CALIBRATING CAMERAS IN POOR-CONDITIONED PITCH-BASED SPORTS GAMES

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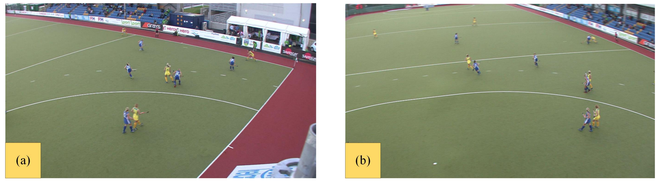
I. Motivation:



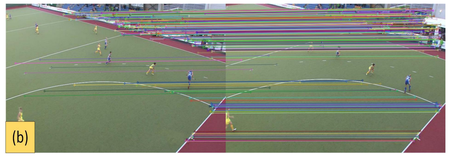
- The first example only contains parts of the playing area due to the small field-of-view. The limited information makes it unsuitable as a key frame. While the second frame covers the whole playing area, the missing line on the farthest side of the playing area and the camera distortion limits it's use as a key frame. Such types of frames frequently appear in video clips which are captured by low-quality cameras positioned in the stands by a coach, or a spectator. Thus for such, there is no so-called key frame that can be used as a reference. These examples demonstrate a common problem*: when a video clip does not have a key frame, prior works generally fail due to the limited information provided by each individual frame*.

II. Introduction:

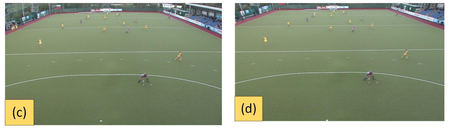
- We introduce an innovative automatic camera calibration system, which does not make use of any key frame, is presented for sports analytics. The proposed system consists of three components: a robust linear panorama module, a playing are estimation module, and a homography estimation module
- In addition, the proposed system can undistort each frame while calibrating using correspondences between adjacent frames.

III. Methodology

- Extract correspondences from adjacent frames. Then adjacent frames can be matched using these correspondences and each frame can be undistorted using the correspondences.



Correspondences extracted by DAISY+SURF



(c) and (d) are an original frame with lens distortion and its corresponding undistorted frame, respectively.

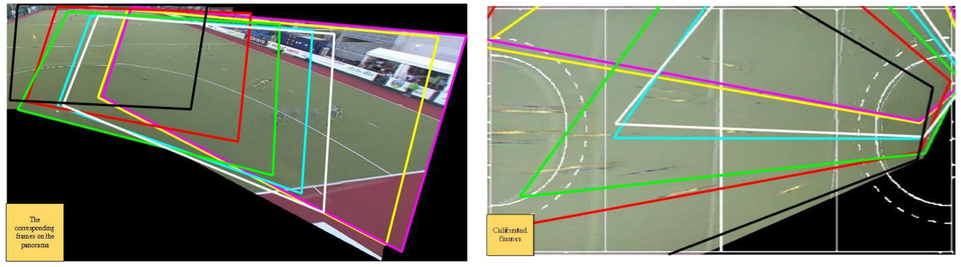
Method	Metric	Video Sequences			
		1	2	3	4
DAISY+SURF	points	**264**	**288**	**281**	**272**
	RMS	**2.519**	**2.318**	**2.732**	**2.556**
KLT	points	34	28	29	30
	RMS	3.807	4.231	3.247	3.334
SIFT	points	92	74	81	87
	RMS	4.986	5.223	5.031	5.274

The homography transfer error and the average number of the correspondences for the tested video sequences

- Playing Area Extraction from the Panorama. Then use the four points to calibrate the panorama.

IV. Calibration Results:

- The calibration result of a field hock video. The left picture is the panorama generated by the proposed system. The yellow, magenta, cyan, red, green, blue, white and black box in the leftmost picture is the individual frame used to generate the panorama respectively. Meanwhile, the relationship between these frames and the standard field hockey pitch is also displayed in the rightmost picture.



V. Conclusion:

In this paper, an innovative camera calibration system for visual content without the need for a key frame is proposed. This system calibrates each individual frame through calibrating the panorama generated from these frames. It utilizes the holistic structure of the frames in a video rather than searching a key frame in isolation. The experiments showed that our system can work even if a given video does not contain any one frame that captures the entire playing area.