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Selectively active markers for solving of the partial occlusion problem in matchmoving and chromakeying workflow

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HIGHLIGHTS

- Partially occluded markers could be difficult to process using chromakeying algorithms.
- The active marker is bright if the distance between actor and marker is enough, otherwise the marker is dimmed.
- Occlusion type (none, partial, full) could be tested using multiple infrared links for every marker, independently.
- Infrared links uses rotating infrared field.

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ABSTRACT

Matchmoving (Match Moving) is the process used for the estimation of camera movements for further integration of acquired video image with computer graphics. The estimation of movements is possible using pattern recognition, 2D and 3D tracking algorithms. The main problem for the workflow is the partial occlusion of markers by the actor, because manual rotoscoping is necessary for fixing of the chromakeyed footage. In the paper, the partial occlusion problem is solved using the invented, selectively active electronic markers. The sensor network with multiple infrared links detects occlusion state (no-occlusion, partial, full) and switch LED's based markers.

1. Introduction

Matchmoving is the process of the estimation of camera parameters (internal and external) for further computer graphics (CG) integration of acquired video image and camera movements (Fig. 1) [8] using video image only.

Intentionally placed objects (markers) or existing scene features are used as a reference points for finding relation between the real 3D space and the camera [8,9,13,19]. Optimization algorithms are used for the estimation of the camera trajectory. There are numerous matchmoving methods specific to the particular cases [8,10]. The typical matchmoving techniques assume the chromakeying background [5,11] with attached markers. Such technique enables actor's placement in the CG environment with adequate camera movement (Fig. 2). This is very important technique in digital cinematography [17].

Acquired image, shown in Fig. 2, needs two separated processes according to Fig. 1. The background and markers removal, and markers tracking processes are necessary.

The extracted image of actor should be preserved for further integration with CG. The background with markers should be replaced by the transparency channel (alpha channel). The transparency channel is shown as a chessboard grid in this paper. The background and markers should be removed in two separated or combined chromakeying processes.

1.1. Processing path of the background

The main problem of the chromakeying is the estimation of transparency for the actor's edges. The secondary problem is the suppression of the spils that occurs on actor's edges. Spils are a mixture of the actor's and background image areas that are visible as green or blue envelopes (Fig. 4 – middle row). Motion blur, related to the camera, actor or object movements, increases both problems, because transparency and spils areas are larger (Fig. 4 – upper row). There are numerous techniques for keying, but uniform color and luminance of background is desired, especially for low budget movies.

1.2. Processing path of markers

Additional processing path is related to the markers (Fig. 1), for the estimation of the camera movements. The position of markers should be estimated with minimal effort, because tens of markers could be visible in image frame. Obtained positions are processed

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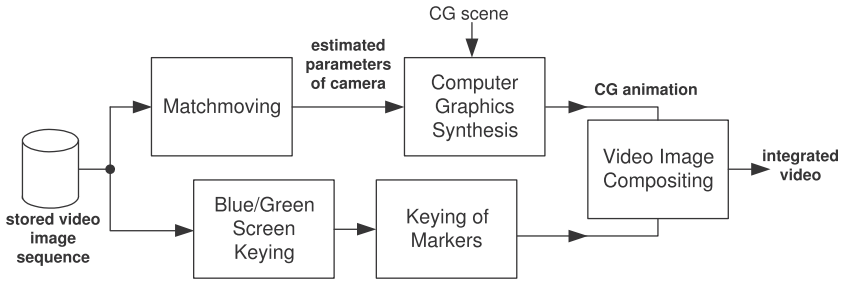

Fig. 1. Keying and matchmoving workflow.

Fig. 2. Example of applications. From left: Original image with markers; actor after keying; CG scenery; final composite [6].

in CG software, so animation synthesis is adequate to the real camera movements. High contrast between marker and the background is desired for the matchmoving process, because automatic tracking is simpler. Markers, that are highly blurred due to actor's partial occlusion or high speed movements of camera, need an additional effort. Low contrast markers are rather simple to remove during keying, but they are more difficult to track, due to low contrast, image noises and motion blur. Moreover, low light conditions reduce the visibility of them (Fig. 5).

2. Markers for matchmoving and alternative camera tracking techniques

2.1. High contrast markers

Even in high budget movie productions the simplest markers are used, like crossed adhesive tape, sometimes LED or bulb lamps. Light emitting markers are used for poor light conditions, especially. Crossed black or white adhesive tapes are very often applied due to desired high contrast between the marker and the background. Such case is shown in Figs. 3–5.

Such markers are extremely cheap and do not require additional time consuming setups. Passive retroreflective markers are also interesting alternative [14].

Markers are removed from every image frame using manual, supervised, or automatic rotoscoping techniques.

2.2. Alternative markers

Frame markers, split markers and dot markers with some modifications are considered in [16]. Special markers, like random dot markers [15], improve the robustest of detection and tracking for Augmented Reality (AR) applications for partial occlusion cases. The multiple camera system improves AR applications [4] in partial occlusion cases. Color based markers are possible to apply [3,12] for partial occlusion also.

Applications of green markers on the blue background, or blue markers on the green background are interesting possibilities for the tracking due to high contrast. Markers and background removals are possible using separated setups of chromakeying software for green and blue colors.

Another technique, based on the markers similarity to background, is available. The light green markers are placed over the dark green background, for example. Such case is shown in Figs. 3–5. The background and markers are removed using the single setup of chromakeying software.

2.3. Alternative processes of camera tracking

Alternative techniques of camera tracking are available, but they are very costly or have additional constraints. The motion control camera crane (motion capture robots) could be used for precise camera movements [7].

Calibrated cameras in a specially prepared studio (kind of the motion capture) [1,2] could be applied to the camera tracking.

Tracking of the film camera, using the optical tracking of the markers located on the ceiling, is possible. This technique is based on additional ceiling-looking camera that is attached to the film camera. Such solution is applied in, e.g. a dedicated Universal's Virtual Stage One system.

The dual chromakeying technique using color pattern (two similar colors are used), located on a flat background for the estimation of the camera movements, is available [18] also.

Matchmoving is much cheaper and is not limited to the special studio.

2.4. Example setup

Three cases of markers: the proposed selectively active marker, the marker similar to background, and the high contrast black mar-