STM JOURNALS

Journal of Artificial Intelligence Research & Advances
ISSN: 2395-6720 (Online)
Volume 4, Issue 2
www.stmjournals.com

A Survey Paper on Image Denoising Technique for Satellite Images

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Abstract

Image denoising (ID) is a material issue found in various image processing (IP) and PC vision issues. There are numerous techniques of denoising images. The most necessary property of ID model is that it ought to totally diminish clamor, however much as could reasonably be expected and edge conservation. This paper gives a knowledge perspective of some real work in the field of ID. Specialists have distributed numerous calculations in the field of ID which have numerous presumptions, focal points and in addition, constraints. We are using satellite images for removing Gaussian noise that are type of image denoising. Satellite images are corrupted by noise in its acquisition and transmission. After brief presentation, different techniques have been explained for removing noise.

Keywords: *Image denoising, filtering, noise models, linear and non-linear filters, Gaussian filter*

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INTRODUCTION

Satellite pictures might be influenced by different sorts of noise during capturing and transmission. Noise types vary from Gaussian noise in natural images to multiplicative speckle noise in synthetic aperture radar (SAR) images. So, ID is a critical step in image processing and remote detecting applications. Image denoising is an imperative picture handling undertaking, both as a procedure itself, and as a segment in different procedures. There are numerous approaches to denoise an image or a data set. The main properties of a good image denoising model are that it will remove noise while preserving edges. Traditionally, linear models have been utilized. One basic approach is to utilize a Gaussian filter. An advantage of linear noise removal models is the speed. But a drawback of the linear models is that they are not able to preserve edges in a good manner. Edges, which are recognized as discontinuities in the image, are smeared out.

Images are produced to show useful information or details. Because of defects in the catching and imaging process, however, the images which have recorded always represent a corrupted form of the original image. The blame of these is risky to a large portion of the progressive picture handling capacities. There are many sorts of debasements, which ought to be thought about, for instance, geometrical corruptions, shading blemishes, light and obscure. Computerized pictures assume an extremely pivotal part both in applications such as TV, attractive reverberation imaging, PC tomography and in the territory of science and novelty such as geological data framework and cosmology. Information given by picture sensors and other specific procedures are constantly adulterated by undesirable flag. Also, commotion could be acquainted due with transmission blunders and pressure. Thus denoising a photo is an essential and starting step to be performed before the photo data is analyzed and arranged. Here, different successful techniques have been considered. A powerful denoising method must be connected to recover the information corruption [1].

IMAGE DENOISING

Denoising an image is an element of correcting defects produced for the period of possession method of a real world scene and its replica on a display, due to physical and technological limitations. It is also useful as a

preprocessing stage to refine the results of higher level applications. The issue of wipe out the commotion of an image for keeping up its principle qualities (edges, surfaces, hues, differentiate, and so forth) has been broadly examined since the most recent two decades and different sorts of methodologies have been produced [1].

The "Linear operation" is either the expansion or augmentation of the noise n(x, y) to the signal s(x, y). Once the noisy image w(x, y) is surrounded, it is filtered through denoising framework to get the denoised picture z(x, y). The aim of this proposal is to recognize and contrast various "denoising methods" (Figure 1) [2].

IMAGE DENOISING MODEL AND NOISE TYPES

Image denoising can be formally characterized as disposal of noise which is available in the picture while protecting the essential and sharp elements of the picture (Figure 2). In gaining, transmitting or handling an advanced picture, for example, the noise actuated corruption might be reliant or autonomous of information which is appeared in Figure 1.

Gaussian Noise

Gaussian noise is otherwise called enhancer noise or electronic noise as it is produced from speaker or finder. It utilizes Gaussian conveyance i.e. typical conveyance. It is added substance in nature, each pixel is free, and flag force of each pixel is likewise autonomous.

