Brightness splitter full-motion low-light processing

Article Overview

Advanced low-light imaging combines brightness splitting, full-motion processing, and event-guided fusion to enhance visibility and reduce motion blur in challenging conditions.

Overview of Low-Light Challenges

Capturing high-quality images or videos in low-light environments is challenging due to insufficient illumination and motion blur. Traditional cameras often increase exposure time to compensate for low brightness, but this leads to blurred moving objects and loss of edge details. Additionally, sensor noise and poor signal-to-noise ratio (SNR) further degrade image quality, making it essential to employ specialized processing techniques .

Brightness Splitting Techniques

Brightness splitting involves separating an image into illumination and reflectance components to independently enhance brightness while preserving structural details. Retinex-based methods and diffusion models are commonly used for this purpose. By applying brightness guidance, these methods can adjust illumination maps precisely and remove perturbations, improving visibility without introducing artifacts . Some approaches also separate color and luminance channels to enhance low-light images more effectively .

Full-Motion Processing with Event Cameras

Event cameras provide high temporal resolution and high dynamic range, capturing motion information even under low-light conditions. When combined with traditional RGB frames, they enable full-motion low-light processing, addressing both motion blur and low illumination simultaneously. Techniques like CompEvent use complex-valued neural networks to fuse event and RGB data in both spatial and frequency domains, achieving holistic spatiotemporal fusion and superior deblurring performance . Similarly, hybrid camera systems with beam splitters allow real-world datasets to be captured for event-guided low-light enhancement and deblurring .

Advanced Neural Network Approaches

Modern pipelines often employ dual-branch architectures: one branch focuses on denoising and brightness enhancement, while the other preserves fine details using full-attention modules. Patch-based fusion strategies help mitigate block artifacts in high-resolution images . Diffusion models and Transformers are increasingly used to model complex noise distributions and improve low-light restoration performance .

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Applications

These techniques are particularly useful in:

o Nighttime surveillance: Enhancing visibility while maintaining motion clarity.
o Autonomous driving: Capturing moving objects accurately in low-light conditions.
o Video restoration: Reducing blur and noise in low-light recordings. By combining brightness splitting, event-guided full-motion processing, and advanced neural network architectures, modern systems can significantly improve low-light image and video quality, outperforming traditional staged or single-modality methods .

This paper proposes a new method for low-light image enhancement with balancing image brightness and preserving

In this paper, we propose an end-to-end low-light image enhancement network based on the YCbCr color space to

Utilizing a pretrained model, adaptive brightness information is extracted and mapped from low-light images, which is

This manuscript introduces an innovative multi-stage image fusion framework that adeptly integrates infrared (IR) and

While significant progress has been made in image enhancement and deep learning-based object detection, their effectiveness and

In the field of image enhancement, low-light image enhancement is a notoriously challenging problem. Generally,

BVILLIE employs a visual decomposition network that separates low-light images into low-frequency and high

Real low-light images commonly exist global non-uniform lightness variation and local brightness smoothness,

The difficulty in obtaining paired low-light and normal-light image datasets has made low-light image processing a challenging task.

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LCDBNet Division Gets Better: Learning Brightness-Aware and Detail-Sensitive Representations for Low-Light Image Enhancement.

Deep learning has been widely applied in many domains including image enhancement , image generation , and image

There are three key modules in non-emissive displays: the light source, the illumination unit and the light modulation

Here, we collect a list of resources related to low light image enhancement, including datasets, methods/codes/papers, metrics, and

This paper presents a comprehensive review of the NTIRE 2025 Low-Light Image Enhancement (LLIE) Challenge, highlighting the

o We present the most recent comprehensive survey on low-light image and video enhancement. In particular, we conducted an

In this review, we present a detailed examination of enhancement methods for both types of low-light degradation,

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