NEW STEREO HIGH DYNAMIC RANGE IMAGING METHOD USING GENERATIVE ADVERSARIAL NETWORKS

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Abstract

This paper proposes a new stereo high dynamic range (HDR) imaging method using generative adversarial networks (GAN) with a low dynamic range stereo imaging system. First, a view exposure transfer GAN (VET-GAN) is constructed to transfer exposure information of the right-view (RV) image to the left-view (LV) image to generate the multi-exposure LV images, and then an HDR fusion GAN is constructed to fuse the generated multi-exposure LV images into an LV HDR image. Similarly, an RV HDR image can be generated using the same way to form a stereo HDR image pair.

Background

It is assumed here that the left-view (LV) image is under-exposed and the right-view (RV) image is over-exposed.

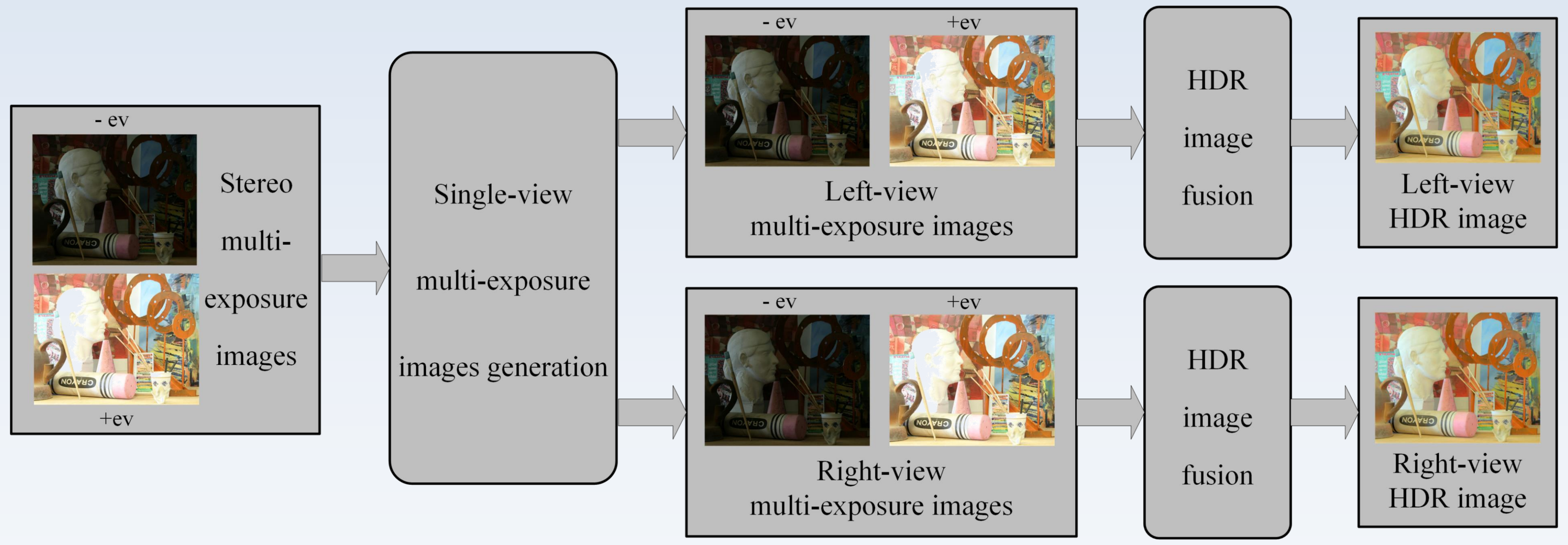


Fig. 1 Basic framework of stereo HDR imaging.

