A Reviewal On Entropy And Peculiar Operations In Image Processing

Amit Nautiyal,Ramya Pandian

Abstract: Image is made of up pixels that contain some information. The dossier load of an image is measured by entropy. Thus entropy is important for fetching the information from the image. This paper is focused on the studies based on detailed overview of different methods which are proposed so far for entropic evaluation. After brief description of each variety, some comparative discussions about various entropic techniques along with some special methods implemented in image processing are discussed. Further the limitations of entropy are highlighted. The investigation of entropy is contributive in advocating the pertinent operation of alive methods, bettering the feat and in systematically intriguing cutting edge entropy genre and methods. As there is wide usage of entropy in the field of image processing so, we have tried to focus on entropy and its related applications in image processing.

Keywords: entropy, entropic evaluation, entropic techniques, image processing

1 INTRODUCTION

Entropy is defined as a measure of information [2] and its concept has been employed in various scientific fields. If we see conventionally entropy is a basic concept of thermodynamic that is associated with the order of irreversible processes in the universe. Physically considering, entropy can be associated with the disordered amount in a physical system. Redefining of entropy concept of Boltzmann/Gibbs as a measure of uncertainty regarding the information content of a system was done by Shannon. In image processing this has been applied as a measure of information. Claude Shannon was the first person who introduced entropy in quantifying information. Entropy is measured in bits, nats, or bans. Shannon entropy is the average unpredictability in a random variable, and is equivalent to its information content. Entropy provides an absolute limit on the best possible lossless encoding or compression of any communication, assuming that the communication may be represented as a sequence of independent and identically distributed random variables. Also it can be said that entropy is a measure of unpredictability of information content. The prime focus of this paper is on describing entropy, its types and how entropy has been used earlier by researchers. The paper is divided into 6 parts. At first we discuss about the evolution of entropy, secondly we discuss about entropy in context to the field of image processing. Part 3 of this paper describes the various types of entropies. The implemented methods have been shown along with figures and algorithms. The limitations of entropy and how it has been corrected or how it could be corrected is too discussed. The next part is result which includes 4 tables.

- *Amit Nautiyal holds a bachelor's degree in Computer Science Engineering from Graphic Era University, India and is currently a computer science engineer. PH-8979690299. E-mail: er.nautiyalamit@gmail.com*
- *Ramya Pandian has a bachelor's degree in Computer Science Engineering from Panimalar Institute of Technology,Chennai India, PH-9677153326. E-mail: rrammya005@gmail.com*

With the help of various tables and figures we have emphasized on simplicity in understanding the contents. The tables show brief comparisons between various types of entropy, comparison between implemented methods there flaws and correction required for future work. Use of various methods have also been depicted though table to emphasize their importance. The last table shows comparison between the current scenario in this field and the ideal conditions for all the proposed methods. These comparisons will help in resolving various issues regarding the entropy and focusing on the use of this important concept in future. In the last part we have concluded the whole paper.

2 EVOLUTION OF ENTROPY

Claude Shannon published a paper entitled "A mathematical theory of communication" [3] . In his paper, this paper, illustrated inside story like mutual information and entropy further he laid foundation of the fundamental laws of transmission and compression of data. Shannon implies a pool of potential events the likelihood of which of the occurrence is (p1, p2 ... pn) and H indicates the possibilities of finding a measure (p1, p2 .... pn). This H also connotes the multiple possibilities associated in the choice of the event. Making it appropriate to attain the aforementioned properties .If this measure of uncertainty exists.

(1) H is endless in pi.
(2) Without pi = n (i.e., all pi are equal), then H should be an increasing monotonic function of n. Similar events are unascertained.
(3) If an uncertainty is partitioned into two successions elect, then H (original) is weighted addition of the inanimate terms of H. The result of this grouping property, is exemplified in Fig1, (This example has been used by Shannon [3]).

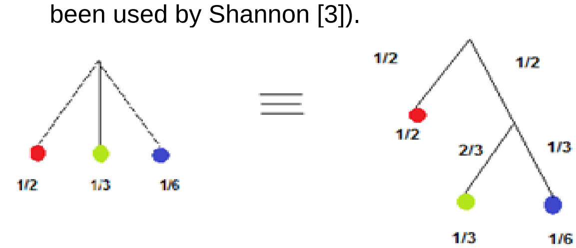

Fig1: Grouping property of the entropy

Let assume X = {
p1 = 1/2
p2 =1/3,
p3 = 1/6
}

On the left, we have three chances with probabilities X. On the other side, first choose from two (each having a probability 1/2) possibilities, else second takes place, make other choice with probabilities 1/3, 2/3. Here we notice that the concluding outcomes have much the identical probabilities like earlier. Here, it is obligatory that H (p1, p2, p3) = H (p1, p1) + (p1) H (2/3, p2). The coefficient p1 is probability of second chance. Shannon justified the theorem 1.1, after these requirements.

Theorem 1.1 The only measure H fulfilling the three above conjecture (1, 2, and 3) is defined as:

$$H = -K \sum_{i=1}^{n} P_I \log P_I \qquad (1)$$

Where, K is a positive constant.
Shannon] used the probabilistic intellection in scheming communication. He assumed that:

(1) From a set of all viable messages a message is just a facet.
(2) Any monotone function or the number could be considered as a standard of the info when single message from the set is picked, if there is limited number of messages in a set, all the choice being likely equal.

