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Satellite Image Enhancement Optical and Sar Image Fusion for Lulc Application: Comprehensive Review for State of Art.

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Abstract: Satellite Image Enhancement is important things in remote sensing. In LULC application, many field is covered like agriculture monitoring, forest monitoring, Urban area development, disaster monitoring, etc. In this paper, image fusion of optical satellite and SAR satellite is focused. Optical satellite gives multi spectral high resolution only in day time images but due to high resolution mixed class pixel problem is occurred which reduce the accuracy of the actual object recognition. SAR satellite gives high resolution images in both day and night time and helps to monitor in all weather and good in cloud penetration but due to thermal energy, SAR has speckle noise problem which creates problem to classify images for recognition. And Image fusion is the trending techniques used in remote sensing for better results is describe in details in this paper. The motive of the paper is to review optical satellite images mixed class pixel problem, SAR satellite speckle noise problem and the image fusion techniques reviewed in this paper for LULC applications.

Keywords: *Satellite Images acquisition, image enhancement, Optical Satellite, SAR satellite, Image fusion*

Introduction:

A broad range of applications use satellite images, such as telecommunication, GPS, navigation, weather and disaster forecasting, object identifications, agribusiness monitoring, ocean behaviour monitoring, and space behaviour monitoring. information gathered by artificial earth monitoring satellites used for remote sensing about the surface of the globe. These photos are blurry, have low quality, and feature a lot of noise. Remote sensors are used to capture satellite images. Remote sensors use their sensing capabilities to gather information about the earth's surface, recoding their emitting or reflecting energy for pre-processing and analysis to get more precise results or information.[1]

Satellite image enhancement is the technique which is most widely required in the field of satellite image processing to improve the visualization of the features. Satellite images are captured from a very long distance, so they contain too much noise and distortion because of atmospheric barriers. After capturing the image, some radiometric and geometric corrections are carried out on it but they are not sufficient for all the applications. It is very important to enhance the restored image before using. [2]

Satellite image enhancement is an important technique which helps us for image processing like classification, segmentation, recognition, or identification etc. For analysing image enhancement of satellites, need to understand how satellite images is captured for processing. Image acquisition is also much more important to understand how satellite image acquire and what types of satellite images used for what purpose. Image acquiring details helps us to identify which satellite is used for which purpose. It also helps us to understand the behaviour of satellite images.

Satellite image acquisition

In Digital image processing, before pre-processing of images like enhancement, transformation , recognition etc is to be done after image acquisition.[3]Image acquisition is an action of retrieving image from an external source for further processing.[4] In remote sensing, this can be done by sensing and recording reflected or emitted energy (which work in the same manner as light and it includes not only the visible spectrum, but also the ultraviolet, near infrared, mid-infrared, far-infrared and radio waves). [5] The non-imaging sensors is used for processing, analysing, and applying that information [6].

Satellite Image Acquisition is the most significant task to make decision for various field of remote sensing image processing. Digital number is used for remote sensing satellite image processing called pixel values is define details features of brightness, colour, texture, or wavelength etc. Using pixel value is a smallest unit of image processing to create matrix of row and column known as raster image. The acquired data in the form of digital numbers using sensor creates raster images and these pixels give all the dimensions and information about the images for better resolution.[7] In remote sensing, resolution refers to the smallest scale of an object or information can be represented in an image. If pixel size is small gives higher resolution means providing more detail. For example, 30cm resolution satellite imagery can capture details on the ground that are greater than or equal to 30cm-by-30cm square matrix. according to this definition, 30cm resolution image capture more photographic details than 1m resolution image.[8] Four types of resolution is present in remote sensing image acquisition.[9] Spatial resolution: Image description based on each pixel values.[10] Spectral resolution: describe the wavelength intervals based on electromagnetic spectrum.[11] Temporal resolution: define the time taken by satellite to revisit the same area.[12] Radiometric resolution: detailing of image contrast(low or high). [10]

The image acquisition in remote sensing takes seven steps to complete the procedure. As seen in Figure 1, the procedure requires an interaction between incident radiation and the desired targets.

