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Antiblurry Dejitter Image Stabilization Method of Fuzzy Video for Driving Recorders

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Received December 14, 2016; revised February 27, 2017; accepted March 20, 2017; published June 30, 2017

Abstract

Video images captured by vehicle cameras often contain blurry or dithering frames due to inadvertent motion from bumps in the road or by insufficient illumination during the morning or evening, which greatly reduces the perception of objects expression and recognition from the records. Therefore, a real-time electronic stabilization method to correct fuzzy video from driving recorders has been proposed. In the first stage of feature detection, a coarse-to-fine inspection policy and a scale nonlinear diffusion filter are proposed to provide more accurate keypoints. Second, a new antiblurry binary descriptor and a feature point selection strategy for unintentional estimation are proposed, which brought more discriminative power. In addition, a new evaluation criterion for affine region detectors is presented based on the percentage interval of repeatability. The experiments show that the proposed method exhibits improvement in detecting blurry corner points. Moreover, it improves the performance of the algorithm and guarantees high processing speed at the same time.

Keywords: Electronic image stabilization, antiblurry dejitter, feature detection, evaluation criterion, binary feature description

1. Introduction

Vehicle cameras can be used to capture any activity within the range of vision; however, the images may contain dithering or fuzzy frames. In general, by detecting and compensating the inter-frame motion using image processing methods, an electronic image stabilization (EIS) technique is utilized for disturbance attenuation. [1-3] Remote sensing, visual surveillance, walking robots, civil infrastructure, and unmanned aerial vehicles are examples of such applications that operate in dynamic environments.

A driving recorder is used as a record of a vehicle to provide evidence for traffic accidents or to memorialize the journey on private trips. In view of the restrictions on volume and the high cost of driving recorder models, adopting either mechanical or optical stabilizations method is less appropriate compared with implementing the EIS algorithms.

Video images captured by vehicle cameras often contain blurry or dithering frames due to inadvertent motion from bumps in the road or by insufficient illumination during the morning or evening. The human eye has persistence and continuity, enabling it to determine the movements of objects in videos when watching a blurry video without jitter; however, the human eye's visual coherence cannot be guaranteed if dithering is added, which greatly reduces the perception of objects expression and recognition. To solve the problem of dithering videos from vehicle cameras, feature points are selected as a characteristic quantity to obtain image information and feature descriptor performs matching.

Feature point detection employing feature descriptors for motion estimation has been widely explored [4,5]. The methods of descriptor matching, discriminated by Euclidean and Hamming distances, are roughly able to divide these descriptors into two categories, scale-invariant feature transform (SIFT)-like algorithms and binary feature descriptor algorithms.

In SIFT-like algorithms, to overcome scaling and rotation inefficiency, a local scale-invariant feature [6,7] was developed, which delivered competitive performance. Developed by Krystian Mikolajczyk et al., the method that used a gradient location orientation histogram [8] was considered more spatial regions for the histograms. Furthermore, it reduced the dimensionality of a descriptor by principal components analysis. The speed enhancing feature [9] exhibited similar performance to SIFT [6] while significantly promoting speed. Its feature points were obtained by computing the determinant of a Hessian matrix, whereas its accumulated description was accomplished using Haar-wavelet response.

Considering the computational complexity of feature point matching, binary descriptors and Hamming space have been proposed as substitutes for the exhaustive Euclidean distance calculation algorithms to perform fast similarity searches, where binary codes are defined based on the relationship between a given adjoining pixel and the central reference. The Binary Robust Independent Elementary Feature (BRIEF) [10], the Oriented Fast and Rotated BRIEF (ORB) [11], and the Binary Robust Invariant Scalable Keypoints (BRISK) [12] are well-known representatives. The first two binary descriptors are described by feature vectors that compare the intensity of 512 pairs of pixels after applying Gaussian smoothing. The positions of the pixels are preselected around one patch center. In addition, ORB allocates the vector directions. To build the descriptor bit stream, BRISK designed a template with a set of concentric circles. In reference to the distance from center to center, long-distance pairs were assigned for orientation, and short-distance pairs describe the keypoints. However, the enhancement of binary matching speed results in degradation of its effectiveness.