Considering his postulations, now information could be assumed as a process dealing with probabilistic. So, if a receiver is designed to collect all possible messages, it's important to know the probability of occurrence of each message. So, from all possible messages in a set for disengaging a single message (k), the occurrence of random event k will be the probability P (k). This means that the amount of self-information of k probability of k is inversely proportional to each other. If the event k is always occurring (k) =1, no (new) information can be transferred. The self-information of k is the quantity I (k) .The logarithmic measurement is only performed for mathematical convenience. In a discrete or continuous source of information, self information for each ki element in a set of message can be given as:

$$I(k_I) = \log 1/P(k_I) = \log P(k_I) \qquad (2)$$

If there are large numbers, C, of elements in a set of messages, by the Law Of Large Numbers, the expected number of k_i will be CP (k_i) times. So, the average self information in that set of messages with C outputs can be written as:

$$I(k) = -CP(k_1)\log P(k_1) - CP(k_2) - \ldots\ldots CP(k_n)\log P(k_n) \qquad (3)$$

The sum of the self-information of all the elements is H(the valve for that set), which is the average information per source output.

$$H = -C \sum_{i=1}^{n} P(k_I) \log P(k_I) \qquad (4)$$

The value (H) increases with the increase in elements and hence more information is associated with the source. If the probability of each element is similar, then the resulting entropy exalts in the delivery of details as effort to member an average. De facto, thermodynamic entropy is the similar as Shannon's entropy (equation 4) to certain extent (see equation 5).

$$S = -k \sum_{i} p_i \ln p_i \qquad (5)$$

Here, $k = 1.38 \times 10^{-23}$ J / K

Shannon's value H is named as entropy. The constant C is the Boltzmann constant (in thermodynamic entropy). However, in order to measure the information content, this constant is set to unity. For the digital manipulation a base of 2 is appropriate, and yields the unit of bit. Further, the natural logarithm of probability is used to linearize this result. Finally, Shannon's entropy is defined as:

$$H = -\sum_{i=1}^{n} P(k_I) \ln P(k_I) \qquad (6)$$

2.1 Entropy in Image Context

Calculating and quantifying the dossier of an image is like ways to quantifying the communication information [2]. According to Shannon's assumption, one element of a large number of messages from an information source is just as likely as another, so the digital number of one pixel. If the numbers of pixels are very enormous in an image then Shannon's assumption may work as to quantify the info content of an image. Hence, Shannon's entropy can prove as a benchmark in image analysis. The formula is modified as:

$$H = -\sum_{i=1}^{G} d(i) \ln_2 \{d(i)\} \qquad (7)$$

Where:
G = values of grey stratum of the histogram (0 to 255 → exemplary 8-bit image) and
d (i) = normalized occurrences of contingency of each grey stratum.

To conclude, the information content (grey level) taken as an average of image is calculated in bit per pixels.

3 Various Types Of Entropy

From our study we have categorized entropy in three types: 1D 2D and non extensive entropy. All three of these entropies have their individual roles.1D entropy can be used when we have to maximize the gray level distribution of foreground and background information .The 2D approach is similar to 1D approach but it also takes the spatial correlation between the pixels of an image. The last variety that we have discussed is non extensive entropy, this method is also known as Tsallis entropy, this method intruded a new physical quantity which can be used in segmentation of the image.

3.1 1- D Entropy

In automatic thresholding we follow 1-d entropy based approach. Automatic thresholding [5] of the gray-level values of an image is useful in the automated analysis of morphological images, and this represents the first step in various applications in image understanding. By choosing the threshold as the value that maximizes the entropy of the 1-dimensional histogram of an image, one might be able to separate, effectively, the desired objects from the background. The fancy behind this (automatic thresholding) is to choose the threshold in order so as to maximize the distributions of gray-level of the background and foreground. The information is measured by the entropy. The appropriate steps in [5] are explained below: Let gray-level frequencies be (f1, f2. . . , fm). The formula for the accordance of a downright gray level now is:

$$P_I = f_I / N * N$$
$$\sum_{i=1}^{m} f_I = N * N \text{ , } I = 1,2,\ldots.m \qquad (8)$$

Here, m = number of gray levels and.
N*N =the total pixels in image.

It's assumed that cluster is made only by foreground values and the noise is because of the background values. Binary image can be formulated by mounting the gray levels on top of a threshold value (s) proportionate to 1 and the remaining one and the same to 0**.**The threshold is obtained by aggrandizing the entropy on the subject for s. Ψ(s), the entropy criterion, is:

$$\psi(s) = \ln P_s(1 - P_s) + H_s / P_s + (H_m - H_s)/(I - P_s) \qquad (9)$$

Where,

$$H_s = -\sum_{i=1}^{s} (P_i \ln P_I) \qquad (9.1)$$

$$P_s = -\sum_{i=1}^{s} (P_i) \qquad (9.2)$$

$$H_m = -\sum_{i=1}^{m} (P_i \ln P_I) \qquad (9.3)$$

$$P_m = -\sum_{i=1}^{m} (P_i) \qquad (9.4)$$

A 2-d approach is required as the above mentioned approach fails in considering the spatial reciprocity in the midst of the pixels in an image resulting in degrading the accomplishment, making it tough to partition the object and the rest. Because gray-level values becomes less dominated when compared with the spatial interaction between the pixels.

3.2 2- D Entropy

Concepts worn in the interpretation of this benchmark are grayscale distribution and distribution of gray levels-space.To finish a facial photo that has a valley and peak of two of the following things are done. First for all pixels they are premeditated the gray level value and commonplace grayscale dollars in its adjacency. Next, the calculation of the frequency of manifestation of individual duo gray layer is performed. When the 2 peaks assimilate the background and the foreground. They can be spread by deciding the threshold swells entropy in the two sides. The mechanism is explained as so on: Suppose the gray layer divided into quantity 'm' also assume the average gray layer is further divided into similar values 'm'. The average value of gray-adjacent layer is told by individual pixel. This translates into a duet, each duo is a child of a hub 2-d. The duo is the stratum gray pixel and the weighted average of the corresponding pixels. Also the total number of pixels to be tested is N x N and any estimates of containers 'm X m'.