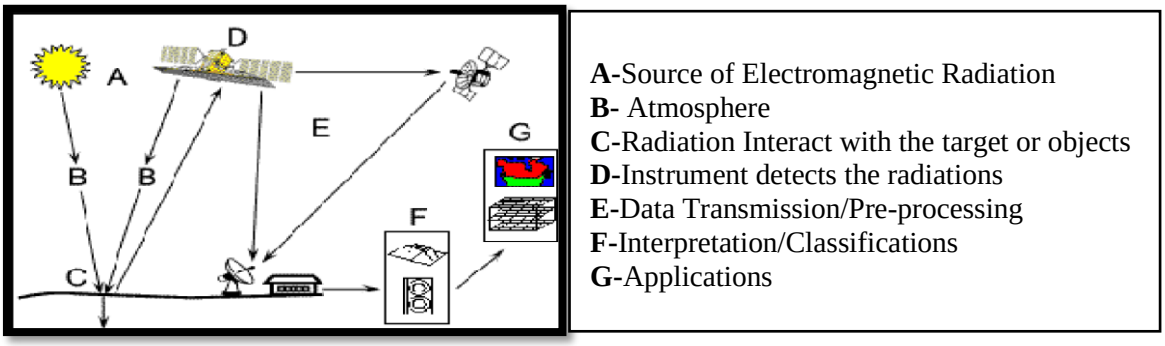

Figure 1. Remote Sensing Process [13]

Image acquisition can be done using satellite sensors, that's why called remote sensors. To collect the information or data about earth surface, satellites are revolved around the near-polar orbit using sensors. Sensors are two types: Passive sensors use Sun energy as a source to detect and measure the reflected energy to make records for creating images and it is not effective in night. Active Sensors has their own source of energy called thermal energy, used to detect, and measure the radiation towards the direction of target and backscattered back towards the sensor to make records for investigation purposes, and it is good in both day and night time. [14,15]

During image acquisition, radiation is used for remote sensing must travel through some distance of the Earth's atmosphere and then reaches to the Earth's surface. The incoming radiation is impacted by dust particles and gases in the atmosphere which creates an effect called **scattering** and **absorption**. When airborne dust or big gas molecules contact with electromagnetic radiation, they cause the energy to divert from its original goal. This is known as scattering. In order to reach a target surface, radio waves are broadcast in pulses. A single beam antenna installed on an aircraft records each pulse that the target surface echoes after the pulses are illuminated.

The pattern of echoes varies depending on how fast the airplane is flying. Light is scattered when the pulse impacts a surface.[17]

Three distinct scattering types exist: The degree of surface scattering is determined by the smoothness of the surface. Snell's Law states that a surface that is extremely smooth, like smooth water, reflects. (b)Volume scattering: When the beam reflects on other objects, it causes volume scattering, which produces a stronger return signal. An illustration of this type of scattering is vegetation's reflection. The signal reflected by the plants has a higher signal to noise ratio than a smooth surface. (c)Double-bounce scattering is a multiple surfaces and volume phenomenon that is brought on by rigid structures like buildings. More cases are reported in cities. Surface roughness and the medium's dielectric properties both affect how much scattering occurs.[16]

Before understanding of image enhancement, need to understand different types of satellites images or data. Basically, satellites data or images are two types: Optical and SAR. Optical satellites work as passive sensor mode means satellite use sun as a source of energy to capture images which is more visible like as human eye. It gives moderate to high resolution images but not good in weather and cloud. It is good for small area covered. Its gives different types of images depend on number of spectral bands used in processing like panchromatic images: single band used and gives black and white images which is good for brightness, multispectral images: multiple bands are used and gives colored images which is good for brightness and observation, hyperspectral images: more than 100 bands are used which is more useful for detection, classification, and characterization of the objects. [18,19,20] SAR (Synthetic Aperture Radar) work in both active and passive sensor mode means in day time sun as a source of energy to capture energy which is reflected after contacting with earth surface to create images and in night time capture energy using their own thermal energy to capture reflection of object to create images, that's why SAR is good in all weather and cloud penetration in both day and night time. It also covers large area for capturing. Mostly, it gives high resolution images. There are three types of scattering as discussed above: smooth surface bounce the very less energy reflect creates black pixel is occur for water or road, and rough surface bounce both high or low amount of backscattering reflection creates grey pixel is occur for vegetation, grasses, double bounced scattering creates mixture of both rough and smooth surface energy refection and transmission is recorded by radar which creates bright white pixel for urban area like building. [21, 22, 23]

