moving objects. It can create additional information like a ball trajectory and contributes to make a sports broadcast more attractive.

Acknowledgment

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References

[1] E. Cuevas, D. Zaldivar, and R. Rojas, "Particle filter in vision tracking," *Av. Revolucion,* no. 1500, C. P. 44430, Guadalajara, Jal. , Mexico, August 2005.