Experimental Efficiency Analysis in Robust models of Spatial Correlation Optical Flow Methods under Non Gaussian Noisy Contamination

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Abstract— In this paper, we present a performance analysis of several robust models of spatial correlation optical flow algorithms including an original spatial correlation optical flow (SCOF), bidirectional for high reliability optical flow (BHR), gradient orientation information for robust motion estimation (GOI), and robust and high reliability based on bidirectional symmetry and median motion estimation (RHR) under the non Gaussian noise conditions. The simulated results are tested on 4 different in foreground and background movement characteristics of standard sequences (AKIYO, CONTAINER, COASTGUARD, and FOREMAN) in a degree of 0.5 sub-pixel translation. In our experiment, an original sequence (no noise), and noise contaminated sequences on Salt & Pepper Noise (SPN) at density (d) = 0.025d, and 0.005d, Speckle Noise (SN) at variance (v) = 0.05v, and 0.01v, and Poisson Noise (PN) are utilized. The experiment concentrates on Peak Signal to Noise Ratio (PSNR) as an indicator in the experimental performance analysis.

I. Introduction

Optical flow is the technique that is used to identify the image velocity or motion vector of the image sequence in a degree of pixel based. It has been applied for several areas such as motion estimation, image separation, motion tracing and image super resolution. There are many proposed models of optical flow but this paper focuses on SCOF [1] and its robust model such as BHR [3], GOI [4], and RHR [7] over non Gaussian noises. Under noisy condition, optical flow presents an inefficient result in motion vector as the results of performance analysis under noisy environments [2]. In 2010 and 2011, performance analysis over many algorithms of optical flow and their robust models under Additive White Gaussian Noise (AWGN) was presented [5-6].

Then, we follow to investigate the performance of these optical flow method under non Gaussian noise such as SPN, SN, and PN. At last, we evaluate the performance by using PSNR that is calculated from the comparation of rebuild image from motion vector with the original image in which the higher value in PSNR means better in performance.

In this paper, we concentrate on the study of performance of 4 spatial correlation optical flow algorithms (SCOF, BHR, GOI, and RHR) for motion estimation when they are processed at sub-pixel translation over multiple non Gaussian noise sequences (SPN 0.025d (more noise), SPN 0.005d (less noise), SN 0.05v (more noise), SN 0.01v (less noise) and PN).

The remainder of this experimental is presented as follows. Section II briefs the referenced motion estimation algorithms. Section III explains the simulated results, which express the accuracy of the estimated movement. And conclusion of the simulated results is in Section IV.

II. Motion Estimation Algorithms (Spatial Correlation Optical Flow)

Spatial correlation optical flow algorithms are comprehensively reviewed in this section that we refer to in our experimental.

A. Spatial Correlation-Based Optical Flow (SCOF)[1]

SCOF is full search block based motion estimation in a degree of pixel for motion vector as a result. First, the area of the block is defined (3×3 ‖ 7×7). Then, the block is used for comparison with sum of absolute difference (SAD) over window searching area (twice of block size extend from the specific pixel position is recommended) where the best candidate motion vector is the minimum SAD over searching area of specific pixel.

B. Bidirectional Based Method for High Reliability Optical Flow (BHR) [3]

This method was presented in 2008 by R. Li and F. Yu. The symmetry of bidirectional in forward motion vector (frame *ti* → *ti+1*) and backward motion vector (frame *ti+1* → *ti*) from traditional optical flow algorithm was presented with confident measurement for an improvement in accuracy on motion vector.

The motion vector of the forward sequence and backward sequence is obtained by using SCOF, the reliability rate is considered from correlation of forward and backward motion vector by:

$$R_l^n(s,ti) = \exp\left(-\frac{|\, v_l^n(s,ti) + v_{l'}^n(s + v_l^n(s,ti), ti+1)\,|}{(|\, v_l^n(s,ti)\,| + |\, v_{l'}^n(s + v_l^n(s,ti), ti+1)\,|)/2 + \beta} \right) \quad (1)$$

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