The mass function joint probability:

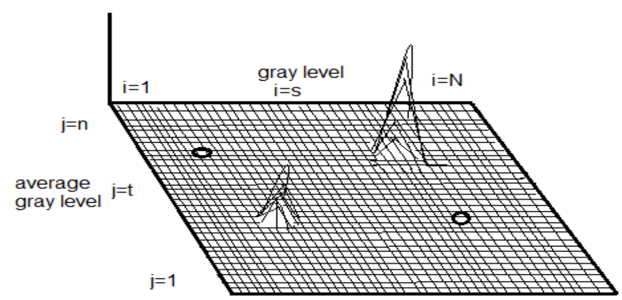

Fig 2: *Schematic of 2-dimensional histogram*

$$P_{IJ} = f_{IJ} / N2 \text{ ,} \qquad (10)$$

and j = I…… m.

$\psi(s,t)$ Percolation linked entropy is computed as the total of the two entropies,

$$\psi(s,t) = H(A) = H(B) \qquad (10.a)$$

It is assumed in the whole → remote diagonal components are in the quarter approaching zero.

3.3 Non Extensive Entropy or Non Additive Entropy

In image processing, entropy-based thresholding is one of the most dynamic for image segmentation techniques. Shannon entropy used herein approach that started from the theory of information of taking everything in mind the chance of layout histogram gray level image. This concept is a recent advancement and a real quantity 'q' was coined and it's a new decorum as a criterion for physical systems that shows fractal-type structures, long range interactions, and long time memories. Recent development based upon a concept of entropy is not extensive, also called entropy

Tsallis that have escalated the interest of research for a possible broadening of the Shannon entropy to the Theory of Information (Tsallis, 2001)[7]. This is due to similarities between Shannon and Boltzmann/Gibbs entropy functions. The Tsallis entropy [7] is a new proposal in order to generalize the Boltzmann/Gibbs's traditional entropy to non extensive physical systems. In this rationale a framework 'q' is made contemporary as a number which is real conjoined to non extensivity of a reliant system. This method is used for image segmentation.Tsallis entropy form [8] is used due to the presence of nonadditive information in some classes of images. The method substitutes a pious expression of addition found in Kapur et al (in 1985) [9] original method for a pseudo-additive expression defined by Tsallis theory for statistical independent systems. Entropy is basically a thermodynamic concept (stereotyped view point), linked to the symmetry of immutable change of action in the universe. It was redefined by Shannon as a measure for the uncertainty about the substance of the information in a system. A look Factors for calculating the amount information generated by the process too defined, (Equation 6). This formalism has been restricted to the domain of validity of the Boltzmann–Gibbs–Shannon (BGS) statistics. Broadly extensive systems are the ones who heed the demographics BGS. So if you cogitate that a system can be festered in two self subsystems A and B, then the likelihood that the synthesized system is P A+B = P A. P B, has license that the entropy of Shannon has extensive property (additive):

$$S(A+B) = S(A) + S(B) \tag{11}$$

Per contra, for systems, which demand long time memory, long-range synergy, and fractal-type arrangement; there some addendum appears to result to imperative. Tsallis gave a vague notion related to BGS demography when exhilarated by the multi fractal concepts. The Tsallis statistics is based on a generalized entropic form and currently weighted useful in the labeling of non-statistical properties of large thermoelectric systems.

$$S_q = 1 - \sum_{i=1}^{k} (P_i * P_i) / q - 1 \tag{12}$$

Here k = number of possibilities of the system.
And q = entropic index .
This responds to the Boltzmann entropy / Shannon Gibbs in the range q ~ 1. In case of statistical autonomous system, it is non extensive pseudo additivity entropic rule defines the system's entropy.

$$S_q(A+B) = S_q(A) + S_q(B) + (1-q).\ S_q(A).\ S_q(B) \tag{13}$$

Given Sq ≥ 0 in the pseudo-additive formalism of Eq. (13), three classifications of entropy is defined as follows:

1. Extensive entropy (q = 1)
   $$S_q(A+B) = S_q(A) + S_q(B)$$
2. Sub extensive entropy (q < 1)
   $$S_q(A+B) < S_q(A) + S_q(B)$$
3. Super extensive entropy (q > 1)
   $$S_q(A+B) > S_q(A) + S_q(B)$$

It is thought-provoking to eyeball the contingency of universality of the Shannon's Information theory as to semblance in entropy forms between Shannon and Boltzmann/Gibbs [10]. This abstraction can be elongated concretely for image segmentation; Tsallis entropy execution has not additive content information in order threshold images.

4 ENTROPY CONCEPTS IMPLEMENTED IN IMAGE PROCESSING

Since 1948 (after Shannon described entropy [3]) this topic has acquired lot of attention and has a wide usage. We have derived a lot of details about how entropy came into existence [3], the types of entropy that various scholars have described [2][3][5][7][9],since the focus of this survey is up to image processing only so, it's quite important for us to know what all has been done in this field i.e. the use of entropy in image processing .