Satellite Image Enhancement

Once we understand, how images are acquired by the satellite and what types of data is recorded by the satellites to creates images. Now, we need to understand image enhancement.

Image Enhancement is a techniques used to improve the quality of images for better understanding than the original images. In digital image processing, after image acquisition image enhancement is needed to improve the image visualization. The main goal of image processing is to translate original image into more informative images is to be done by manipulation of pixel values which is recorded in the form of digital numbers. Image enhancement basically work with pixel value of images manipulations are two types: Spatial domain and Frequency domain. Images are captured using radiation through refection to the object and transmission from the object. In remote sensing image enhancement used both domain for increasing image understanding. Spatial Domain Image Enhancement: work with image pixel manipulation like histogram equalization, spatial filtering. Frequency Domain Image Enhancement: work with low or high frequency of images for smoothening and sharpening like Wavelet or Fourier transformation. The generalized method of image enhancement is to takes original image as an input and then applied enhancement techniques as per requirement to get better image as an output. Spatial domain is good for analysing the images but Frequency domain gives better enhancement due to detection of frequency. As per review, frequency domain is bit difficult because of correct detection of frequency that's why spatial domain is mostly used for image enhancement. [24,25,26,27]

Review Methods

As we all know, every research based on problem with their related challenges. Satellite images are captured from the long distance and due to lots of atmospheric effects, clouds, noise etc. creates problem for better understanding and visualization of the images for processing. Satellite images are used for many LULC

applications but due to many issues and associated challenges creates problem. As discussed earlier, Optical satellite images gives moderate to high resolution but due to multispectral or high spectral images mixed class pixel problem is occur, and SAR satellite images are is good in all weathers and cloud penetration that's why speckle noise is occur. But for better results we need to monitor or data or images in both day and night, that's why image fusion techniques is used for different applications of LULC to monitor change detections.

The Motive of the paper is how to solve mixed class pixel problem means if pixel value belongs to multiple class create mixed pixel class problem which creates problem during classification and detection. And the second motive of the paper is how to solve speckle noise problem means due to variation of backscattering of radiation generate light or dark pixel and due to cloud penetration pixel value is changed compared to original image pixel values for better visualization. And the third motive of the paper is which techniques is best for image fusion means how two different images can be merged to create new images with better resolutions.

With the help of literature survey, we can understand more about the issues and their associated challenges for solving the problem. For the literature survey, we used many keywords for searching papers like "optical satellite", "mixed pixel problem", "Multispectral optical satellite", "Hyper spectral optical satellite", "SAR satellite" , "Speckle noise", "Despeckle noise", "LULC applications", "Image Fusion", "Change Detection" etc. To prepare Literature survey, we used qualitative paper compared to quantitative papers. Mostly, papers are selected by Elsevier, MDPI, IEEE transaction, Taylor and Francis, Willey, etc. All papers are journal papers no conference paper is used in literature survey for better understanding.

Literature Survey

As stated in the introduction, satellite images are used for various applications. It acquired by using sensors from long distance. That's why, satellite images have lots of issues during acquisition due to weathers, clouds, global warming etc. Due to these issues or effects creates problem in original images which is not directly used for classification, detection, or recognition. It needs some techniques which helps to create clear image for processing in different purposes. In this literature survey, author focused on two main problems in both Optical and SAR satellite images which creates problem during classification and enhancement. Both optical and SAR satellite is more useful in LULC application and change detection, that's why Image Fusion is used in current trends. But image fusion creates registration problem means for ground truth validation need registration process for change detection in LULC. The literature survey is divided into three main categories:

- Mixed pixel problem in optical satellites review
- Speckle noise problem in SAR satellite review
- Registration problem in Image Fusion review

With the help these three reviews, we understand problem more appropriately and helps to find the accurate techniques to solve. These three reviews are in the form of tables which helps other researche to understand quickly and reduce time consumption for reviewing three major problems.