Salt-and-Pepper Noise

Salt and pepper noise is otherwise called impulsive noise or spike noise. In this kind of commotion, the image is degraded by white and dim spots on it, having faint pixels in splendid areas and magnificent pixels in dull districts. Exceptionally differentiating spot in the photo have some clamor regard i.e. 0 and 1 independently. This clamor is made because of easy to-cutting edge converter oversights and bit blunders. Uninteresting pixels deliver a comparable, however non-arbitrary show in a LCD screen.

Film Grain

Film grain is ordinarily watched around an isotropic (non-arranged) noise source, its effect is made dreadful by the movement of silver halide grains in the film moreover being sporadic.

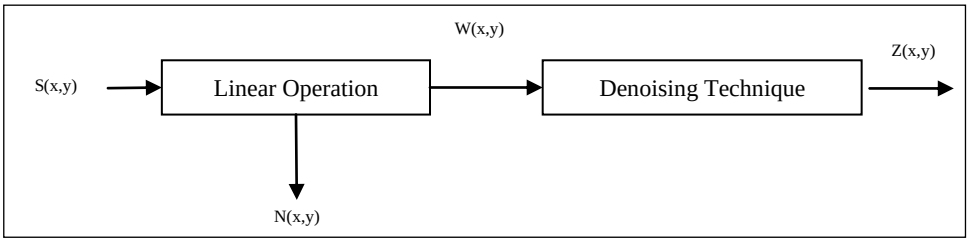

Fig. 1: *Denoising Concept.*

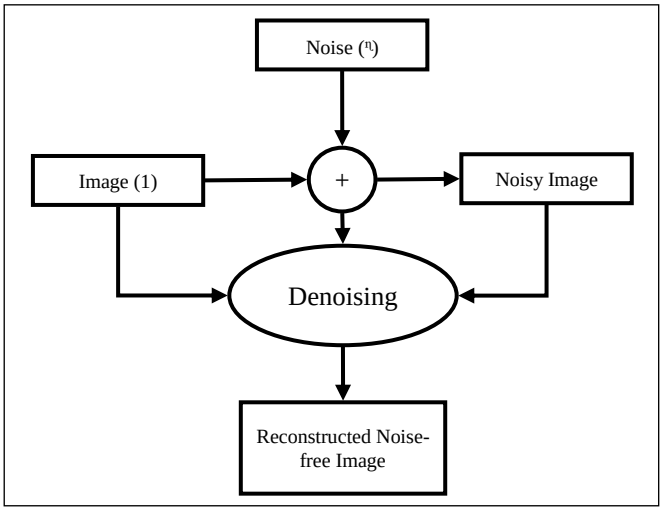

Fig. 2: *Image Denoising Process.*

Shot Noise

The shot noise is produced by statistical fluctuations, for example, variety in the amount of photons occurrence at a given introduction level. Shot clamor has a RMS regard about the square base of the photo constrain, and the commotions at individual pixels are allowed to each other. Shot clamor obey Poisson course, which is not exactly the same as Gaussian. Despite photon shot commotion, there can be additional shot clamor from the diminish spillage current in the photo sensor; this clamor is generally called "diminish shot clamor" or "diminish current shot noise".

Quantization Noise

This commotion takes after a generally uniform assignment and moreover called as uniform clamor. Quantization implies the strategy for separating, hence the uproar brought on by quantizing the pixels of an identified picture to different discrete levels is known as quantization commotion. Despite the way that it can be banner subordinate, yet in the occasion that dithering is explicitly associated, it will be banner self-governing.

Anisotropic Noise

Anisotropic noise tests are valuable for some perception and representation applications. The spot tests can be utilized as contribution for surface era, such as, line fundamental convolution (LIC), yet can likewise be utilized straightforwardly for perception. The meaning of the spot tests utilizing a metric tensor makes them particularly reasonable for the perception of tensor fields that can be converted to a metric for the anisotropic thickness field.

