# Automatic Segmentation Based on Genetic Algorithm and Dynamic Statistical Region Merging (DSRM)

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***Abstract:*** **In recent days, Statistical Region Merging (SRM) is an effective image segmentation technique for remote sensing images with partial occlusion and noise. On the other hand, because of the multifaceted nature of remote sensing image the SRM not give agreeable results. In order to solve this issue, there is a need of enhanced image segmentation for remote sensing image focused around SRM. With a specific end goal to tackle this issue a Dynamic Statistical Region Merging (DSRM) for multi scale image segmentation is utilized, it tries test the most related regions. To begin with, it reclassifies the uniqueness focused on regions, and afterward it alterably updates the difference and adjusts the test request amid the strategy of merging. But, segmentation is not enhanced in DSRM, in view of the fact that the segmentation execution nearly identifies with the scale; automated selection of scales is not done. With this motivation, the present work utilizes evolutionary algorithm based on Genetic algorithm for selecting best scales for each one image is implemented. The proposed framework naturally chooses the best scales and extracts the features in those scales for segmentation process. Genetic algorithm (GA) is utilized to help the dynamic framework in discovering a better solution for enhanced segmentation. Experimental results demonstrate the proposed algorithm can attain to better segmentation results from coarse to fine compared with SRM and DSRM.**

***Keywords: Image Segmentation, Remote Sensing Image, Statistical Region Merging (SRM), Dynamic Statistical Region Merging (DSRM), Genetic algorithm (GA).***

## 1. INTRODUCTION

Image segmentation is the partition of an image into areas or groups that relate to different items or segmentation of objects. Each pixel in an image is selected to one of various these groups. Normally, a good quality of segmentation is one in which pixels of comparative classification have comparable grayscale of multivariate values and structure a related region and closest pixels which are in diverse classes have disparate qualities. Essentially, Image segmentation is the system for separating an image into a few portions. The objective of segmentation is to make more straightforward or adjust the representation of an image to some degree that is more essential and not hard to examine. Generally, image segmentation is used to discover objects and edges namely shapes, curves, and etc., in images. All the more precisely, image segmentation is the methodology of passing on a label to each pixel in an image in a manner that all pixels with the same mark part unmistakable optical qualities. The result of image segmentation is a group of fragments that commonly encase the entire image, or a group of forms removed from the image. Each pixel in a segment is connected as for a couple of features or figure property, for example, color, quality, no roughness and no edging.

Remote Sensing Image (RSI) segmentation is the process of dividing an image into homogenous farming examination, natural checking and military discernment. The remote sensing society is right now being offered a wide mixture of advanced symbolism that covers the vast majority of the Earth's surface. For delivering precise area spread maps, this cutting-edge image information is a guaranteeing apparatus. To boost the profit of such information, automatic and effective routines are required. and non-overlapping regions, which is an essential step toward higher level image processing such as image analysis, pattern recognition and automatic image interpretation. Segmentation in RSI is a challenging task in image processing . A Dynamic Statistical Region Merging (DSRM) for multi scale image segmentation purpose is used as an existing work , It tries test the most similar regions . First, it redefines the dissimilarity based on regions, then it dynamically updates the dissimilarity and adjusts the test order during the procedure of merging. However segmentation is not improved, since the segmentation performance closely relates to the scale, automatic selection of scales is not done. To address with this problem, the present work uses evolutionary algorithm on Genetic algorithm for selecting best scales for each image. The proposed system automatically selects the best scales and extracts the feature in those scales for segmentation process. Genetic algorithm (GA) is used to help the dynamic system in finding a better solution for improved segmentation. Experimental results shows that the proposed system achieves better performance than an existing system.

