

**UNIVERSITI TEKNOLOGI MARA**

**TWO-PHASE IMAGE  
RESTORATION BY USING  
SPECTRAL CONJUGATE  
GRADIENT METHOD**

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## ABSTRACT

The study aims to adapt the method to restore several photos with noise. Image restoration is a vital field that seeks to recover an original image from a damaged version. Noise leads to image loss, including issues such as corruption and blurring, consequently reducing the efficacy of restoration efforts. Nevertheless, one often-occurring kind of corruption that seriously compromises image quality is salt-and-pepper noise. This study intends to build and assess a two-phase image restoration method for efficiently eliminating salt-and-pepper noise. It aims specifically to enhance restoration performance by combining the SCGM with conventional filtering approaches. Two phases comprise the suggested approach. To lower noise, first conventional filtering techniques, including Median, Adaptive Median, Gaussian, NLM, and FFT are applied first. The SCGM is then used to further improve the restoration. Several coefficients of CGM are used to compare their metric evaluations, which are FR, HS, Xue Paper and RMIL+. Moreover, the first phase without SCGM is also being compared to show that SCGM provides better results. The success of the technique is measured using PSNR and SSIM measurements. All methods are compared in Jupyter Notebook Python with several libraries such as NumPy, Skimage filters, morphology, metrics, and signal. The results show that, especially when combining adaptive median with SCGM along with the RMIL+ coefficient, the two-phase technique yields better PSNR and SSIM values than using traditional filtering alone. SCGM improves image details and greatly lowers residual noise. Therefore, the study concludes that the two-phase strategy is a promising technique for salt-and-pepper noise reduction. Appropriate filtering combined with SCGM offers a strong way to restore images and provides potential advantages in applications where image quality is crucial.

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