4.1 Entropic Segmentation Using Thresholding

The most common method used to figure out objects from background n image processing, is ''thresholding''. Over these decades, various methodologies are proposed related to automatic thresholding excerpt stationed on the upsurge of a few paradigm functions. Pun (1981) feigned that image is aftermath of an indication birthplace. from the total of posteriori entropy an upper bound was maximized, so as to select the threshold. He counterfeit two (for object and for the background) probability distributions. Thereafter in order to obtain the inception level they exaggerated the total entropy of the partitioned image. Kapur et al. (1985) assumed two probability distributions, one for the object and the other for the background. Next they maximized the total entropy of the partitioned image in order to obtain the threshold level. Abutaleb et al. (1989) extended the method using two-dimensional entropies. Li (1993) and Pal (1996) used the directed divergence of Kullback for the selection of the threshold, and Sahoo et al. (1988) used the Reiny entropy model for image thresholding. Based on the concept of entropy, in this survey a technique will be tossed around for untried thresholding. This modus operandi is in agreement to the Kapur et al. we will also discuss non additive entropy[8] . Per contra,tailored for the theory of information the non extensive entropy approach was used by Tsalli. Let pi = p1, p2 ..., Pk is the probability distribution in the levels of an image with gray levels k. Probability distributions were assured. For classes, A and B, the scattering probability that the bottom and the object is represented by:

$$P_A : P_1/P^A\ ,\ P_2/P^B \ldots\ P_t/P^A \tag{14}$$

$$P_B : P_{t+1}/P^B\ ,\ P_{t+2}/P^B \ldots\ P_k/P^B \tag{15}$$

Sq (t) entropy is dependent on the value of t for the background and foreground. This is coded as individual entropy addition, the property granting pseudo-sovereign addition graphed demonstration systems

4.2 Compression Techniques

Amir Said [16] designed an algorithm that operates through set partitioning in hierarchical trees (SPIHT) and accomplishes embedded coding. This SPIHT algorithm uses the principles of:

(1) Partial magnitude Management
(2) Set partition importance of magnitudes with respect to a transmission sequence of ordered bit plane.
(3) Octave decreasing thresholds and
(4) Self-similarity across scale in an image wavelet transforms.

Raffaele Pizzolante[17] also emphasized the use of entropy in Lossy and Lossless Compression of Hyper spectral images. Hyper spectral imaging provides the ability of viewing the same spatial scene under different electromagnetic spectra. There are different approaches for lossless and lossy compression of hyper spectral images .These lossless approaches are based on predictive model which exploits the spatial and spectral redundancy .In a second stage, the prediction errors are generally entropy coded. In his method an entropy coder is used which generates the compressed bit streams. The prediction error e is denoted by:

$$e = \lfloor x - x` \rfloor \qquad (16)$$

And this prediction error is entropy coded by using an arithmetic coder. Hyper spectral image processing has a wide variety of important applications including remote sensing to estimate mineral detection, agricultural crop yield, atmospheric cloud identification, military surveillance and tracking, manufacturing, and security. real-time processing of hyper spectral data flows requires tremendous computational workloads and performance I / O throughput.

4.3 Detecting Image Saliency

Saliency detection is involved in various applications such as image retrieval [19], image segmentation [20], object tracking [21], adaptive coding [21], and so on. To find the salient objects automatically, quickly and correctly has become the challenging problem Yanbang Zhang [18] presented an algorithm to solve the problem of saliency detection based on histogram. At First, he considered the images in RGB color space and Lab color space. Secondly, histogram features are computed in six color channels, respectively. The difference between the pixel and the other pixels is defined as a feature. At the same time, 2D entropy [5] is used to evaluate the distribution of the pixels with the same color value, and which is used to adjust the weights of the pixel to the saliency map. At last, he fused the six saliency maps to get the final map. The framework of detecting saliency [18] is shown in Fig 3:

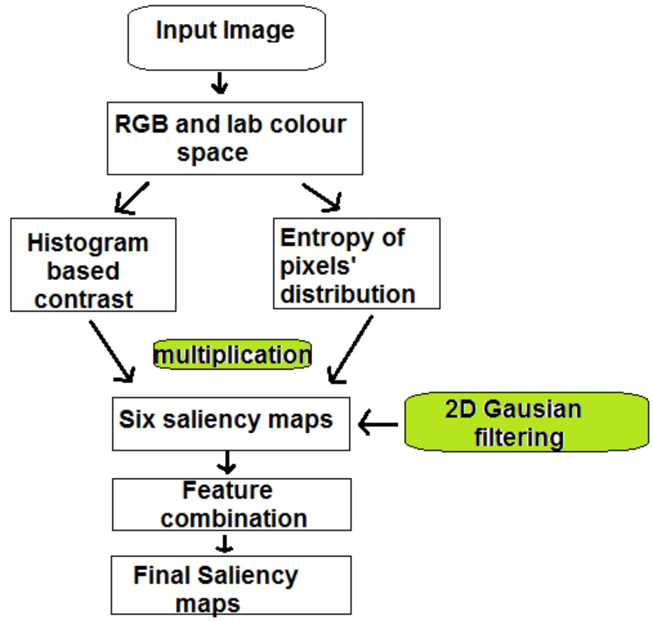

Fig 3: *The framework of detecting saliency maps*

4.4 Image Encryption

In recent years, there is a great improvement in the broadcast of digital images above media of communication. The difficulty of confidential visual information transmission and storage security is pacing in importance. A variety of image encryption systems which are chaos-based and based on discrete chaos, random number generation algorithms were proposed, but in these proposed methods safe keeping is normally not tight. De facto, there are flaws in many chaos-based cryptography schemes. [24-33], but security is generally not high enough in these proposed methods. In fact, many chaos-based cryptography schemes have shortcomings. Salwa [23] introduced a new scheme to encrypt an image. His thought is to produce several fledgling conditions of chaos from the first chaotic map of an initial condition. Next apply the array chaotic corollary of the second map in fashion, (1) the real any form (2) the binary form, and putting it into practice to confuse and to promote the image. Furthermore, agility delay serves to reinforce the shield. In its [23] evaluation criteria entropy is used to decide the randomdomness, the more is the entropy of encrypted image the more difficult is to decrypt it.