In this work, Genetic algorithm is utilized with Dynamic Statistical Region Merging (DSRM) algorithm for choice of best scales for Remote Sensing Image (RSI) segmentation. DSRM can likewise be utilized to multi-scale segmentation. On one hand, it can deliver segmentations with different coarseness by tuning its parameter merely. Tuning the parameter changes the factual multifaceted nature of the scene, can acquire segmentations with different coarseness. Then again, a various leveled structure of segmentations at distinctive scales can be developed using a coarse-to-fine procedure. Distinctive scales for each one image are chosen consequently by utilizing Genetic algorithm. Every chromosome in genetic algorithm speaks to distinctive sizes of image that is coded in genuine qualities structure. Notwithstanding crossover operation, the mutation operation is likewise key factor for the GA on the grounds that transformation causes oddities in the conceptive cycle. Last, the best scale is chosen by ascertaining the fitness of chromosome here is scales, which has a basic part in genetic algorithm and controls the entire procedure. This can be iterated progressively and regions chose focused around these scales are consolidated utilizing Dynamic Statistical Region Merging (DSRM) algorithm.

## *1. RELATED WORK*

**Qi Ge, Liang ,et al [1]** proposed a new region-based active contour model is presented for image segmentation. Image segmentation plays an important role in the field of image processing and computing vision. The active contour models (ACM), which are based on the theory of contour evolution and geometric flows, have been extensively studied and used in image segmentation The presented model is different from other general region-based models in two ways. First, the new regularization term proposed in the presented model is capable of extracting the complete local structural information from an image. It is represented by the dual formulation and implemented by the efficient dual algorithm. Second, the statistics of the intensity and the magnitude of gradient are extracted in the local region adjacent to the contour to distinguish different regions .

**E.A. Carvalho, et al[2]** proposed an algorithm to segment synthetic aperture radar (SAR) images, corrupted by speckle noise. The present approach performs radar image segmentation using the original noisy pixels as input data, i.e. without any preprocessing step. The algorithm includes a statistical region growing procedure combined with hierarchical region merging. The continuous demand for SAR images interpretation by automatic procedures is a key issue in the remote sensing field due to the increasing amount of data generated by SAR systems recently .

**Zhongwu Wang et al[3]** introduces a new automatic Region-based Image Segmentation Algorithm based on k-means clustering (RISA), specifically designed for remote sensing applications. The algorithm includes five steps: k-means clustering, segment initialization, seed generation, region growing, and region merging. The advent of high-spatial resolution imagery has required more sophisticated image processing algorithms for diverse remote sensing applications such as land cover and land-use classification .

**Bo Peng, Lei Zhang, and David Zhang [4]** proposed a novel method for segmenting an image into distinct components. A DRM process was then presented to automatically group the initially Peng, Lei Zhang, and David Zhang over segmented many small regions. Although the merged regions are locally chosen in each merge stage, some global properties are kept in the final segmentations. For the computational efficiency, this method introduced an accelerated algorithm by using the data structure of the RAG and the NNG .

**Shigang Liu ,YaliPeng [5]** presence a new region-based active contour model is presented, i.e., Local Region-Based Chan–Vese (LRCV) model, for image segmentation. The LRCV model can efficiently segment the images with intensity in homogeneity by employing the local image information. Meanwhile, for an automated initialization, a degraded CV model was proposed, whose segmentation result is taken as the initial contour of the LRCV model. Image segmentation is the process of dividing images into meaningful subsets that correspond to surfaces or object .

**Dr.G.Samuel Varaprasad Raju , et al [6],** presents a new, simple, and efficient segmentation, edge detection approach, based on a fusion procedure which aims at combining several segmentation maps associated to simpler partition models in order to finally get a more reliable and accurate segmentation. End edge detection is one of the most commonly used operations in image analysis. The reason for this is that edges form the outline of an object. An edge is the boundary between an object and the background, and indicates the boundary between overlapping objects accurately, all of the objects can be located and basic properties such as area, perimeter, and shape can be measured. In this work paper, we present methods for edge segmentation of satellite images we used seven techniques for this category; Sobel operator technique, Prewitt technique, Kiresh technique, Laplacian technique, Canny technique, Roberts technique and Edge Maximization Technique (EMT) and they are compared with one another so as to choose the best technique for edge detection segment image. These techniques applied on one satellite images to choose base guesses for segmentation or edge detection image .

