Digital Zoom Video of Swimmers by High-Definition Camera

Yoshinari Kameda, Itaru Kitahara, Yuichi Ohta, Joe Yoshimi, Keisuke Ishikura, and Hideki Takagi
University of Tsukuba, Japan.

INTRODUCTION

Swimming video in fine resolution could be helpful for swimmers to review their races. However, conventional manual tracking by a zoom camera on a tripod can produce only one video for single swimmer at a time.
We propose a new video production approach that can produce multiple zoom videos for each swimmer in a race. 4K camera with the resolution of 3840 pixels by 2160 pixels is used for capturing source video.
Note that a swimmer registration method is also developed for this approach but it is beyond the scope of this article.

METHOD

The 4K camera is set to cover the whole water surface of a pool. Usually we set the camera in the middle of the longer side of the pool at higher elevation of audience seats. The 4K race video is marked with a starting signal of a race. The video is then geometrically undistorted in order to remove the artifact of lens distortion. Since the water surface can be recognized as a plane, homography projection can be applied so that we can obtain a pool region in rectangle shape. Four corners of the pool should be manually given before we start the process. Since the video process of undistortion and homography projection does not high computation cost, it could be processed within a couple of minutes for a race.
Both the perspective video (original video) and the squared video are utilized to produce the final digital zoom video of each swimmer in each lane.
The perspective video is good for providing natural zoom view of swimming while the squared video has the advantage of clearly showing the location along a swimming lane.
In order to help reviewing process, virtual lines are imposed on water surface at every five meters in both perspective video and the squared video.

IMPLEMENTATION AND DISCUSSION

Our preliminary system has been implemented on a laptop computer with Intel-i7. OpenCV is used for video conversion part. When we align the longer side of 4K image with the longer side of the pool, the upper limit of the resolution is 1.3 cm/pixel. It is about 5 cm/pixel in practical camera set-up.
The final video can contain a couple of zoom video in any layout. After we have interviewed swimming coaches, we have adopted two perspective zoom video in different zoom parameter and one squared video which covers whole lane in the aspect of 100:5 (50 meters by 2.5 meters). We adopt the resolution of 1920 pixels by 1080 pixels in MP4 format because it could be played in major popular devices.
We have got comments from swimming coaches who tell more resolution is needed when they see the final video in large display. We are planning to utilize multiple 4K cameras to archive higher resolution.

REFERENCE

[1] Y. Minato et al, “Video-based Tracking for Digital Zooming of Swimmers,” ECCS 2015.