$$\text{Entropy} \rightarrow H(m) \sum_{i=0}^{255} p(m_i) \log 2 \; {}_1/p(m_i) \qquad (17)$$

Where, m is a character,

The cipher image performed analysis [23] demonstrated very broad classifications of entropy showed that its pixels are truly unrelated side coincides with the results of image format. Indications are highly erratic to arbitrary values for images of encryption are in the range of 0 to 255.

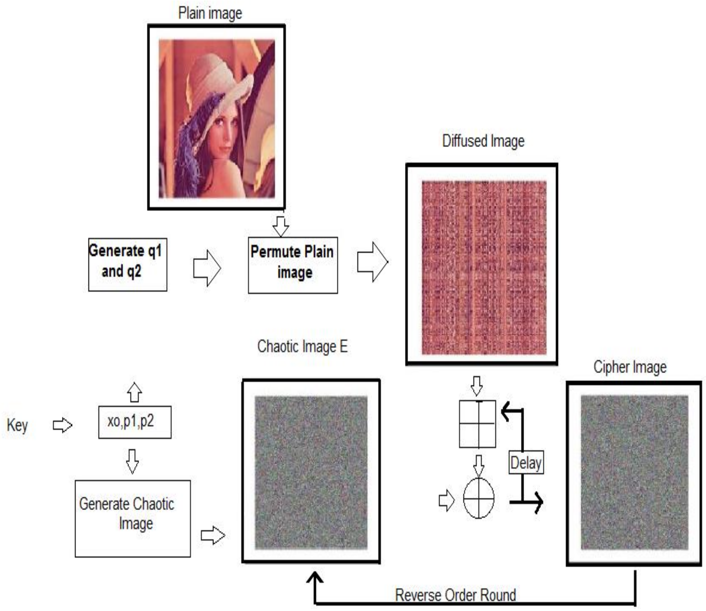

***Fig 4**: Encryption Scheme*

4.5 Jamming Suppression in Synthetic Aperture Radar (SAR) Signals

Deceptive and barrage jamming make the SAR useless by masking the synthetic aperture radar (SAR) signals.Xiao-Hong Lin [33] proposed a novel jamming suppression method based on polarization SAR . proposed a novel jamming suppression method.Via a minimum entropy algorithm barrage jamming is removed. Fig 5 shows the proposed algorithm [33]

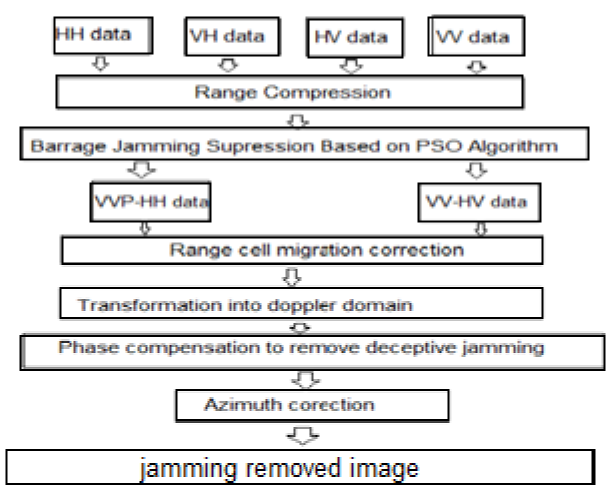

***Fig5**: Flow chart of proposed technique [33].*

4.6 Image Noise Index (INI)

Basically the usage of entropy in image fusion techniques is to find the difference in the parent and the child image. This difference is the change in quantity of information of former and later image. Now the difference is produced due to the presence of noise in the image. Now to eliminate this unwanted noise image child matrix to a reverse image algorithm has to be applied. To measure this unwanted noise present an index based approach on entropy is applied. Its algorithm is designed as follows [2].

Algorithm. Image noise index
Step 1: apply a reverse process where, original resolution value of multi spectral image is substituted to restore fused image to its original image.

Step2:
If Forward entropy =backward entropy

Then, entropy of child image = entropy of parent image

Else Noise is present in the child image

Step3:
Let entropy value of original image=x
Let entropy value of fused image=y
Let entropy value of restored image=z
Then, amount of noise present =|x-z|.
Further the amount of added useful information (signal) is:

$$\text{Signal} = (y - x) - (|x - z|)$$

And, INI = $\frac{(y - x)}{(|x - z|)}$

So, INI may be also defined mathematically as the signal to noise ratio.

Further, INI is used as an index to create an improvement or deteoration of fused image.

If
INI>1
Improvement in information of fused image

If
INI<1
Deteoration in information of fused image

4.7 Flaws in Entropy

Entropy is a good method to get the information content of an image, so far we have seen that this has various practical implementation also liked in section 4 of this paper, but still entropy has a few drawbacks too. Entropy is a method that has been used to get the information from the image but this method to avenue the effect of information refinement in fused image has not been used. [2]. Secondly entropy cannot be used to distinguish between a scene and noise. But this drawback can be corrected by using the concept of INI (4.6), the INI method can be used to assess the information change in a image.