Stereo HDR imaging can be divided into two steps:

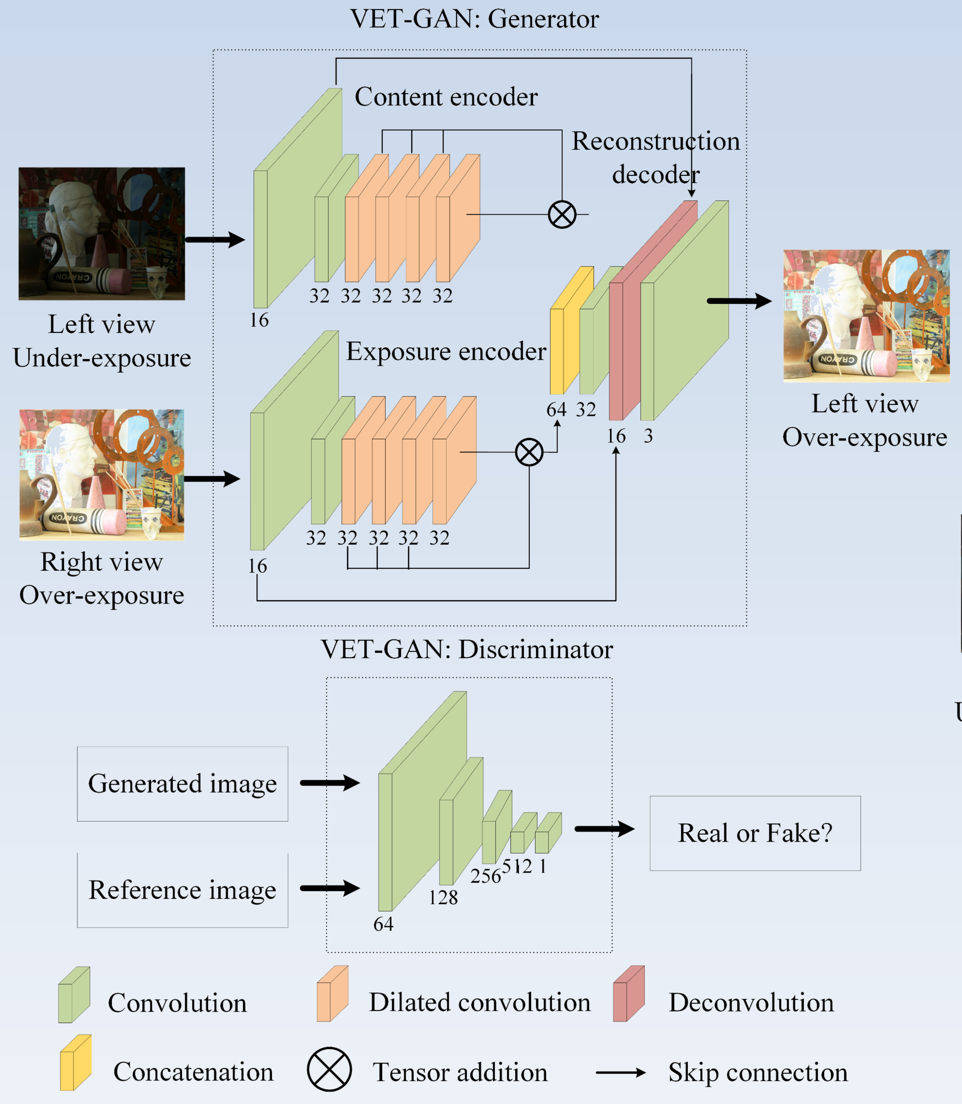
- ***Single-view multi-exposure images generation***
  1) Camera response function estimation.
  2) Stereo match.
  3) Warping and hole filling.

  Multi-step processing is prone to error accumulation.
- **VET-GAN modeling the above process.**
- ***HDR image fusion***
  Under- and over-exposed images with excessive exposure intervals tend to produce low-quality HDR images.
- **HDR fusion GAN performs image enhancement tasks by using high quality fused images as training labels.**

Methods

Architecture of VET-GAN:

- **Content encoder: extract the content information.**
- **Exposure encoder: extract the exposure information.**
- **Reconstructed decoder: reconstruct the required image.**



Based on the same processing, the RV under-exposure image can be generated to form the RV multi-exposure images.