Speckle Noise

It is a granular clamor that characteristically exists in and debases the way of the dynamic radar and manufactured gap radar (SAR), therapeutic ultrasound and optical soundness tomography pictures. In customary radar, spot commotion occurs in view of subjective changes in the entry signal IP segment. It grows the mean dim level of an area. This is a multiplicative clamor. The wellspring of this commotion is self-assertive impediment between the sensible return [3].

SATELLITE IMAGE

Satellite picture has properties of high determination and are multispectral, it is initially utilized as a part of the military and natural field. Be that as it may, it is utilized increasingly in the field of guide generation, horticulture, ranger service, arranging of national land, foundation of city plan, and so forth of late. Probability of intermittent information obtaining of satellite picture and differing satellite pictures amongst hyper spectral and high determination satellite picture, makes the satellite pictures the vital asset for the record of national land (Figure 3). In this way, it is important to protect the satellite pictures which contain the change of geographic data, national land, and condition for the type of advanced library or exhibition hall [4]. Despite the fact that numerous administration associations, self-administering body and open research organization make utilization of satellite picture and do its own venture under the base of satellite picture now in Korea, lacking participation and collaboration result in the covering buys of satellite picture generally. What's more, handling of satellite picture is done utilizing outside programming in view of non-precise administration of the created innovation and these certainties result in the mass spending waste for every year. For the arrangement of these issues, it is important to build up the administration which gives and deals with the data of satellite picture methodically and circulates data to the foundation which require it unreservedly [5].

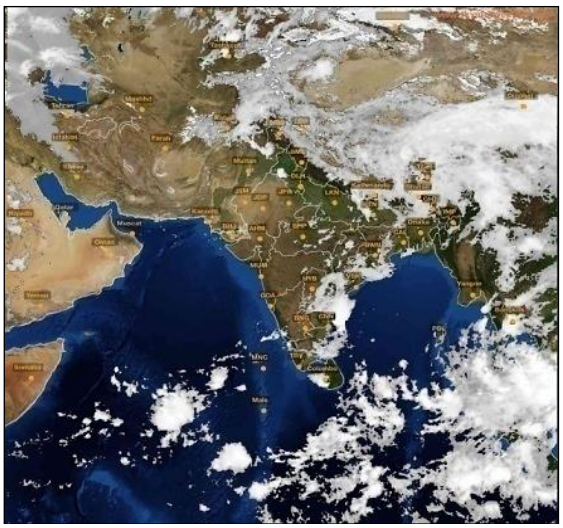

Fig. 3: *Satellite Image.*

DENOISING TECHNIQUES

Denoising is the method for wiping out or reducing the characteristic commotion from a given picture. Many sorts of frameworks open hence. The decision of the denoising methodology depends on upon the type of image and the noises shown in that picture. The sorts of picture denoising strategies are:

- Spatial domain filtering, and
- Transform domain filtering.

The detailed classification is illustrated in Figure 4, followed by a discussion of the various denoising techniques [6].

Spatial Domain Techniques

An immediate framework to expel clamor from a picture is to utilize spatial channels, which can be assembled into nonlinear and straight channels. In image processing, shifting is a limit familiar with performing many works like, commotion reducing, contribution and rethinking. The channel is picked in view of the way of the undertaking performed by channel and kind of the information. Channels are utilized to take out clamor from a picture while secure the first picture in picture preparing.

Non-Linear Filters

Non median channels are used to diminish the noise from the picture, however there is no exact exertion made to recognize the noise first. These channels every now and again oust clamor to a sensible degree, however at the cost of clouding pictures and along these lines, makes the edges in picture imperceptible. Investigation work is going on and some new strategies have been proposed to address those issues. Middle Filter (MF) is a non-direct smoothening strategy that diminishes the obscuring of edges. The process replaces the near point's power by the middle of the powers in its neighborhood in the picture. The middle of the powers in the area is not influenced by individual clamor spikes. The middle channel evacuates motivation commotion in a proficient way. Since median filtering does not distort boundaries so much, it can be applied iteratively. The huge issue of the MF is that it is comparatively costly and is hard to work out. It is important to manage the overall values in the neighborhood into numerical that find out the median value that is relatively slow.