5 Results And Comparisions

In this paper we have presented various types of entropies. Now some comparisons between the types of entropies we have discussed above in this paper is made. Table 1 shows the comparisons of the 3 entropy forms. Whereas Table 2 discusses the various methods where the entropy is implemented.

TABLE 1: *COMPARION BETWEEN 3 ENTROPIES*

S.NO	ENTROPY FORM	FORMULA'S USED	POSITIVE ASPECTS	DRAWBACKS
1	1-d entropy	$\psi(s) = \ln P_s(1-P_s) + H_s/P_s + (H_m - H_s)/(I - P_s)$	1) Can be used in automatic thresholding. 2) gray-level distributions of the foreground and the background is maximized	Performance degrades as this does not take into consideration the spatial correlation between the pixels in an image
2	2-d entropy	$\psi(s,t) = H(A) = H(B)$	1) The power of the 2D entropy-based method becomes apparent when the SNR is reduced.	When the SNR of large values both approaches (1D and 2D entropy) yields Comparable results.
3	Non-additive entropy	$S_q = 1 - \sum_{i=1}^{k} (P_i * P_i) / q - 1$ And $S_q(A + B) = S_q(A) + S_q(B) + (1 - q) .S_q(A). S_q(B)$	1) A real quantity 'q' is introduced as a parameter for physical systems that presents long range interactions. 2) This generalization can be extended specifically for the image segmentation, applying Tsallis entropy to threshold images	Mostly useful if the system contains some non additive information

TABLE 2: *COMPARION BETWEEN VARIOUS METHODS*

S.NO	METHOD	USE/BENEFIT	FORMULAS OR ALGORITHMS USED
1	ENTROPIC SEGMENTATION	1) This is used where we have to distinguish between the foreground and the background data. 2)Can be used to separate information according to the requirements	1) PA: P1/PA , P2/PB ….. Pt/PA 2) PB: Pt+1/PB , Pt+2/PB ….. Pk/PB
2	COMPRESSION TECHNIQUES	1) This method is used for the Lossy and Lossless Compression of Hyper spectral images. 2)reduces the image size by compression of same or useless information 3) High-definition electro-optic images Used in surveillance, geology, environmental monitoring, and meteorology	$e = \lfloor x - x` \rfloor$
3	DETECTING IMAGE SALIENCY	1) This is used in image retrieval, image segmentation, object tracking, adaptive coding. 2) Image saliency used 2D method. For the detection of salient images.	Ref , FIG 2
4	IMAGE ENCRYPTION	1) This is presently one of the best techniques present for image encryption which uses several chaotic initial conditions and chaotic map.	Ref , FIG 3
5	JAMMING SUPPRESSION IN SYNTHETIC APERTURE RADAR (SAR) SIGNALS	1) Barrage and deceptive jamming effects can be reduced by the application of this algorithm 2) Maintains signal strength.	Ref , FIG 4
6	IMAGE NOISE INDEX (INI)	1) This concept of INI is used in removal of useless unwanted information or noise from the child Image	Ref , algo discussed in [5.6]

Now we derive another table to suggest the drawbacks in the above methods and find a better way that can be used in above methods to yield a better result. Further we will also compare some methods that have now been discussed so far but still have some relevance with the above methods. Refer table 3.

TABLE 3: *DRAWBACKS AND FUTURE SCOPE*

S.NO	METHOD	WORK DONE	DRAWBACKS/ LIMITATIONS	FUTURE WORK REQUIRED/
1	ENTROPIC SEGMENTATION	M Portes de Albuquerque, IA Esquef	This works better only when processing tasks depend on an automatic thresholding. And the quantity 'q' has no physical meaning.	A correlation between 'q' and images could be made; this method could be made more effective by using global thresholding techniques in place of automatic thresholding. Tsallis factor 'q' can be used more effectively for same class of images.
		I Hannah, D Patel, R Davies	This entropic measure which decides whether a single or dual threshold is appropriate is depended only on the histogram data	This method only takes into consideration the automatic thresholding phenomenon. So rest methods too needs to be emphasized
		YJ Zhang	As there is currently no general segmentation theory, the empirical methods are decided as more suitable and useful than the analytical methods for performance evaluation of segmentation algorithms.	One evaluation method is not enough to judge all properties of an algorithm and different methods should be cooperated. So other evaluation methods too need to be focused upon.
2	COMPRESSION TECHNIQUES	Raffaele Pizzolante	Sensors have only limited hardware capabilities, limited recourses in terms of power and memory are used	Future work will include additional tests of both approaches, by considering other measures for our band ordering approach and other classification tools for the band clustering approach.
3	DETECTING IMAGE SALIENCY	Yanbang Zhang	To find the salient objects automatically, quickly and correctly is still a challenging problem	In future work, experiments with non-rectangular shapes for salient objects, and non-linear combination of features should be done. More sophisticated visual features will further improve the performance.
4	IMAGE ENCRYPTION	Atul Kumar	emphasis is on image encryption using chaotic map in spatial domain only.	Due to the rigid relationship between chaos and cryptography, the use of chaotic maps to construct an encryption system should be extensively investigated
		salwa	This is far better process then other process , but still chaotic studies are focused primarily.	highly secured encryption process to resist brute force attacks should be emphasized more. Modern encryption schemes must focus on entropic security.
		Vishnu G. Kamat	Not very much vulnerabilities have been discussed in his paper .	Algorithm must be defined for other colour formats other than color(RGB) images.
	JAMMING SUPPRESSION IN SYNTHETIC APERTURE RADAR (SAR) SIGNALS	Xiao-Hong Lin	They cease to be effective when the jamming works in wide-band or the jammer locates inside the main lobe region.	Image degradation due to various jamming is an important problem in SAR imaging, which cannot be neglected during SAR image analysis.
6	IMAGE NOISE INDEX (INI)	Lau wai leung	This method is reliable for medium and low size spatial images only .	Further studies on the high resolution spatial images is yet to be made, where perspective distortion plays a significant role. Entropy alone cannot provide quality assessment of the fused image ,so INI stands as an important factor.