**Shivendra Singh, Manish Soni, Ravi Shankar Mishra [7**] proposed a compelling and snappy submerged image segmentation system using thresholding with class 3 Fuzzy C-means group and CLAHE change framework. CLAHE redesign technique is used before image segmentation to upgrade the multifaceted nature and light of submerged image this accordingly upgrades the segmentation execution basically. The proposed strategy uses frequently spread pseudorandom numbers generator to present the soft enlistment limit. This adjustment upgrades the combining rate of the standard FCM framework. Results of the proposed object segmentation method are attempted open the assorted kind of submerged images. It is watched that entropy of separated thing is improved with the proposed framework. Paper in like manner differentiations the execution of FCM and unique detachment masers.

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**Zuoyong Li, Kezong Tang, Yong Cheng, Yong Hu [8]** has focused on the Existing move region based image thresholding which was not suitable for images with covering light dark levels amidst thing and establishment in view of the substance of overall thresholding. To upgrade this issue, this paper proposed an inventive move region based single-thing image segmentation procedure. The proposed figuring at first thought move regions of a image by using close-by distinction as the descriptor. Its second step, image decreasing, was to skeletonize move regions as single pixel edges. The third step, edge dividing, emptied useless short edges and edge spikes. The last step filled object ranges limited by the thing structures with dim or white, and simply the greatest thing area stayed as the last image segmentation result. The proposed estimation was differentiated and different sorts of image segmentation frameworks on a mixture of certifiable images, and exploratory results displayed its pervasiveness.

## 2. PROPOSED METHODOLOGY

In this segment, an element method is proposed. The Dynamic Statistical Region Merging (DSRM) tries to test the most comparable areas first. Right away, the Dissimilarity is re-imagined as the distinction of the regions, to which every pixel has a place. At that point, it rapidly overhauls the divergence and changes the test request amid the method of fusing. So the blurry edge and the progressive change region can scarcely cause mistakenly consolidating. The proposed work is delineated in Fig.1.

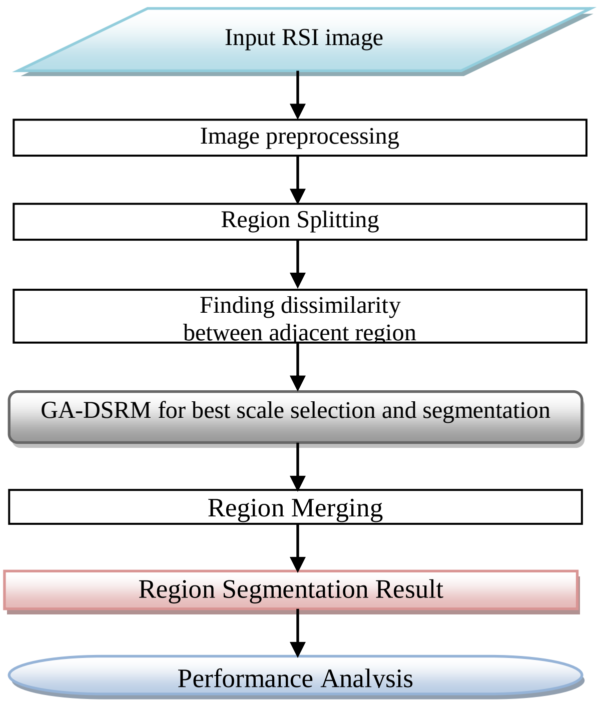


Fig.1. Proposed Work flow of GA-DSRM based Segmentation

Dynamic Statistical Region Merging Not quite the same as the SRM, the DSRM tries to test the most comparative areas first. The DSRM characterizes the Dissimilarity as indicated by the distinction of neighboring areas, i.e:

$$d_n(p,p') = \max_{a\in\{R,G,B\};p\in R_a,p'\in R'_a} \left|\overline{R'_a} - \overline{R_a}\right|$$

