Extract 3 pixel matrixes from Input image

Obtain the histogram distributions of each image matrixes and set the Number of levels for thresholding

Set the parameters for optimization algorithm such as number of solutions as 4, number of generations 40, Maximum Iterations etc.

Input Image histogram and Number of thresholding levels to Optimization algorithm like Cuckoo Search, PSO etc.

Using Optimizing algorithm and thresholding functions like Fuzzy’s Entropy, Kapur’s, Otsu etc. obtain solutions and calculate fitness for each.

Obtain the best solution and store it in threshlevels

Obtain Optimized thresholding values for all three Image Matrixes using repetitive call of the algorithm

Using these optimum Thresholding values segment the image into Number of Levels+1 regions

Step 1: Take an input image, extract the red, green and blue pixel matrixes

Step 2: Obtain the histogram distributions of individual image matrixes and set the Number of discrete levels for the image to be segmented in.

Step 3: Set the required parameters for Optimization Algorithm like Nest size, upper and lower limits as 255 and 0, Maximum Number of iteration etc. Also, for Otsu’s Method calculate the mean of pixel values.

Step 4: Input Image histogram and Number of thresholding levels to Optimization algorithm which includes thresholding function, for calculation of Optimum thresholding values with maximum entropy.

Step 5: Obtain solutions from optimization algorithm and after feeding it through Thresholding function, calculate the fitness value(entropy) for each solution; compare it with global best to find current best solution.

Step 6: Obtain the best solution and best fitness value from the optimization algorithm, and route these values for segmentation of image.

Step 7: Obtain the Segmented image, analyse it visually and Calculate the other required performance matrics like PSNR, SSIM, FSIM, Computational Time etc.

Fitness Function Justification:

As opposed to using the conventional Method of Sum of entropies as the Fitness function, in this paper we are using the Sum of Difference of the Entropies of Adjacent thresholded divisions of the histogram of image matrixes. In the previous case, the Fitness value was provided by maximizing the sum of Entropies, however this doesn’t allow control over the proper division of histogram(or rather Image) in accordance with the number of Levels required. While our adopted fitness function is the sum of difference of all adjacent thresholded regions required, hence since that it is difference of adjacent entropies, minimizing the fitness function will provide us with thresholding levels such that all the regions have almost equal entropies and so will lead to a better extraction of data from Satellite images.

Conventional Objective Function for number of levels as 3 can be demonstrated as:

Zcon = Max abs(H1 + H2 + H3)

While we modified it to the sum of differences of adjacent segmented entropies that is

Zmod = Min abs(H1-H2) + abs(H2-H3) +abs(H3-H1).

Ideally when Zmod is desired to be zero which would lead to the conclusion that entropies of each level is equal, hence image is segmented into three parts having equal randomness. But since not every image can be divided into three equal parts hence achieving the value of Zmod as zero is exceptional, however from experiments it is seen that values < 0.5 segment the image well in terms of both visual and performance metrics assessment.