Table 4 highlights the comparisons between the problems faced in the current scenario and how an ideal technique or method should be like. This comparison is essential as this provides researchers to attain a nearly perfect or ideal condition for a situation.

TABLE 4: *COMPARION BETWEEN CURRRENT TECHNIQUES AND IDEAL TECHNIQUES*

S.NO	METHOD	PROBLEMS IN CURRENT SCENARIO	IDEAL TECHNIQUE
1	Entropic segmentation	1.) those current assessment methods have System specific. 2.) Error in the determination of whether a segmentation approach is at par for another variety of pictures (eg, medical imaging, natural looking images, etc.) 3.) they failed comparison of the following: • Parameterizations method. • Several methods for segmentation.	1.) Within each region of minimizing uniformity throughout the regions and inflate the similarity between pixels. 2.) entropy is a natural characteristic for inclusion in assessment function 3.) If we balance commitment among consistency on the individual regions with the complexities of segmentation, a low description length corresponds to the best segmentation (According to credits from the principle of minimal length).
2	COMPRESSION TECHNIQUES	1) most meaningful algorithms applied to raw hyper spectral data are too computationally expensive 2) In a hyper spectral (high information content) image and a large degree of redundancy in the data, dimension reduction is an integral part of analyzing a hyper spectral image. 3)Techniques exist for reducing dimensionality in both the spatial (principal components analysis) and spectral (clustering) domains	Salient object detection and Object-based image similarity for content-based image retrieval.
3	DETECTING IMAGE SALIENCY	1)manually collection of images is very costly operation 2) There are various vital prevailing issues for further investigating this. 3) hierarchical salient object detection is still a challenge	Salient object detection and Object-based image similarity for content-based image retrieval.
4	IMAGE ENCRYPTION	1) There are various types of attacks made to decrypt the data.	1) A good encryption scheme must be which helps in Minimizing attacks and maximizing security.
5	JAMMING SUPPRESSION IN SYNTHETIC APERTURE RADAR (SAR) SIGNALS	1) Loss of the target information for PolSAR. 2) Some loss of polar metric information	A good jamming technique must not lost data after suppression and this is still unachievable
6	IMAGE NOISE INDEX (INI)	This method has its limitations till low and medium quality spatial images. And thus images of high resolution are not emphasized so much.	INI is a good way to distinguish between noise and information, since entropy alone cannot highlight the information (an image contains noise too). But this technique needs to focus on

6 CONCLUSION

In this paper we have summed a lot of examples and techniques that tells what entropy is, how it emerged and how various researchers have proposed algorithms to show the usage of entropy in image processing. We have seen the formula of entropy as given by Shannon. The Shannon theory of entropy related to information basis is then shown along with his grouping theory. Then we described and discussed about 1D and 2D entropy, however, 1D approach failed in considering the contiguous analogue betwixt the image's pixels. In this case we discussed 1D resulting in degrading the performance, making it harder to segregate the background and the object. Because gray-level values becomes less dominated when compared with the spatial interaction between the pixels. Thus a 2-d approach is required. Further moving we dealt the usage of entropy in most important part of image processing i.e. segmentation. A new approach emerged known a s Tsallis entropy in which as framework for physical systems a long time memories bona fied 'q' was introduced that present fractal-type structures, long time memories and long range interactions .We discussed and described the techniques and methods applied in image processing including the usage of entropy like summarizing the segmentation and thresholding techniques using the entropy along with the Pun and Kapur method, lossy and lossless compression, framework for detecting saliency maps using entropy, image encryption techniques which are of concern in problem of transmission of confidential visual information and security in storage , jamming suppression of SAR signals and the proposed technique applied for it, the concept of image noise index which emerges to be an important part of entropy as this can be used is differentiating noise and information, the flaws and limitations of the entropy and how it could be corrected. The comparison has been done using tables. table 1 highlights comparisons between the thee entropies , table 2 discusses the implemented methods and their usage , table 3 shows problems and the future usage of various methods discussed in part 4.the last table is most important from future aspect, this table enlightens the current scenario and how the ideal condition should be like. This paper as a whole describes fully what entropy is all about, how it has been utilized and how it could be utilized for further usage.

REFERENCES:

[1]. T Pun, "Entropic thresholding, a New Approach".Computer Graphics and Image Processing, 1981 Elsevier.

[2]. Lau Wai leung, Bruce king and Vohora, "Comparison of Image data fusion technique using Entropy and ini". Presented at 22 nd Asian Conference on remote sensing.

[3]. Claude Shannon, "A Mathematical Theory of Communication".

[4]. Yeung's book, "Discussion on Probability Distributions Which Are Not Strictly Positive".

[5]. Ahmed s. Abljtaleb, "Automatic Thresholding of Gray-Level Pictures Using Two-Dimensional Entropy".Comput. Vision Graphics Image Process. 47, 22–32.

[6]. Yanbang Zhan, Junwei Han, Lei guo, "Image Saliency Detection Based on Histogram". Journal of Computational Information Systems 10: 6 (2014) 2417–2424.

[7]. Tsallis Abe, S Okamoto, Y. (Eds.), "Nonextensive Statistical Mechanics and its Applications".Series Lecture Notes in Physics. Springer, Berlin. 2001.

