Close-up Imaging of a Moving Object by Cooperative Multiple Pan-Tilt Cameras

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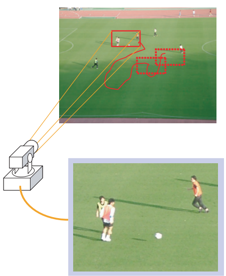
Abstract We propose a new method for filming a moving object by fixed framing of multiple pan-tilt cameras. This filming approach assures the acquisition of high-resolution images of moving objects without blurring, which may occur when a conventional tracking system rotates a pan-tilt camera to film the object. In our approach, we decouple the framing task into two parts, a monitoring part and a stand-by part. We assign the monitoring role to one camera and the stand-by role to other cameras. While the monitoring camera is filming a moving target object, other cameras, which are in stand-by role, are directed to cover the outer areas of the field of view of the monitoring camera as much as possible by predicting the motion of the target object. We propose to estimate prediction of the moving target object based on marginal distribution obtained by projection of the probability density function of the motion model onto the circumference of the image plane. The validity of our method was demonstrated through experiments involving filming a player running around a real soccer field with switching of two to nine pan-tilt cameras.

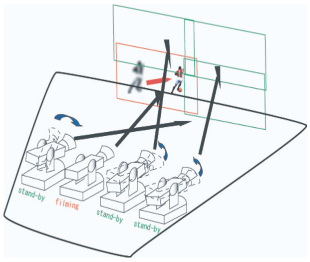
Purpose

Eliminate blurs in videos that appears when a pan-tilt camera is being rotated

A New Filming Method of ;

A moving object (c.f. a running football player)
Automated pan-tilt cameras
Fixed framing (the camera is fixed while its video is on air)



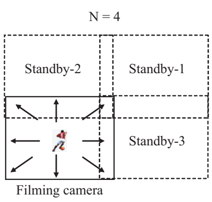


System

N pan-tilt cameras
= One filming camera + N-1 stand-by cameras
The system produces one video by switching N cameras.

Problem

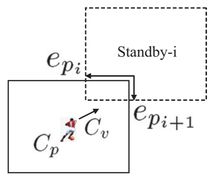
How to place frames of stand-by cameras around the frame of the filming camera by the time when the object is running away from the on-air video?



Frame-out Probability

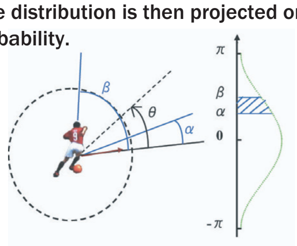
The object may go out through the segment of $[e_{p_i}, e_{p_{i+1}}]$ on image edge after time T_1 has passed. (Object location C_p and direction C_v at t=0)

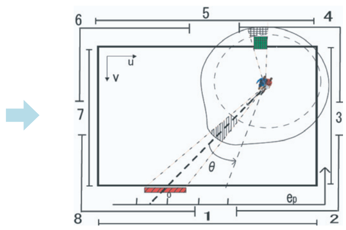
$$E^{T_1}_{e_{p_i} e_{p_{i+1}}} = \int_{e_{p_i}}^{e_{p_{i+1}}} \int_{T_1}^{\infty} f(e_p, t, C_p, C_v) dt de_p$$



Azimuthal Probability Distributions

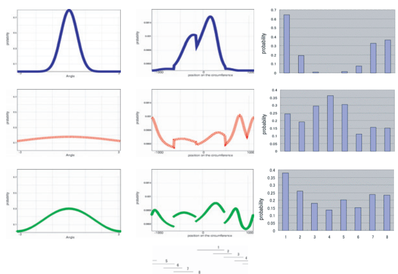
A motion model of the object is described in azimuthal distribution.
The distribution is then projected onto image edge to compute frame-out probability.





Implementation

Three motion models
Eight segments



Experimental results

at National Kasumigaoka stadium, Tokyo.