Where adjacent pixels $p_a$ and $p'_a$ correspondingly belongs to region $R_a$ and $R'_a$(corresponding averages are $\overline{R_a}$ and $\overline{R'_a}$). Clearly, the $d_n$ is more meaningful. On the other hand, the regions are shifting at some point in the procedure of merging. As a result the testing order should regulate dynamically to test the most like regions foremost. The DSRM exploits a dynamically strategy as shown in Fig. 2.b. The DSRM judges whether the Dissimilarity of current couple need to be updated before merging testing. Here, $p$ and $p'$ are the pixels of the couple $C_i$. Based on current regions, recalculate the Dissimilarity with Eq. If $d_n(p,p') \leq d(p,p')$, test $(p,p')$ with merging predict. Else, revise $d$ with $\lfloor d_n(p,p')\rfloor$, where $\lfloor\cdot\rfloor$ indicates the floor function. Then, reorganize the couples with a bucket sorting. Nothing like the traditional bucket whose element number is constant, the bucket here contains couples with the same difference. Usually, the number of buckets is equal to the number of gray levels, here it is 256. Because the couples in a bucket have the same difference and they do not need to be sorted. It is easy to reorder the couples by push current into the bucket labeled by $\lfloor d_n(p,p')\rfloor$ once updating. The complexity is $O(1)$and the whole procedure of the DSRM is described in Fig. 2.

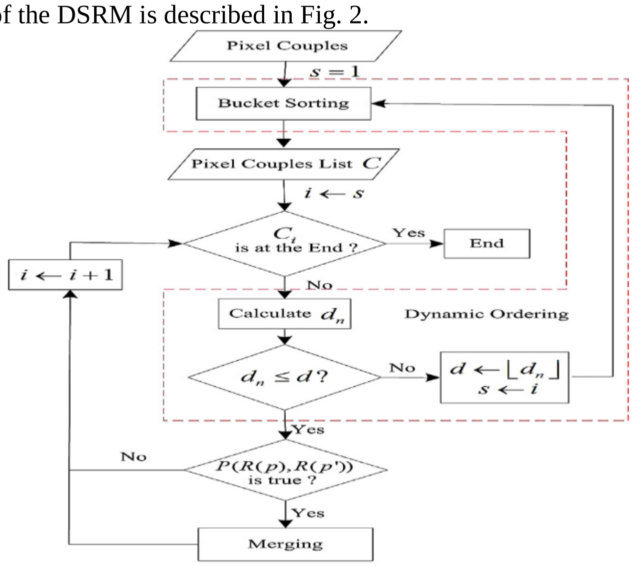


Fig.2. Procedure of the DSRM

*Multi-scale DSRM*

The DSRM can also be used to multi-scale segmentation. It can produce segmentations with various coarseness by tuning its only parameter using Genetic. Seen from the Eq., $b(R) = g\sqrt{\frac{1}{2Q|R|}\left(\ln\frac{|S_{|R|}|}{\delta}\right)}$ there is only a parameter Q, which is the statistic difficulty of the perfect scene I*. Turning Q modifies the statistical complexity of the scene, be able to obtain segmentations with various coarseness. On the other hand, hierarchical structures of segmentations

Fig.3.(a) SRM Based Segmentation   Fig.3.(b) DSRM Based Segmentation   Fig.3.(c) DSRM-GA Based Segmentation

at different scales can be constructed using a coarse-to-fine strategy. With the coarse-to-fine strategy, a hierarchical structure can be characterized as a tree .

### *2.1. Multi-Scale DSRM with Genetic Algorithm*

The DSRM can likewise be utilized to multi-scale division. It can deliver segmentations with different coarseness by tuning it's parameter. The parameter tuning is carried out by utilizing enhancement calculation to proficiently enhance the scaling parameter for productive division. By this better scale parameter is picked by Genetic Algorithm and described as follws:

**Start**
**Initialization**
**for** size of population (scale parameter )**do**
Randomly create an initial population of operation sequences from the available primitives (terminal set & function set)
**end for**
**for** number of generations **do**
**for** each individual **do**
**end for**
**Return**
**If** An acceptable solution is found or the maximum number of generations (defined by user) exceeded
**end for**
**Return** The best scale parameter is selected
**end**

*STEPS*

(1) Process activity successions with advanced individual faeture descriptor
(2) Evaluate the wellness of the individual by means of Segmentation result
(3) Choose individuals from the population with a specific likelihood one-sided in their fitness
(4) Create new generation of individuals applying genetic operations (crossover & mutation)
(5)An expected solution is discovered or the greatest number of generation as threshold value provided by user exceeded
(6)The best scale parameter is chosen

The main step is to settle on the population size and the number of generations. Ordinarily, the choice of these parameters depends emphatically on the measure of the image. With a specific end goal to discover the best results, the new choice technique is run with diverse mutation and reproduction rates. The segmentation aftereffects of SRM, DSRM and proposed system are indicated in Fig.3.