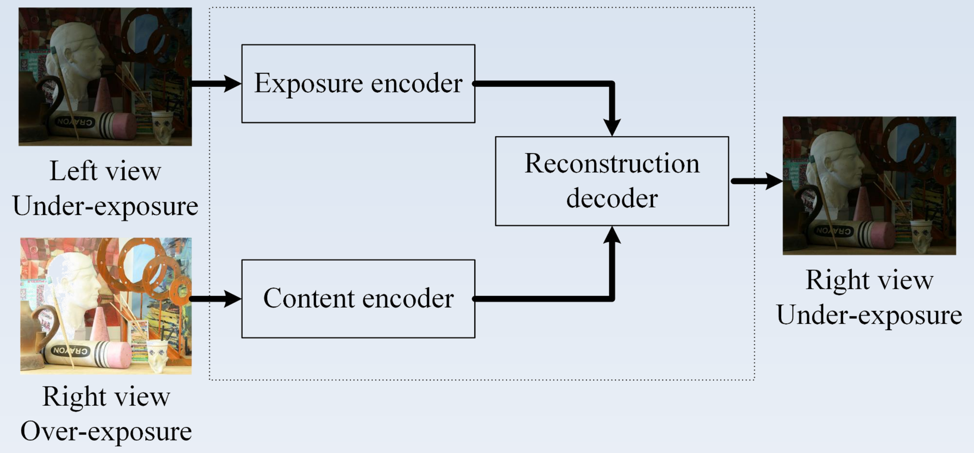


Fig. 2 Architecture of the proposed VET-GAN.

Architecture of HDR fusion GAN:

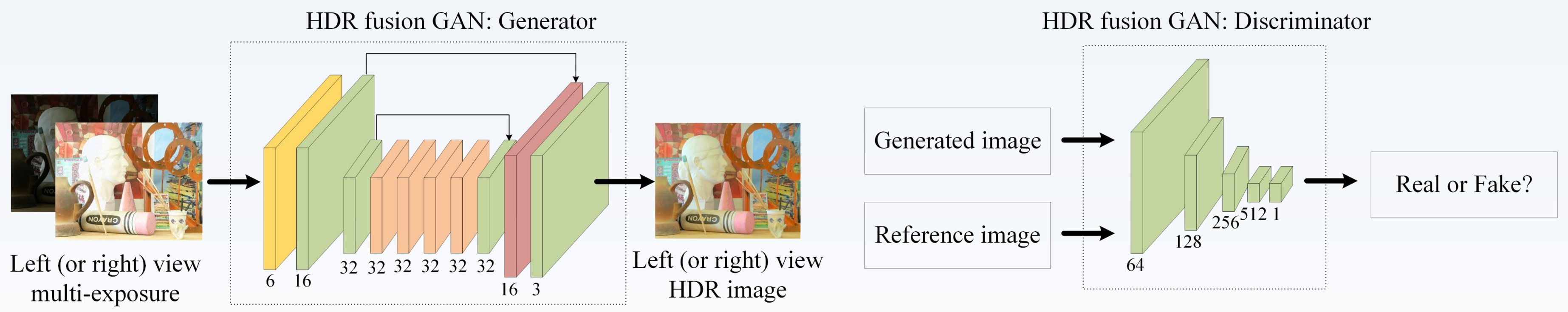


Fig. 3 Architecture of the proposed HDR fusion GAN.

HDR fusion GAN reference image (label) generation:

