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## **GANSAN: Towards Efficient Image Restoration Using Optimised Generative Adversarial Networks**

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## ABSTRACT

Restoration of degraded images is a naturally ill-posed problem which has been an open research problem for many years in the domain of computer vision. Whilst analogue images were primarily affected by physical degradations, digital imaging systems still struggle with visual corruptions and degradations such as blurring, image noise, low resolution, and haze. Since imaging systems are used in many other cutting-edge applications such as autonomous vehicles, surveillance systems and robotics, it is essential to develop efficient and robust image restoration systems capable of dealing with different types of visual degradations.

The proposed image restoration model is a result of experimenting with NAS to optimise a base U-Net generator, the introduction of a novel PatchGAN based discriminator with self-attention, and subsequently, the usage of automatic hyperparameter optimisation to refine the compiled GAN model through iterative training, using a reinforcement-learning like approach for fine-tuning. Additionally, improvements made by tweaking the normalisations applied to both the generator and discriminator have allowed the model to achieve better overall performance and increased generalisability across different types and levels of degradations whilst minimising visual artifacts in the output.

After training for 500 epochs on relatively light datasets with less than 2000 training image pairs each, GANSAN is capable of denoising noisy images with average output [PSNR/SSIM] scores of (30.58 dB/0.885) and is also capable of restoring low-res blurry images with average output [PSNR/SSIM] scores of (32.19 dB/0.894) as tested on popular benchmark datasets, CBSD68 and Set5 respectively.

**Keywords:** Image restoration, Image denoising, Image deblurring, Computer Vision, Deep Learning, Data Science

### Subject Descriptors

- Computing methodologies → Artificial intelligence → Computer vision
- Computing methodologies → Machine learning → Machine learning approaches → Neural networks
- Computing methodologies → Machine learning → Machine learning approaches → Bio-inspired approaches → Genetic algorithms
- Computing methodologies → Machine learning → Machine learning approaches → Bio-inspired approaches → Generative and developmental approaches