Linear Filters

In a linear filter, the output will change linearly with a change in the input. You could plot some sort of straight line from the connection linking the two. The mean filter is the ideal straight channel for Gaussian noise in the feeling of mean square error (MSE). It is the basic procedure of denoising the image. Every pixel’s esteem is supplanted by the mean or normal estimations of the neighboring pixel values. This has the impact of wiping out pixel values which are variable of their environment. Second direct channel is Wiener filter.

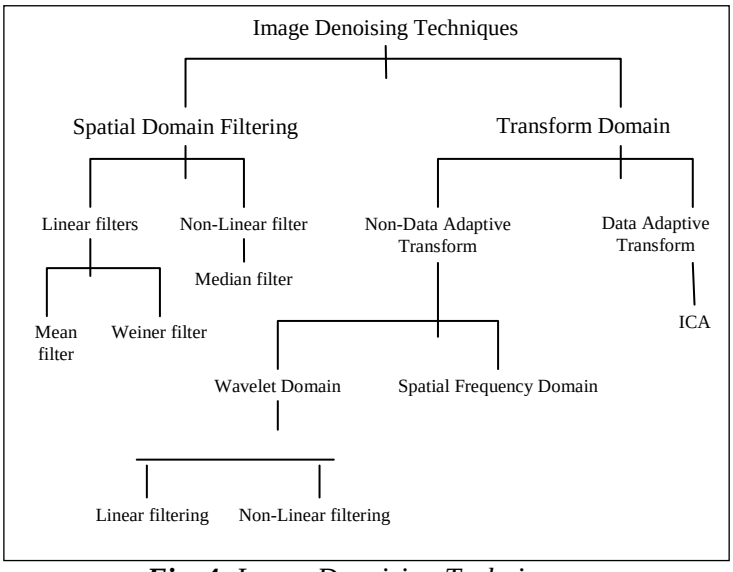

Fig. 4: *Image Denoising Techniques.*

It is utilized to deliver a gauge of a coveted or target arbitrary process by straight time invariant shifting of a watched uproarious process, expecting known stationary flag and noise spectra and added substance noise. The Wiener channel diminishes the MSE between the evaluated irregular process and the coveted procedure.

Transform Domain Techniques

Change space for the most part incorporates wavelet based separating strategies. The change space sifting is arranged on the premise capacities. The change area sifting can be moreover isolated information versatile and non-versatile channels.

Non-Data Adaptive Filters

This class of channels can again be additionally separated into wavelet domain and spatial frequency domain. Spatial recurrence sifting procedure is a type of change space separating. It uses Fast Fourier transform (FFT) with low pass filters (LPF). In spatial repeat system, denoising is done by arranging a cut-off repeat, yet these are tedious and may convey non-regular frequencies in arranged picture. Wavelet area can be parceled into linear and non-straight sifting procedures. Generally, Weiner channel is the picked straight sifting strategy as it creates the most critical outcomes in the wavelet area separating. Wiener channel is used to direct filtering methodology which gives most vital outcomes in the wavelet space isolating. It is used where data debasement can be shown as a Gaussian strategy and precision foundation is MSE. Regardless this, filtering result is outwardly more deficient than the first corrupted picture. Non-Linear limit separating utilizes the wavelet change that maps clamor in flag space to that of commotion in change area. While flag quality gets the chance to be more assembled into less coefficients in change area, clamor quality does not. Two sorts of thresholding limits are used:

- Hard thresholding; and
- Soft thresholding.

