Background Subtraction for Video Produced by Moving Camera based on Patch Match verify

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ABSTRACT

In this paper, we present and implement a efficient and accurate universal algorithm to do background subtraction on video produced by moving camera.

Our algorithm keeps both temporally-consistent and spatially-consistent during the post-processing, we keep temporally-consistent with patch match verify and we keep spatially-consistent with probabilistic patch Markov Random Fields.

As for the motion compensate, we do that with vote and sparse optical flow. Linear analysis and vote works more efficient than normal optical flow.

Our subtract part follows ViBe and SubSENSE with a little change to suit moving video, where SubSENSE is a non-parametric pixel-based universal background subtract algorithm for fixed video.

REFERENCE

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INTRODUCTION

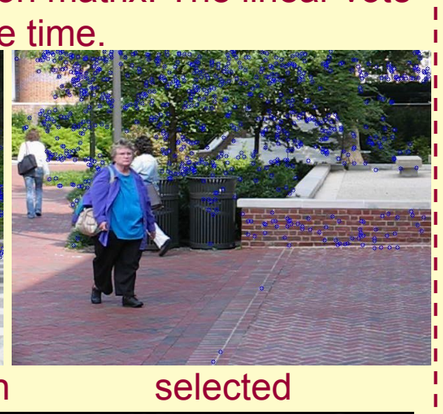
Unquestionable, background subtraction is an important and classical problem in computer vision. It has been studied and implemented since no latter than 2000. The background subtraction for fixed camera have been done almost perfectly. However, if the camera is not fixed, it is not so well anymore. Someone had made it kind of accurate but need 7 second to process a little 300*200 frame. And the best real-time algorithm's accuracy is less than 0.5. And now we want to make our contribution to it.

Our algorithm is like most other algorithms for moving video subtraction. It consists of three parts: 1. Preprocessing : to detect the motion, 2. Subtract : background subtract, 3. Postprocessing : fix the problems comes from the movement.

REPROCESSING

While doing the preprocessing, almost everyone start with feature detection. Then try to correlate features from the background. Instead of trying to detect the optical flow as accurate as possible and find the whole background, we select and work with a small set of points which should be on the background. The size of the set make it faster to calculate the transformation matrix. The linear vote and select could also save time.

features detect and match



selected

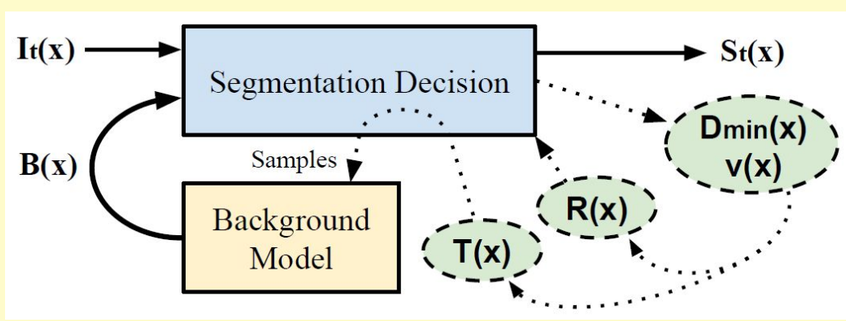
final transform result, only different is foreground

REPROCESSING

Now, we can get quite nice subtract for foreground. That means Recall is nice. But a little problem still exist, if foreground is in the first frame and is initial in the background model, it quite needs time to update it. But it will be fixed.

SUBTRACT

The method we used for subtraction follows ViBe and SubSENSE. It is a kind of self-balanced non-parameter universal model based on LBSP. Its main principle is like below:



POSTPROCESSING

Postprocessing contains patch match verify for temporally-consistent and probabilistic Markov Random Fields which also based on patch for spatially-consistent. Patch match is a random based correspondence algorithm often used for texture synthesis and image editing. We match those patch between two adjacent frames. Then improve the result with result before so that temporally-consistent is protected. Moreover, new edge come in because of the motion can get better result with this. (a match result is followed)

after subtract

after patch match

Then based on the patch, use maxflow min a energy.

after maxflow on field for spatially-consistent

REPROCESSING