## 3. EXPERIMENTAL RESULT

The proposed framework execution is compared and the existing framework. The execution measure in term of accuracy rate in the framework is assessed. The existing framework i.e, DSRM has less precision rate compared with the proposed Genetic algorithm framework. The accuracy rate in the framework is expanded for proposed framework relatively. The comparison graph demonstrates that the accuracy, precision and recall of the proposed method is highly effective than the SRM and DSRM methods.

Satellite imagery gives a compelling method for watching and measuring the complexities of the surface of the earth. Sensors can be utilized to get particular data about an object. A remote sensing instrument gathers data about an item. A sample of info image is indicated in Fig.5.

Fig.5.Source Image

The preprocessing is carried out further control and examination of the image information to concentrate particular data. This operation expects to revise misshaped or corrupted image information to make a more devoted representation of the first scene. Preprocessing capacities are for the most part assembled as Radiometric indicated in Fig.6.

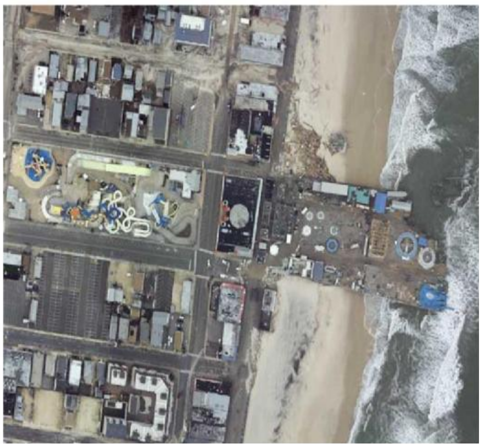

Fig.6.Preprocessed Image

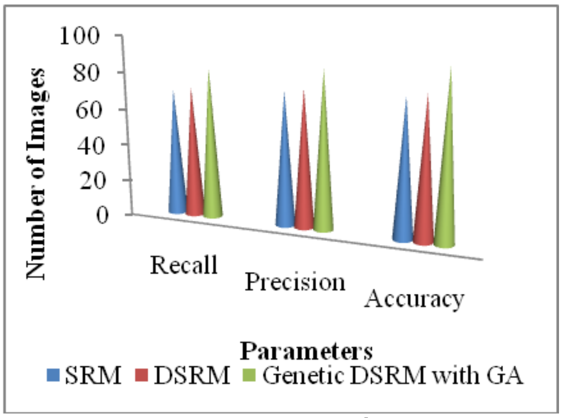


Fig.7. Comparative Analysis

The above near examination in fig.7 demonstrates the accuracy, precision and recall chart for DSRM and genetic DSRM based image segmentation. The proposed genetic DSRM accomplishes better and enhanced segmentation result when compared and existing DSRM.

## 4. CONCLUSION

Finally, the present work has been proposed a Genetic Algorithm for selecting best scales for each one image. Initially, it utilizes the Statistical Region Merging (SRM) for RSI segmentation, discovered the result is unsatisfactory. To enhance segmentation precision and the accuracy, this work utilized Dynamic Statistical Region Merging (DSRM). It tries to let the most comparative districts to be tried first and it reclassifies the difference focused around areas. At that point, it powerfully upgrades the uniqueness and changes the test request amid the system of combining. Examinations show that precision and accuracy of the DSRM is higher than the SRM. Its computational multifaceted nature is still give or takes straight. The DSRM can likewise be utilized for multi-band RSI segmentation and for multi-scale segmentation. By utilizing genetic algorithm best scales are chosen for DSRM. In not so distant future we will change the proposed strategy further by utilizing the extraordinary clustering methodologies.

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