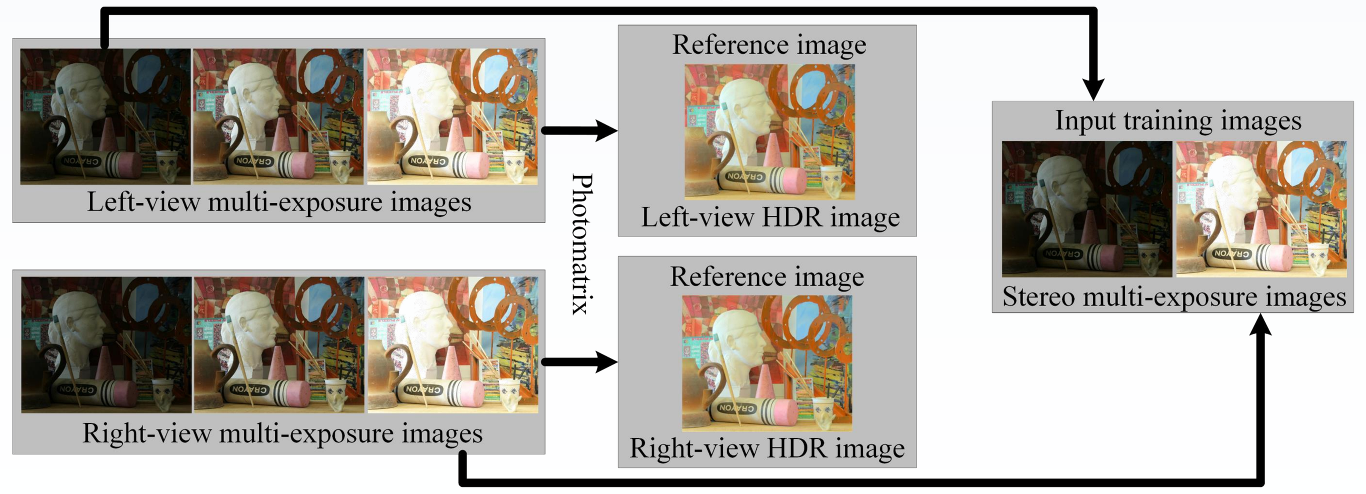


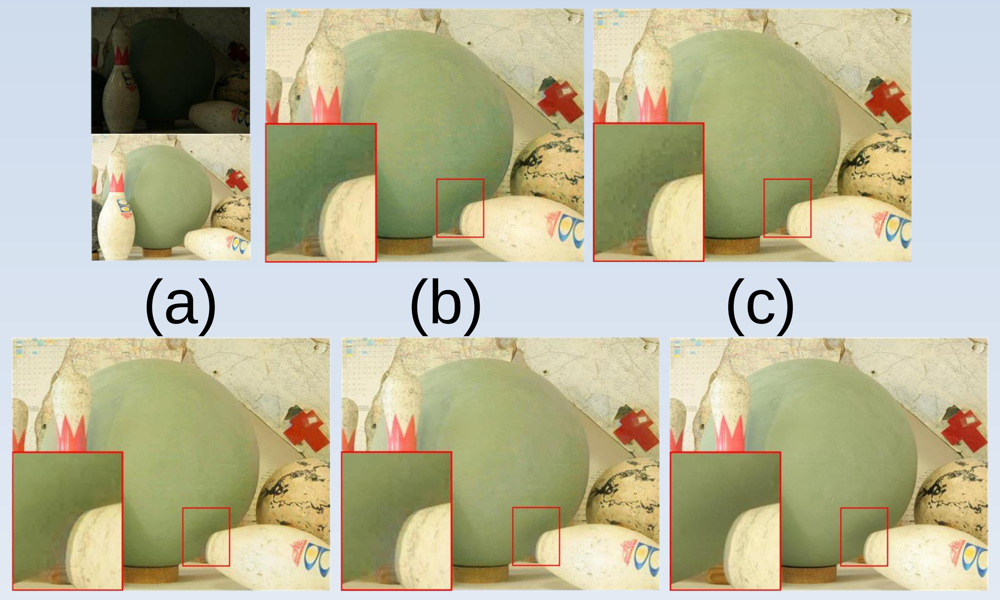
Fig. 4 Reference image (training label) generation.

Experimental Results (LV HDR imaging)

- **Middlebury dataset is used for experiments**

Table I Objective comparison of different loss functions

Loss	*Loss1*	*Loss2*	*Loss3*	*Loss4*
PSNR	27.4082	27.7657	25.5053	**28.8665**
SSIM	0.8754	0.8793	**0.8867**	0.8813
FSIM	0.9761	0.9663	0.9747	**0.9766**



(a) Input stereo images
(b) L1 loss (*loss1*)
(c) SSIM loss (*loss2*)
(d) SSIM loss + detail loss (*loss3*)
(e) SSIM loss + detail loss + adversarial loss (*loss4*)
(f) Reference

Fig. 5 Comparison of different loss functions (VET-GAN).

(a) Input stereo images
(b) Single view fusion
(c) Proposed (d) Reference
HDR image is displayed by tone mapping.

Fig. 6 The overall performance of the proposed method.

The proposed method can generate stereo HDR images with high visual quality.

Conclusion

1. **VET-GAN skips the steps of stereo matching and warping in the conventional methods, which can avoid ghost artifacts due to parallax.**
2. **HDR fusion GAN can reduce color and brightness distortion.**
3. **Experimental results demonstrate that the proposed method performs satisfactorily in stereo HDR imaging.**