LITERATURE REVIEW MIXED PIXEL PROBLEM IN OPTICAL SATELLITES

As previously stated, optical satellite gives high resolution images due to sun as a source of energy for capturing but more visual images like human eyes creates problem called mixed pixel. Mixed pixel problem means one pixel belongs to many classes, that is why it is also called mixed class pixel. As per there name, mixed class pixel is kind of problem to identify object accurately and during segmentation, or classification creates more problem. [28,29] This problem occurs due to atmospheric effects and shadow effects. Atmospheric effects means when radiation is reflected from the satellite using sun as a source of energy is scattered by some atmospheric elements like rainfall, clouds, gas, aerosol concatenation and some are absorbed. Due to this, optical satellite lack on spectral information which falls in mixed class pixel problem. [30, 31,32] The below table 1 show overview, how to solve mixed class pixel problem using different techniques and what are the pros and cons of that.

Table 1. Mixed pixel problem in literature review.

Ref	Years	Dataset	Methods	Performance	Limitations
[33]	2017	Pléiades	Supervised classification technique-Neural Networking and Random Forest	Mixed pixel identification base on band values of pure pixel and mixed pixel, merging of these pixels increase accuracy	Unsupervised classification techniques are unsuitable due identification of unbaled pixel is not always correct and that's why band values changes which reduce accuracy
[34]	2018	MODIS	NDVI	Using simulation techniques gives better green-up-dates compared to max and min NDVI threshold comparison	Lack of consistency due to remote sense data and ground truth data which creates problem like artifacts gridding, observation geometry, time composition.
[35]	2019	Airbus defence and space library	Fuzzy Clustering	Single spectral band is used for mixed pixel classification with high accuracy and les computational time	Deep learning concept can be used with both spatial and spectral components for classification of mixed pixel.
[36]	2020	Landsat 8	Transverse dyadic wavelet transforms	TDyWT enhance more information compared to Haar wavelet	Accuracy can be improve using hybridisation of cross transformation and machine learning.
[37]	2021	Landsat 8	transverse dyadic wavelet transform (TDyWT) Revers of Haar Wavelet	TDyWT enhance more information but reverse of Haar Wavelet is used for mixed pixel decomposition	Time consuming process but machine learning can be used to reduce time consumption.
[38]	2021	EO-1 Hyperion images	Linear spectral mixture analysis	LSMA with deep learning analyse the effects of spectral angles and distance which creates mixed pixel interference in NIR images compared to Visible images	Endmembers types and their abundance of each pixel is bit difficult and for identifying mixed pixel need to creates spectral index would be easy and quick.
[39]	2021	EO	LSMA, Vegetation index, Regression tree and Random Forest	Parametric methods is good for medium spatial resolution but non parametric methods is good for high spatial resolution.	For Low resolution data, combination of parametric and non-parametric method gives good results for long time series.

[40]	2021	Optical and SAR	Pixel based, object based, machine learning	For Classification, spectral, spatial, and temporal characteristics is important used for mapping and monitoring	For increasing accuracy, need to include pattern recognition and deep learning can be used.
[41]	2022	Sentinel 2	Fuzzy supervised classification	Fuzzy classification overcome mixed pixel but not define boundaries	Clustering and discriminant analysis of unsupervised learning improve results.
[42]	2022	Sentinel 2	Fuzzy unsupervised clustering	Unsupervised Fuzzy clustering improve results by modifying membership function	Two problems arise how to compute similarity between pair of observation and how to calculate partition for clustering.

