

# Measure of Filtering Quality Assessment of Image Noise Using Nonparametric Statistic

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**Abstract**—The paper proposes a new numerical measure for filtering quality assessment of additive white Gaussian noise in digital images based on the analysis of closeness of the difference image to white noise. Such analysis is often conducted visually that leads to undesirable subjectivism. The numerical analysis of difference image using the properties of nonparametric BDS statistic was performed in this paper aimed at reducing the impact of subjectivism on the filtering quality assessment. The specified statistic is applied for the analysis of time sequence in testing the hypothesis on independence and identical distribution of its values. It can serve as a measure of quality of different filtering methods of noisy images. This statistic complements the toolkit of known practical measures of image quality, such as PSNR, MSE and SSIM. It is well known that a good quality of image filtering, from the viewpoint of these measures, not always corresponds to the better quality of filtering from the viewpoint of its visual perception. It has been shown that the measure using the values of BDS statistic demonstrates a high sensitivity to the structuring (dependence) of elements of difference image determined by the chosen filtering method. Using the simulation of image filtering algorithms implementing the methods of local and non-local filtering, a comparative analysis of their quality was conducted based on using BDS statistic.

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## 1. INTRODUCTION

The filtering (image denoising) problem is one of the classical problems of image processing. The Gaussian, Poisson, Rician, speckle-noise, and salt-and-pepper noise can be referred to noises of digital images. The additive, multiplicative and pulse noises are distinguished in terms of image distortion.

At the same time, artefacts and residual noises hampering their visual perception and interpretation are often observed in images after the application of different filtering methods. The development of the methods for image processing and enhancement gives rise to the appearance of new criteria for image quality assessment.

The processing quality of noisy original image can be considered as a characteristic of the proper image and determined by its eigenproperties: statistical, semantic, and structural. The corresponding quality criteria are either subjective, in case of visual (expert) image quality assessment or based on objective numerical measures of image characteristics (attributes): shape and parameters of brightness distribution, estimation of detail distortions, etc.

With the second approach, quality is considered as a measure of similarity (closeness) of two images: real and reference. Such approach is a more constructive, and it allows us to estimate the quantitative changes of brightness values, level of distortions of original images in the process of transformations (filtering, data compression, etc.). Thus, we can assess the quality of proper transformation tool (algorithm or device/system).

This is important in constructing the image processing systems and estimation of the quality of algorithms of image processing. There are many examples of images, for which the numerical measure of

#### CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

#### ADDITIONAL INFORMATION

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