[8]. M. Portes de Albuquerque, I.A. Esquef , A.R. Gesualdi Mello, "Image Thresholding Using Tsallis entropy".

[9]. Kapur, J.N Sahoo, P.K, Wong, A.K.C., "A New Method for Gray-level Picture Thresholding using the entropy of the histogram". Computer Vision Graphics Image Process. 29, 273–285, 1985,

[10]. Yamano T,"Information theory based in nonadditive information content". Entropy 3, 280–292, 2001.

[11]. Lucas Assirati, Alexandre Souto Martinez, Odemir Martinez Bruno."Satellite classification and segmentation using non-additive entropy".2nd International Conference on Mathematical Modeling in Physical Sciences 2013 IOP Publishing Journal of Physics: Conference Series 490 (2014) 012086 doi:10.1088/1742-6596/490/1/012086'

[12]. Pun,"Entropic thresholding A new approach". Comput. Graphics Image Process. 16, 210–239'.

[13]. Li, C.H, Lee, C.K,"Minimum cross entropy thresholding".Pattern Recognition 26, 617–625, 1993.

[14]. Pal, N.R, "Minimum cross entropy thresholding".Pattern Recognition 29, 575–580, 1996.

[15]. Sahoo, P.K, Soltani, S Wong, A.K.C,"Comput. Vision Graphics Image Process. 41, 233–260". 1988

[16]. Amir Said, Willian A. Pearlman,"A New Fast and Efficient Image Codec Based on Set Partitioning in Hierarchical Trees'' .IEEE Transactions on Circuits and Systems for Video Technology, Vol. 6, June 1996'

[17]. Raffaele Pizzolante and Bruno Carpentieri," Band Clustering for the Lossless Compression of AVIRIS Hyperspectral Images".ACEEE Int. J. on Signal and Image Processing, Vol. 5, No. 1, January 2014'

[18]. Yanbang ZHANG, Junwei HAN, Lei GUO, "Journal of Computational Information Systems 10: 6 (2014) 2417–2424"

[19]. Y. H. Tsai,"Hierarchical salient point selection for image retrieval".Pattern Recognition Letters, 2012, 33(12): 1587–1593'.

[20]. J. Han, K. N. Ngan, M. Li, H. J. Zhang,"Unsupervised extraction of visual attention objects in color images" .IEEE Transactions on Circuits and Systems for Video Technology, 2006, 16 (1):141–145'.

[21]. V. Mahadevan, N. Vasconcelos,"Saliency-based discriminant tracking". IEEE Conference on Computer Vision and Pattern Recognition, 2009, 1007–1013'.

[22]. Z. Chen, J. Han, K. N. Ngan,"Dynamic bit allocation for multiple video object coding" IEEETransactions on Multimedia, 2006, 8: 1117-1124'

[23]. Salwa K. Abd-El-Hafiz, Gamal A. Fuad, Lina A. Sayed, " A Novel Chaos-Based Stream Cipher for Image Encryption','International Journal Of Computers & Technology" ISSN 2277-3061 4110 | P a g e M a r c h 3 1 , 2 0 1 4'

[24]. M. Amin, O. S. Faragallah and A. A. Abd El-Latif,"A chaotic block cipher algorithm for image cryptosystems" .Commun Nonlinear Sci Numer Simulate 15 (2010)3484-3497'.

[25]. M. K. Feng, S. S. Qiu, X. Y. Liu and J. X. Jin, "Research on Test of Random-like Property of Chaotic Sequences in Image Encryption".Fifth International Conference on Natural Computation IEEE, 2009 .

[26]. Y. Mao, G. Chen and S. Lian,"A Novel Fast Image Encryption Scheme Based On 3D Chaotic Baker Maps".International Journal of Bifurcation and Chaos, Vol. 14, No. 10(2004) 3613-3624.

[27]. A. Rukhin, J. Soto, J. Nechvatal, M. Smid, E. Barker, S. Leigh, M. Levenson, M. Vangel, D. Banks, A. Heckert, J. Dray and S. Vo ,"A Statistical test suite For random and pseudorandom number generators for Cryptographiic applications". NIST Special Publication, (2010)800-22'.

[28]. X. Tong, Y. Liu, M. Zhang and Z. Wang, "A Novel Image Encryption Scheme Based on Dynamical Multiple Chaos and Baker Map".11th International Symposium on Distributed Computing and

Applications to Business, Engineering and Science, IEEE, 2012.'

[29]. M. Usamaa, M. K. Khana, K. Alghathbar and C. Lee, "Chaos-based Secure Satellite Imagery Cryptosystem".Science Direct: Computers and Mathematics with Applications, 60(2010)326-337". Cyber Journal: Multidisciplinary Journals in Science and Technology, Journal of Selected Areas in Telecommunications (JSAT), April Edition, 2011.

[30]. W. Yanling, "Image Scrambling Method Based On Chaotic Sequences and Mapping".First International Workshop on Education Technology and Computer Science IEEE, 2009.

[31]. R. Ye, W. Zhou and H. Zhao,"An Image Hiding Scheme Based on 3D Skew Tent Map and Discrete Wavelet Transform".Fourth International Conference on Computational and Information Sciences IEEE, 2012.

[32]. Guo-Yi Xue, and Pei-Guo Liu, "Novel Jamming Suppression Method Using Polarization SAR Data".Progress In Electromagnetics Research C, Vol. 48, 95{102, 2014.

[33]. J N Kapoor and P K Sahoo, "gray level picture thresholding using entropy of histogram".computer vision graphics and image processing. 29,273-285'.