LITERATURE REVIEW SPEKLE NOISE PROBLEM IN SAR SATELLITES

SAR is a Synthetic Aperture Radar whereas RADAR is a Radio Detection and Ranging. RADAR worked by sending an electromagnetic signal and receiving an echo reflected from the target, to determine the distance, or range, to an object. Since the signal travels from the radar to the object and then back to the radar after reflection, the total distance covered by the signal is twice as far as the distance between the radar and the object. SAR is a radar system that resembles a long antenna's effect by moving a small antenna near to the target. [43,44]

SAR work in both active and passive mode. Radar systems, which operate in the microwave area of the electromagnetic spectrum and easily connect with passive sensors, mostly used to gather active sensors. [45] The active functioning mode enables these sensors to operate independently from external sources (such as sunlight), and the frequency bands significantly lessen the effects of clouds, fog, and rain on the captured images. An essential prerequisite for ongoing, global monitoring of the Earth's surface, these are enabling in day, night, and all-weather imaging.[46] The primary drawback of these sensors, which are commonly referred to as real aperture radar is poor resolution. SAR images Speckle noise is occurred due to coherent nature of radiation which creates different visual interpretation and it is multiplicative noise in nature. Due to speckle noise decrease the usefulness of images. [47,48]

The interior of the targets, which would otherwise be undetectable to the naked eye, can be seen using SAR pictures, which are created from a coherent sum of backscattered signal components at the boundary of various media. But when acquiring SAR images, if the pulses are reflected off the boundary of a target with an uneven surface, scattering and interference waves are produced. As noise components, these wave signals directly affect a SAR image of the target's structure. Speckle noise is a generic term for the generated noise, which interrupts the original image data and results in a SAR image with speckle corruption. Changes in radial characteristics and orbital surfaces cause the target's scattering description to diminish, hence affects the feasibility of recognition. It is important to note that several studies have been done and published on de-spreading (or denoising) SAR images [49-55]. Table 2 below gives an overview of the benefits and drawbacks of various approaches to solving speckle noise problems.

Table 2. Speckle noise problem literature review.

Ref	Years	Dataset	Methods	Performance	Limitations
[56]	2017	UCID	ID-CNN	Supress the speckle noise and lowest runtime due to	Like PBB, CNN facing artifact problem but undoubtedly ID-CNN

				fully connected 7 layers CNN	also exist speckle noise and BM3D generate blurry images.
[57]	2018	Sandia National Laboratories -RADAR	DB2-dual tree DWT	Less time consumption and low computational cost DWT gives best results compared to SWT and CWT	Despeckled image prevention of homogeneous and non-homogeneous is difficult
[58]	2019	Sentinel-1, COSMO SkyMed and RADARSAT	U-net CNN	Encoder-decoder architecture generate smooth results with all relevant information and less artefacts and blurry image	Smooth results only for homogeneous region, need to generative model to improve quality
[59]	2020	NWPU-RESISC benchmark	Deeper CNN	End to end deeper CNN gives optimal solution and reduce artefacts	In homogeneity of SAR images need some other noise suppression model
[60,61]	2021	Sentinel-1	Bayesian and Non-Bayesian hybrid method, deep learning	Non-Bayesian is good for preserving fine details but Bayesian are good in reducing noise	Hybridisation of both method gives better results but reducing time consumption and computational cost need to use deep learning.
[62]	2021	Sentinel-1	EN2N-U-net CNN	Enhanced noise to noise CNN gives better results	Not suitable for unlabelled data
[63]	2022	RADARSAT-2	BEMD-based adaptive frost filter	Effectively filter the noisy image without loss	Suitable for high frequency noisy components
[64]	2022	Sentinel-1	Spekle2void-blind spot CNN	Reduce speckle noise and give excellent results with all relevant information	Time consuming to reconstruct the entire clean images
[65]	2022	Sentinel-1	SAR-DRDNet	Composition of two blocks Non local to reduce speckle noise and details recovery block to recover lost information of images	Computational cost and maintenance of two block is not so easy
[66]	2033	Terra-SAR and Gaofen-3	GAN based-blind SR methods	Improve image quality and visual perception	Not suitable for synthetic low-resolution images