If the information is bigger than the limit, then it is a hard-thresholding capacity, it is set to zero; generally the information contentions are lessened toward zero by the edge called soft thresholding capacity. The outcome might be still noisy. Motion with expansive number of zero coefficients is created by huge limit. This delivers a smooth flag. Determination of an ideal limit is finished with more prominent consideration.

Data Adaptive Transforms

Independent component analysis (ICA) transformation method is important which includes key component, factor analysis and projection detection. ICA process is mostly used for the blind source partition problem. The real preferred standpoint of utilizing ICA is it's supposition of flag to be non-Gaussian which assists in denoising of pictures with non-Gaussian and Gaussian circulation. The burden of utilizing ICA based techniques are the high computational cost since it needs a sliding window and includes test of no less than two picture edges of a similar scene [6].

IMAGE DENOISING APPLICATIONS

To concentrate the impact of our model and its estimation technique, we apply our method to ID, which is a process of estimating the true intensity corresponding to the scene radiance from the noisy observations. For image denoising, we adopt the Bayesian non-local means (BNLM) method [7], which is an extension of the non-local means denoising algorithm with more robust similarity measures. NLM algorithm denoises the images based on the nature of self-similarity in natural images. The picture rebuilding system is utilized as a part of the accompanying fields of IP:

- Astronomical imaging;
- Medical imaging;
- Printing industry; and
- Defense applications.

Problem Statement

Image denoising is the most imperative undertaking of picture preparing for both, as a procedure itself and as a part in numerous different procedures. There are different sorts of ways to deal with dispose of commotion from an arrangement of information or picture exists. Picture denoising is until now a noteworthy striving for experts, since departure of noise presents doodads and

clouding effect of the photo. This paper characterizes wavelet based denoising strategies utilized for clamor decrease giving the diverse calculations that ought to be located on the most solid gauge, the limit estimation of the first picture information is its diminished variant. In pictures, noise showing is phenomenally affected by getting the instruments, data transmission mode, picture quantization and wellsprings of radiation in discrete casing. Unmistakable systems and counts are used depending upon the commotion appearance. Most of the primary pictures are acknowledged to have included substance discretionary clamor which is shown as a Gaussian.

Objective of the Work

In view of perceptions made in the past area, the paper is centered around denoising, an inspiration commotion corrupted and restored by settling the above tended to challenges. The objective of the work is to recognize the clamor remains in a photo which is contaminated with high compel of inspiration commotion denoising of an extensive variety of clamorous pictures. Taking after are the key focuses, which are seen at the season of outlining the framework:

- Solve the problem of picture looking from a big database.
- Improve the nature of the photos to hint at change recovery comes to fruition.
- To deal with time many-sided quality.
- Compared the pictures with PSNR, MSE and NCC values with the assistance of proposed framework.

LITERATURE SURVEY

The concentration of the proposed paper by Saraf *et al*., first examines the fundamental denoising approaches and have a look at them [8]. Also, to study post-arrange sifting procedure, utilizing the technique for clamor and reweight plans. For this situation, we see from our examinations that the post-sifting procedures can possibly weaken the commotion appropriately, which is left by the first connected denoising approach.

Sadreazami *et al*. presented another shading picture denoising procedure in the contourlet space for diminishing commotion in pictures undermined by Gaussian noise [9]. This procedure accounts the quantifiable conditions among the contourlet coefficients of the RGB shading channels. To this end, the multivariate Cauchy movement is used to get these between channel conditions. This model is then manhandled in a Bayesian most prominent a posteriori estimator to restore the spotless coefficients by construing a powerful close edge shrinkage work. Trial results are performed on a course of action of shading pictures to survey the execution of the proposed denoising system. The results demonstrate that the proposed procedure beats a segment of the present methods to the extent both, subjective and target criteria.

