Live Demonstration: PINK: Polarity-based Anti-flicker for Event Cameras

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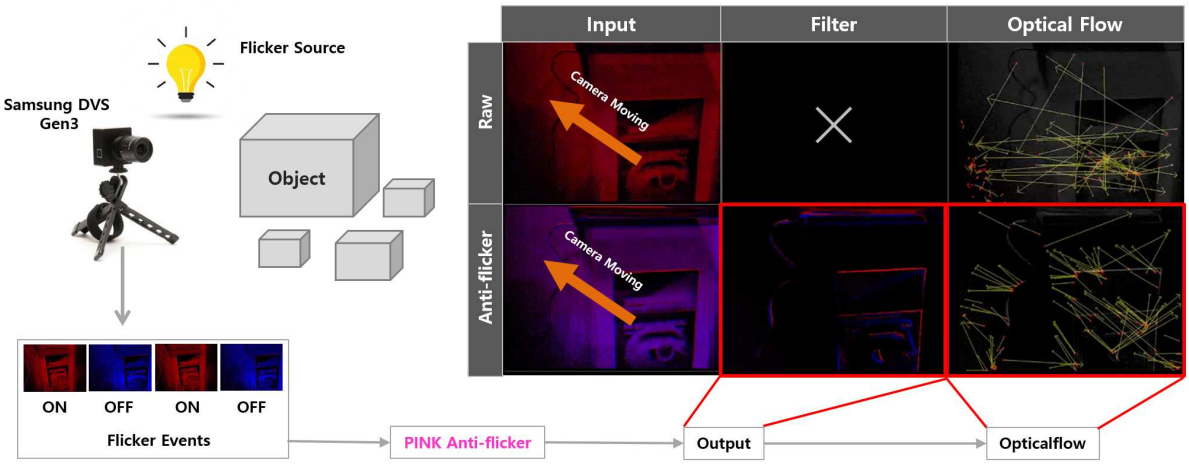

Figure 1. Illustration of the PINK anti-flicker live demonstration.

Abstract

Dynamic Vision Sensor (DVS) is an event sensor that asynchronously captures an event whenever there is a brightness change in the scene. However, due to the event sensor's high temporal resolution property, it is particularly vulnerable to flicker. Numerous unwanted events caused by flickering can cause serious loads on computing power and prevent the event sensor from extracting useful information, making it difficult to use the event sensor for machine vision applications in practice. In this demo, we propose the PINK (PolarIty-based aNti-flicKer), which filters flicker based on the event polarity (on/off). The proposed method is lightweight and efficient and can be used in real time. To the best of our knowledge, this is the first anti-flicker algorithm that works in real time and provides a usable opticalflow result for machine vision applications in an extreme flicker environment. A video showing the example of live demo is available online at https://youtu.be/5UdU0PLZaf8.

1. Introduction

Dynamic Vision Sensor (DVS) is a bio-inspired vision sensor that detects light changes and captures them asynchronously each pixel. The event sensor has high temporal resolution and high dynamic range compared to the frame-based image sensor, making it promising for use in machine vision applications [3]. However, the high temporal resolution property makes an event sensor sensitive to unwanted flicker environment. In contrast to the noise removal methods for the event sensor that have been studied [1], the flicker removal problem is a more challenging issues that needs to be removed actual edge events are repeatedly sensed by the flickering light. An event sensor responds to the lights blinking at high speeds, which in turn many unwanted events are generated, and most machine vision applications do not use these noise event.

Recently, Wang *et al.* has proposed a flicker removal method that removes flicker events through a linear comb filter in the fluorescent lamp environment [4]. However, in this method, 50 Hz of the flicker frequency of the lamp is fixed to remove events, which means that the other frequency events are not filtered. In addition, it seems to be hard to utilize this method immediately for practical ma-

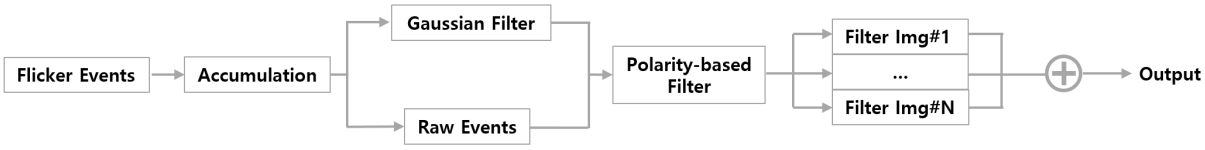

Figure 2. Illustration of the process pipeline

chine vision applications because it uses offline methods to store all flicker events and then filter.

In this demo, we present the PINK (shorts for PolarIty-based aNti-flicKer), which can remove flicker in real time, regardless of the flicker frequency. To the best of our knowledge, this is the first anti-flicker algorithm that works in real time and provides a usable opticalflow result for machine vision applications in an extreme flicker environment.

2. Method

This section describes the detailed explanation of the PINK anti-flicker. The overall process pipeline of this method is shown in Fig. (2).

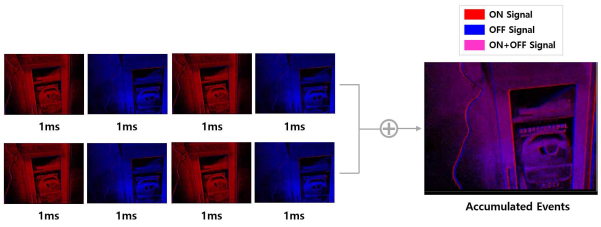

Figure 3. Events accumulation in the flicker environment

When DVS receives events in the flicker environment, as shown in Fig. (3), these are accumulated during 1ms to each image pixel space, which is divided into on (red) and off (blue) signal. Next, the anti-flicker accumulates the event several times to capture the overlapping part of the on and off signals (pink).

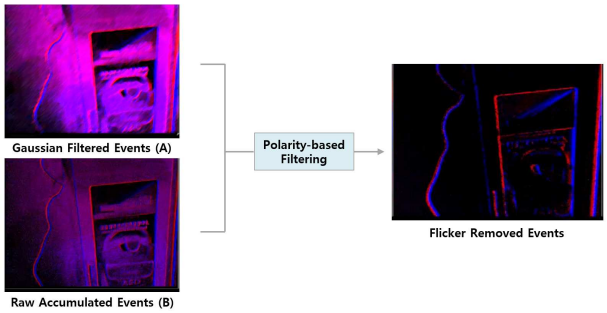

Figure 4. Polarity-based flicker filtering

Then, carry out the gaussian filtering on the accumulated image as shown in Fig. (4). It has the effect of widening the overlapped area of the accumulated image. The wider the overlapped areas, the more tightly the flicker noise is removed. Next, remove the area corresponding to the overlapped pixels in the gaussian filtered image (A) from the raw accumulated image (B). Therefore, the events caused by the camera movement can be maintained while the noise due to the flicker is removed. Finally, the above process repeats empirically to maintain excessively filtered useful signals. As a result of our experiments, it was enough to repeat three times.

3. Demonstration Setup

The demonstration consists of the Samsung DVS Gen3 camera with a resolution of 640x480, the Ubuntu laptop and the flicker lamp. The flicker lamp blinks at a rate of 50 $\sim$ 60 Hz and illuminate the surrounding objects. The DVS sensor is connected to the laptop via a USB 3.0 cable and the PINK algorithm runs internally via the Robotic Operating System (ROS) [2].

4. Visitor Experience

Visitors can interact with a demonstration that utilizes a DVS sensor in a flickering environment. They can observe two sets of results: the raw data without any filtering, and the same data processed using our PINK algorithm with optical flow result.

References

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