Yu Liu

CYCLE CONSISTENT GENERATIVE ADVERSARIAL NETWORK FOR UNPAIRED IMAGE TRANSLATION

Unpaired image translation has become an important research topic in computer vision due to the difficulty of obtaining paired datasets. Cycle-consistent generative adversarial networks provide an effective solution by learning mappings between two image domains without paired supervision. This paper analyzes the CycleGAN model, including its architecture and training strategy. Experiments are conducted on benchmark datasets such as horse-to-zebra and seasonal translation tasks, evaluated using SSIM and PSNR. The results show that CycleGAN generates visually realistic images while preserving structural content and reduces reliance on labeled data compared with supervised methods.

Introduction

Image-to-image translation aims to convert an image from one domain to another while preserving its semantic content. Traditional supervised methods require paired datasets, which are often difficult to obtain in real applications. Therefore, unpaired image translation methods have attracted increasing attention. CycleGAN addresses this problem by learning bidirectional mappings between domains without paired data. It introduces cycle consistency to ensure that the translated image can be reconstructed back to the original one, which improves stability and preserves structure.

I. Model architecture

CycleGAN employs a dual mapping structure with two generators and two discriminators. The generators learn bidirectional transformations, while the discriminators distinguish real and generated images. Generators use convolutional networks with residual blocks to preserve content, and PatchGAN discriminators capture local details. Cycle consistency ensures that reconstructed images remain close to the original, improving stability and structural preservation.[1]

II. Training strategy

The model is trained using adversarial learning with alternating optimization between generators and discriminators. Identity mapping is introduced to preserve color and brightness consistency. The Adam optimizer is commonly used, together with learning rate scheduling to improve convergence stability.

III. Experimental Results

Experiments on tasks such as horse-to-zebra and seasonal translation show that CycleGAN successfully transfers visual style while preserving overall structure. Performance is evaluated using SSIM and PSNR. Although artifacts may appear in complex regions, the method achieves realistic results without requiring paired data.[2]

Conclusion

CycleGAN provides an effective solution for unpaired image translation and reduces dependence on labeled datasets. Despite limitations in semantic consistency and controllability, it demonstrates strong practical value. Future work will focus on improving robustness and controllability.

References

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Liu Yu, Master student, Department of Information Security, BSUIR, lydzemail@163.com.

Supervisor: Tsviatkou Viktar Yuryevich, Head of the Department of Infocommunication Technologies Doctor of Sciences at BSUIR. Full professor. Ph.D.,vtsvet@bsuir.by