Literatur Review Of Registration Process In Image Fusion

Images are combined to create a single image with better image quality and the integrity of key characteristics while merging relevant multi-temporal, multi-view, and multi-sensor information. [67] The objective of the fusion process is to analyze the information at each pixel location in the input images and keep the information from that image that best describes the natural images content or boosts the value of the fused image for a specific application.[68]

Thermal radiation is the terminology for the electromagnetic radiation which are produced by objects under natural circumstances. Thermal radiation is problematic to see with the human eye [60]. To process the infrared image and extract its thermal radiation information, which possesses a good target recognition ability [69], it is required to employ various sensors [70,71,72,73,74]. Deal with sensitive which use infrared technology can minimize the effects of the surrounding environment, including daylight, noise, and other causes [75].

Moreover, infrared images have poor feature quality, low contrast, and dynamic backgrounds. Visible images have several edge features and vast information, and they are comparable with the visual nature of the human eye.[76] Visible light sensors are often used to obtain images with great spatial resolution, richer spectrum information, and identifiable scene details and textures. The target might not be clearly seen in the visible image, but, due to the impact of the external atmosphere, such as the night-time environment, camouflage, smoke hidden items, background clutter, etc. In order to combine the benefits of the both, infrared and visible light fusion technology maintains more information in the fusion output. [77]. The major problem of image fusion is registration process means pixel to pixel exact image matching of two different images.[78] In this process, two most essential factor play an important role called as feature extraction and feature fusion. If accurate feature is extracted as per specific application, then based on requirements features are fused using different methods for better results. [79] Many types of image fusion are possible like feature level image fusion or pixel level image fusion, but compared to feature level, pixel by pixel image fusion gives better results. if registration of images must be accurate. [80,81,82] The information in table 1 below provides an overview of the upsides and downsides of several approaches to registration process problem in image fusion with different methods.

Table 3. Registration process Image Fusion literature review

Ref	Years	Dataset	Methods	Performance	Limitations
[83]	2020	Multi-temporal Google and UAV	SIFT and deep learning	Combination of Scale Invariant Features Transform with CNN gives best results	The selection of features points and time complexity
[84]	2020	RISAT-1 SAR and Resourcesat-2 multispectral data	Component substitution methods (CS) Multiscale decomposition methods (MSD) Hybrid methods Model-based methods	Hybrid method is the combination of MSD and CS gives better result in both spatial and spectral resolution	Many challenging issues in SAR and optical image fusion like multi-sensor image registration, the noise present in source images and computational complexity
[85]	2020	TNO	CNN and GAN	GAN gives better results in terms of brightness, texture and contrast compared to CNN	Pixel intensity is reduced, large amount of calculation, suitable selection of model and

					adjustment of parameters according to model is still challenging
[86]	2021	MODIS, Sentinel-1/2	Self-Supervised pixel level fusion in early data, intermediate data and late data.	Self-supervised pixel level fusion of intermediate data gives best result compared to early and late pixel level data fusion.	Difficult to train data model with noiseless labelled images.
[87]	2021	Sentinel-1/2	pseudo-Siamese network self-supervised method	Self-supervised pixel level fusion of intermediate data gives best result compared to early and late pixel level data fusion.	Need to use unlabeled(unsupervised) dataset images for training model but for testing need to validate with labeled dataset(supervised learning)
[88]	2021	Landsat-7, MODIS	Cycle GAN STF	High Spatial information is achieved using Spatial-Temporal fusion compared to traditional GAN method	In Cycle GAN large amount of noise and edges are blurred that's why iteration concept is used which increase time complexity and still fused image is not as much as similar to real image.
[89]	2022	World view-2, LiDAR	Feature Fusion based Image Registration	FFBR increase accuracy and fast output for survey and monitoring	Tradition method of registration work with pixel shifting and deviation which creates misregistration problem of heterogeneous data and lack of constraints.
[90]	2022	Sentinel-2, TerraSAR	Pixel Level, Feature Level, Decision Level Image Fusion	Feature level is less sensitive to registration error and optical images give better results to handle geometric registration error	In Land Cover classification, Registration error in Optical and SAR image fusion still challenging to clear determination of homogeneous and heterogeneous region.
[91]	2022	Sentinel-1,2	Improved Conditional GAN	Parallel level feature fusion used low and high level information gives better contour analysis and	Still need to focus on artifacts problem in Optical SAR image translation for better performance.