Sethunadh *et al*. proposes a review of spatially flexible picture denoising arrangement for Gaussian commotion in perspective of DT by considering the states of the directionlet coefficient transversely over different scales [10]. The photo is first disintegrated using DT and the coefficients so procured are shown using a bivariate generous took after probability thickness work with an area contrast parameter to speak to cover and intra scale states of the coefficients. The DT is made flexible to the area dominating headings in the photo by recognizing the common course in the spatially partitioned picture through the estimation of a parameter called 'directional change'. Bayesian 'most extraordinary a posteriori' estimator is then used to enroll the commotion free coefficients from the bivariate models of the banner and clamor. The denoised picture is procured from the changed coefficients, which were modified using the bivariate shrinkage work, using directional information and turn around DT. Exploratory outcomes display that the bivariate shrinkage in directionlet space achieves favored execution over that in wavelet territory, to the extent numerical and perceptual quality.

Fedak *et al*. presented “Image denoising based on optimized NLM algorithm” [11]. Pictures and recordings are frequently coded utilizing piece based discrete wavelet transform (DWT) or discrete cosine transform (DCT) that cause a lot of visual bends. Non-local means (NLM) is picked through looking at many-sided quality and nature of various calculations and is

considered to the better calculation for ancient rarities decrease, as implementation of this calculation is computationally serious. In this note, enhancement to the non-neighborhood implies presented will be introduced and extremely viable execution improvement approach is displayed. This approach depends on extra memory utilization for storing pixels separate in the picture. We introduce the fundamental structure and exploratory outcomes for video that is prepared by NLM with various parameters.

Malini *et al*. showed that in denoising issues, banner and clamor can be disconnected at the same time and accordingly end of commotion winds up obviously less requesting [12]. When a nonlinear center channel is used as a piece of multiresolution condition, once in full assurance and after that with half assurance, denoising ends up being more incredible. This framework is a non-straight dealing with and is seen to be useful in diminishing drive commotion notwithstanding Gaussian and speckle clamor. Help, it is in like manner proposed that use of a nonlinear adaptable center channel makes all the more fulfilling picture with better denoising.

Dhanushree *et al*. proposed a center channel and flexible wavelet thresholding shrinkage technique for picture de-noising [13]. The loud picture is gone through pre-preparing middle channel to evacuate the commotion and two level discrete wavelet change is connected which is gone through post-handling middle channel to expel clamor. Finally, Bays thresholding shrinkage is associated with all sub-gatherings to procure de-noised picture. The inverse discrete wavelet change is associated with redo the photo. The image quality is measured similarly as the PSNR and is watched that the proposed system procures better PSNR diverged from existing methodology.

Gupta *et al.* demonstrated a study of some basic work in the domain of picture denoising [14]. The renowned philosophies are requested into different sets and a graph of different computations and examination is presented. They presented a survey of some vital work in the range of picture denoising. The famous methodologies are arranged into various sets and an outline of various calculations and examination is exhibited.

Kheradmand *et al*. introduced an examination for the filtering behavior of the proposed technique in perspective of the spooky properties of Laplacian systems [15]. A bit of the settled iterative philosophies for upgrading bit based denoising like scattering and boosting cycles are remarkable cases used as a piece of maker's structure. Their proposed approach gives a predominant appreciation of redesign frameworks in self-equivalence based systems, which can be used for their further change.

Kaimal *et al*. presented "A modified anti-forensic technique for removing detectable traces from digital images" [16]. The expanding attraction and trust on computerized photography has given rise to new worthiness problems in the images of criminology. Many preferences are given to utilizing computerized pictures. Advanced cameras create quick pictures, enabling the photographic artist to standpoint the pictures and promptly choose whether the photos are adequate immediately of sitting tight for the film and prints to be handled. It does not require outer creating or proliferation. Moreover, advanced pictures are effortlessly put away. No regular "unique picture" is set up here like conventional camera. In this manner, when scientific analysts investigate the images they do not have entry to the first picture to look at. Extortion by traditional photo is moderately troublesome, requiring specialized skill. Though huge elements of mechanized photography are, ease and diminished cost, in changing the picture. Control of advanced pictures is less complex. With some central programming, a carefully recorded picture can undoubtedly be altered. Various procedures are accessible to check the validness of pictures. Be that as it may, the truth of the matter is that number of picture altering is additionally expanding. For this reason, they need to locate the new hostile to legal strategies and answers for them.

