

Camera Calibration in Football Broadcast Videos

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Abstract. A novel continuous camera calibration algorithm is proposed, which can address the calibration for non-goal area of soccer video. By considering the fact that the position of main camera is stable, a novel continuous camera calibration algorithm is proposed for soccer video analysis. There are two stages for calibration: the first stage addresses the calibration only for goal area and the position of camera is computed and recorded, and then the second stage can address calibration for any area including non-goal area where the camera position is given at first stage

Keywords: Video content analysis, Soccer videos, Tactic analysis, Field lines detection

1 Introduction

The semantic analysis of physical sports videos featuring with football videos is always research focus. Of it, one important task is to extract low-level features which are helpful for semantic parsing. Football match broadcast videos are recorded generally by one camera. In the course of shooting, the camera usually needs simple and continuous adjustment as to capture highlights in the competition. Camera alignment can be depicted by the variations of the involved parameters, for example, horizontal rotation of camera being expressed by Pan parameters; vertical rotation by Tilt parameters and focal distance setting by Zoom parameters. Changes of all those parameters contain plenty of information, which can be used as low-level features for semantic parsing [1-5].

Recently, some algorithms have been developed to deal with mid-court area scenes by using kick-off circle as marker [6-8]. For the scenarios of midfield area in the football videos, Luo [9-10] demarcated it with the information of kick-off circle, centerline and two end lines. The method required sufficient information of midcourt line. Zha [11] made use of vanishing points to calibrate with the help of only kick-off circle and incomplete centerline. However, the two algorithms need complete information of kick-off circle and are highly complicated.

2 Camera calibration in non-goal mouth areas

The premise for the court calibration system is to create a football pitch model. At present, the common model is based on court line, which are composed of white lines like sidelines, base lines, major penalty area lines, minor penalty area lines and kick-off circle lines. But, for the image frames which don't have dense court lines, it's impossible to calibrate with court lines. With upgrading of football ground, modern playfields provide other information apart from court lines, such as offside auxiliary lines helping referees determine if there is offside position (see joint lines between medium grey area and white area in Fig1). With those marking lines (like court lines and offside auxiliary lines) containing distinctive semantic information, we develop a more subtle court model, a model with offside auxiliary lines (Figure 1).

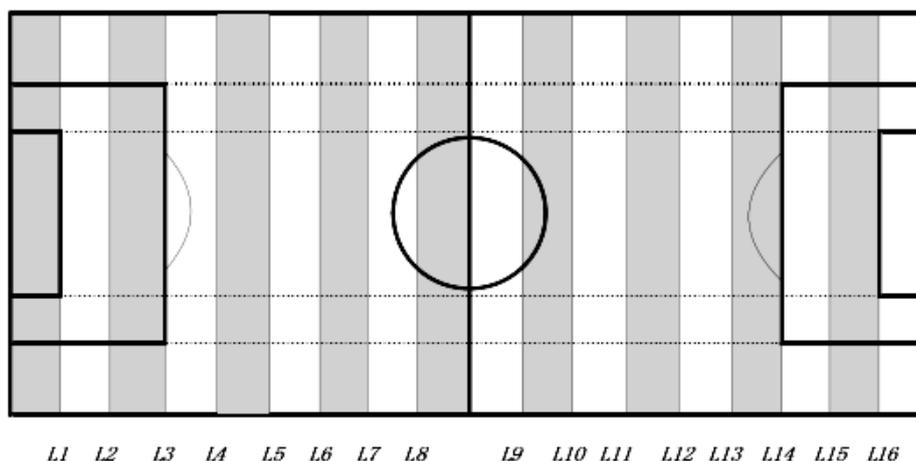


Fig. 1 Football field model with the offside auxiliary line

3 Experiment Design and Discussion

To find out by what factors the method calibration accuracy is much affected, we should make tests with comprehensive data. Specifically, by using the camera shooting process of 3-dimensional scenes, we can simulate camera imaging procedure with the aid of computer. The imaging is sensitive to camera parameters. By setting different camera parameters, we can get different simulation camera images. In accordance to FIFA rules, we set football field model 99×68 meter. The camera position parameter is known as $(T_x = 5, T_y = 60, T_z = 30)$ meters; with $f=1000$ pixels, tilt rotation angle $\alpha = 100^\circ$, pan rotation angle $\beta = 38^\circ$. The image resolution

is 720×480 . The model is displayed in Figure 2: (a) the position of the field model and camera in the 3-dimensional world coordinate system (X-Y-Z), where (Xc-Yc-Zc) refers to camera coordinate system; (b) camera images generated by computer simulation when camera parameters are given.

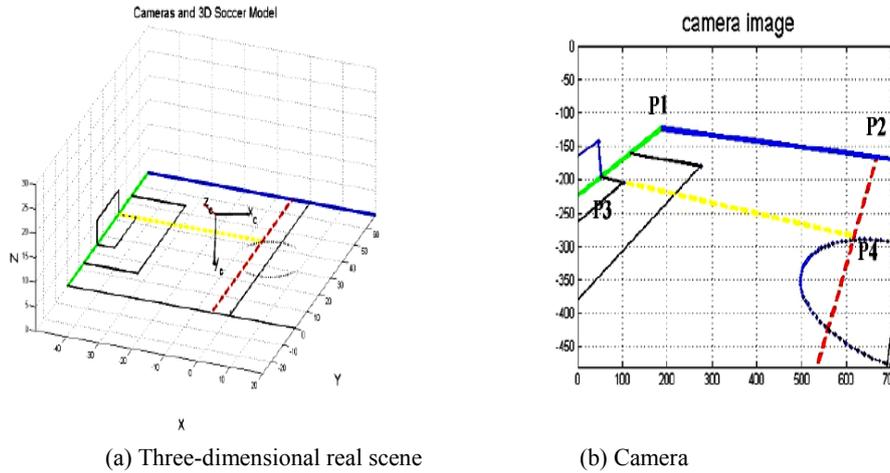


Fig. 2 Diagram of generating synthetic data of DLT and PPC algorithm performance analysis

4 Conclusion

In the football broadcast videos, there are plentiful non-goal mouth scenarios like midcourt or front court or sideways. Owing to inadequate calibration information, the existing algorithms are not able to realize accurate calibration of the camera. To solve the problem, it introduced a two-stage camera calibration method. The proposed method used a new pitch model and related court mark line pick-up algorithms. Then on that basis, it employed fully the information of the unchanged physical position of the camera in the ball match to accomplish the calibration when there are only two calibration points.

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