				Multi scale discriminator for texture analysis and chromatic abbreviation loss to improve colour representation gap	
[92]	2022	Landsat-7 and MODIS	pseudo-Siamese deep convolutional neural network	Using two independent feature extraction stream in end to end network with adding feasible perception design gives better spatial information and increase accuracy	PDCNN use fine and coarse image differences as a two predicted images fused by weight which affects by error and changes in some spectral information

Discussion:

Images are used for many applications like LULC, weather or environment monitoring, Change detections etc. But satellite images are captured from long distance through sensors, that's why images are not very much clear which create issues and challenges during processing. Many techniques are used for solving many problems. As per literature review, three major problem is analysed are as follows:

❖ Optical Satellite gives clear images but due to mixed pixel problem, identification of the objects is difficult.

❖ To propose a framework for solving mixed pixel problem in Optical Satellite data by using Machine Learning (Unsupervised) Approach.

Unsupervised approach is more useful than supervised, because mixed class pixel problem means if any pixel belongs to many classes. These mixed class pixels are unlabelled that is why unable to identify their class. According to my opinion unsupervised techniques is more useful than supervised for solving mixed class pixel problem like fuzzy clustering.

❖ SAR satellite major issue is noisy images and it is difficult to get noise free image.

❖ To propose a framework for solving noise problem in SAR Satellite data by using Machine Learning (Deep Learning) Approach.

Deep learning approach is more useful than other techniques because speckle noise is multiplicative in nature, so neural networking layer concepts handle better and also helps to maintain original image information without loss. As per literature review of speckle noise in SAR, combination of blind spot GAN and DRDNet gives good results.

❖ Image fusion major problem is registration process.

❖ To propose a framework for solving registration process of two different image data by using Machine Learning (Self Supervised) Approach.

Image fusion is the process of merging two different images to give better resolution for classification and recognition. Before image fusion, image registration process is must which is more difficult in SAR compared to optical images. Registration process means exact pixel is located in each point of the original images for better change detection monitoring. As per literature survey, three main types of image fusion techniques is focus, decision based, feature based and pixel based. As per review, pixel based and feature based self-supervised deep neural networking approach gives better results.

Conclusion:

In this paper, based on literature review of different Optical, SAR and Image fusion satellite image enhancement techniques,frequency domain image enhancement gives better results but due to different frequency detection for noise distortion blurring, ringing etc. is quite difficult. So that spatial domain is the only way to

analyze satellite images. If the spatial domain is used for enhancement, then image fusion of different satellite sensors can be fused and then enhanced their features for better results.

As per the above review table, Satellite image enhancement facing geographical issues such as clouds, fog, sunlight, weather which create shadow or dark regions but it changes from time to time. All these techniques help to recognize advanced execution like segmentation and classification and helps to monitor change in the earth environment for evaluation. The optical satellite gives better resolution in day time but mixed pixel problem is arise and SAR satellite gives better resolution in day and night in any kind of weathers or clouds issues, but speckle noise is the major problem during capturing. Various supervised and unsupervised techniques used for solving these problems. The two different sensor image can be fused for better results and monitoring in LULC and change detection application. Many techniques were used for testing different satellite sensor images and used fusion algorithms for result improvement. Hybrid system techniques at pixel level give the best result. During fusion of different satellite images facing many issues, because various techniques have their pros and cons. But it concludes that image fusion techniques can apply differently are of image processing and in the future, Deep Neural Networking based Image Fusion method will improve the quality of images.

In future, these techniques can apply in video images and 3D images. Image fusion technique to enhance the Satellite images for better visualization and classification accuracy.

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