

Paper Title*

Davide Lusuardi

Department of information engineering and computer science

University of Trento

Trento, Italy

davide.lusuardi@studenti.unitn.it

Abstract—In this document, we discuss some methods to accomplish free-viewpoint video visualisation for soccer scenes. These methods generate novel views of actions from any angle and allow viewers to virtually fly through real soccer scenes.

I. INTRODUCTION

Nowadays, sport broadcasting plays a large role in current society. Therefore, it is important to provide a high quality and visually pleasing reporting of sports events. As we know, incidents in sport tend to be over very quickly. Slow-motion replays can be used to illustrate these incidents as clearly as possible for the viewer.

Although time is stretched in these replays, there is no exploration of the spatial scene information, which is usually important for understanding the event. A system that allows a replay from any angle adds a lot of value to the viewer experience.

Free-viewpoint video (FVV) is one of the new trends in the development of advanced visual media type that provides an immersive user experience and interactivity when viewing visual media. Compared with traditional fixed-viewpoint video, it allows users to select a viewpoint interactively and is capable of rendering a new view from a novel viewpoint. FVV has been a research topic in the field of computer vision since the virtualized reality system [4] was developed, ranging from static models for studio applications with a fixed capture volume, controlled illumination and backgrounds [5] to dynamic object models for sports scenes [6]–[8]. Live outdoor sports such as soccer involve a number of additional challenges for both acquisition and processing phases. The action take place over an entire pitch and video acquisition should be done at sufficient resolution in order to do analysis and production of desired virtual camera views.

In this paper we briefly present and compare some methods to accomplish free-viewpoint video visualisation for soccer scenes...

II. OVERVIEW

In the field of computer vision, the techniques for synthesizing virtual view images from a number of real camera images have been studied since the 1990s [1]–[3]. Free-viewpoint video in sports TV broadcast production is a challenging problem involving the conflicting requirements of broadcast picture quality with video-rate generation. FVV techniques for generating novel viewpoints using a multiview camera setup can be categorized into two classes: 3D reconstruction and

image-based rendering. Using 3D reconstruction, it is possible to construct 3D models of objects to generate the desired view from an arbitrary viewpoint. The quality of the virtual view image generated by these methods depends on the accuracy of the 3D model. In order to produce an accurate model, a large number of video cameras surrounding the object are used. Moreover, ... TODO:01

It is not practical to apply these methods to a scene that contains multiple objects with complicated movements such as a sporting match. TODO

III. THE IVIEW SYSTEM

In this section we present the *iview* free-viewpoint video system (www.bbc.co.uk/rd/iview) which enables the production of novel desirable camera views such as the goal keeper view, the referee view or even the ball camera. This system exploits the already placed live TV broadcast cameras as the primary source of multiple view video. Usually football matches are covered by 12-20 high-definition cameras placed all over in the stadium providing wide-baseline views. Match cameras are manually controlled to follow the game play zooming in on events when occurs. However, only a fraction of these are focused on specific events of interest and can be used for production of free-viewpoint renders, the remaining cameras cover the pitch, crowd and coaches.

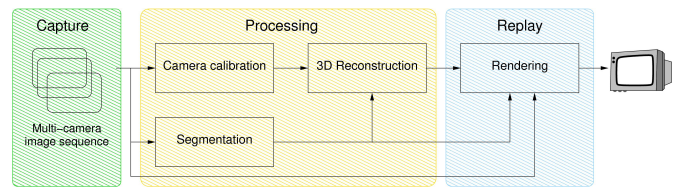


Fig. 1. Overview of the free-viewpoint system. [TODO: cite 02.1]

The *iview* system is composed of three main modules as shown in Figure 1: capture, processing, and replay module.

Capture is performed using time synchronised acquisition from both auxiliary and match cameras. The minimal number of cameras is about four, but for good quality results a higher number is required. Camera synchronisation is achieved using standard genlock process.

The processing module computes a 3D model of the scene. This is done using segmentation of objects from the background and 3D reconstruction [9].

In order to allow the use of footage from match cameras and to avoid the need for prior calibration, automatic calibration of all cameras is performed using a line-based approach against the pitch lines of the captured footage, achieving a root-mean-square error of 1-2 pixels for moving cameras. The calibration is very fast and robust, capable of real-time operation for use during live match footage. Calibration estimates the extrinsic and intrinsic parameters of each camera including lens distortion.

The segmentation is needed to separate the foreground, i.e. the players from the background. Matting of players from the green pitch is performed using chroma-keying matting. The authors developed and tested a k-nearest neighbour approach for chroma-keying and evaluated two other known techniques, *Fast green subtraction* in RGB colour space and keying in HSV colour space. The k-nearest neighbour classifier is controlled by a GUI where the user has to click on position in the image that correspond to background. The process is repeated until the resulting segmentation is satisfying. A deeper explanation is present in the paper [9] where the authors present and evaluate also *Fast green subtraction* and keying in HSV.

Aperture correction is also applied to each video sequence to correct for the camera edge enhancement used in standard broadcast footage [?].

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The preferred spelling of the word “acknowledgment” in America is without an “e” after the “g”. Avoid the stilted expression “one of us (R. B. G.) thanks ...”. Instead, try “R. B. G. thanks...”. Put sponsor acknowledgments in the unnumbered footnote on the first page.

REFERENCES

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