Xu *et al.* presented "Monochromatic Noise Removal by methods for Sparsity-Enabled Signal

Decomposition Method" [17]. Monochromatic commotion constantly intrudes with the comprehension of the seismic banners and degrades the mode of subsurface pictures procured by further methodology. Standard systems encounter the evil impacts of a couple problems in recognizing the monochromatic commotion subsequently, sparing seismic signs, etc.

In perspective of different morphologies, two waveform dictionaries are addressed, each portion meagerly and the division methodology is progressed by the sparsity of both parts in their relating addressing word references. Both produced and field shot data are used to speak to the reasonability of our technique.

Padmagireeshan *et al*. presented "Execution Analysis of Magnetic Resonance Image Denoising Using Contourlet Transform" [18]. X-beam pictures of remedial field using contourlet change are proposed and the execution of the planned procedure is first destitute down with the current frameworks. Commotion in MRI pictures has a Rician dissemination despise AWGN clamor. Rician spread is a banner dependent. Secluding sign from the Rician clamor is a troublesome task. The proposed methodologies have been differentiated and other change techniques for example wavelet thresholding and square DCT. Hard, sensitive and semi-fragile thresholding frameworks are portrayed and associated with test pictures with point of confinement estimators like comprehensive edge. The outcomes are taken a gander at in perspective of the parameters: PSNR and MSE. Numerical results exhibit that the frame let change can procured higher PSNR than wavelet based and square DCT based denoising counts (Table 1).

CONCLUSION

The aim of this paper is to present a survey of different techniques on satellite images. Different filters display different outcomes. Extent of this examination is as yet open in ranges like further improvement as much as speed and augmentation of the methods to other related territories like shading and dark picture denoising. Such reviews would additionally increase the down to earth utilization of these systems.

Table 1: *Summary of Literature Survey.*

Year	Author	Title	Methodology	Result
2012	Zuofeng Zhou, *et al.*	Contourlet-based picture denoising calculation utilizing versatile windows.	Contourlet change with adaptice windows.	Achieved preferable execution over current subsampled contourlet based image denoising calculations.
2012	Joachimiak, *et al.*	Multiview 3D video denoising in sliding 3D DCT area.	Denoising in 3D DCT space.	Up to 1.62 dB pick the extent that typical Peak Signal to Noise Ratio (PSNR).
2013	Kaimal, *et al.*	A modified anti forensic technique for removing detectable traces from advanced images.	Anti-scientific technique.	Remove the mark hints of sifting.
2013	Hagawa, *et al.*	Using broadened three esteemed additional signs for a denoising model of high recurrence relics in jpeg pictures by estimation of particular frequency.	Simple assessment esteem named augmented three esteemed augmentation sign (ETIS).	The model succeeded to reject noise with maintenance of edge information.
2013	Jin *et al.*	Monochromatic noise removal via sparsity enabled signal decomposition method.	Sparsity empowered flag disintegration strategy.	Synthetic and field shot data are utilized to exhibit the viability of our technique.
2013	Padmagireeshan *et al.*	Performance analysis of magnetic resonance image denoising using contourlet change.	Contourlet transform	The contour let transform can get higher PSNR than wavelet based and square DCT based denoising calculations.
2013	Fedak and Nakonechny	Image denoising based on optimized NLM algorithm.	Optimized NLM algorithm.	Improvements to the NLM implies presented will be introduced.

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Cite this Article
Roopali Arya, Nirupama Tiwari. A Survey Paper on Image Denoising Technique for Satellite Images. *Journal of Artificial Intelligence Research & Advances*. 2017; 4(2): 1–9p.