Adaptive K- means Image Segmentation Based on Meta Heuristic Algorithm

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Abstract – In the presented paper, image segmentation based on K-means techniques is improved. This technique is used for grouping an image depends on main characteristic or similarity regions of an image. Therefore each group represents each image segment. Segmentation is an unsupervised learning process that has many utilities in image processing and data mining; however it is affliction by centroid selection. This paper proposes a Meta heuristic algorithm for the centroid selection of K-mean segmentation. The proposed adaptive K- means image segmentation based on meta-heuristic algorithm is capable of segmenting the regions of image. The meta-heuristic algorithm used here is Genetic Algorithm (GA), Particle Swarm Optimization (PSO) and Global Optimum Determination by Linking and Interchanging Kindred Evaluators (GODLIKE) which are very fast and efficient. Moreover, in order to test the efficiency of the proposed method, the results of the K- means image segmentation based on proposed method, GA PSO and GODLIKE are compared. The simulation results showed that the proposed method provides better output.

***K**eywords: K- means, Genetic Algorithm, Particle Swarm Optimization, GODLIKE*

I. Introduction

Segmentation is the unsupervised classification of similarity characteristic such as patterns, observations, or feature into grouping a data [1]. Researcher can randomly selects the data points and centroid without the help of a supervisor. In the group, data is similar to other data but difference from the data in different groups [2]. It is applied in data mining, image processing and medical etc. A brief description of the K-Means applied on image processing is described in section II. In section III, an overview of using meta-heuristic algorithm has been described. A proposed segmentation algorithm of images has been described in section IV. In section V, Showed the simulation results. Section VI has been used for the conclusion and contribution of the research.

II. K-Means Segmentation

A K-Means technique is the well-known clustering technique. It chooses the centroid and it compares centroid with the data points based on their distance and characteristics, the data points which are closed to the centroid are assigned to the group. The K-means technique is an iterative calculation that is used to separate an image into clusters [3].

III Meta Heuristic Algorithms

The PSO [6,7] is a meta heuristic algorithm. . It models that a group of animals and swarm behaviour. It requires assignment of random weights and velocity vector of search points (or agents). The GA [4, 5] is based on an analogy to the genetic code structure; it is consisting of many genes. The GA represented a population by strings or digits. By using the evolutionary theory, only the most suited population are likely to survive and transfer their genes to the next generation. The GODLIKE [6, 7] is an attempt to generalize and improve the robustness of the GA and PSO algorithms, and generalize the optimization process to solve single-objective and multi-objective optimization problems.

IV Proposed Segmentation Algorithm

The following standard images are used for testing the K- means image segmentation based on proposed method, GA, PSO and GODLIKE. Tables 1, 2 and 3 represent the various parameters chosen for the implementation of GA, PSO and GODLIKE algorithms respectively. Nine images namely mountain, peppers, lena, boat, cameraman, brain, outdoor, buildingA and buildingB are taken as the test images.

Table 1. Parameters chosen for GA implementation

Parameter	
Population size	
PopulationType	
Generations	
EliteCount	2
SelectionFcn	
CrossoverFcn	
MutationFcn	Mutationadaptfeasible

Table 2. Parameters chosen for PSO implementation

Parameter	Value
Swam Size	
No. of Iterations	500
Wmax	0.9
Wmin	0.4
C1	2.5
C2	1.5

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Table 3. Parameters chosen for GODLIKE implementation

Parameter	Value
Popsize	250
No. of Iterations	100
Convergence	1e-4
MaxFunEvals	1e5

The segmented mountain, peppers and lena images for GA, PSO and GODLIKE with 5-level thresholding are presented in Figures 1. The quality of the thresholded images for GA, PSO and GODLIKE based methods has been evaluated in Tables 4 and 5.

Figure 1. Thresholded images obtained by GA, PSO and GODLIKE method (5-level thresholding)

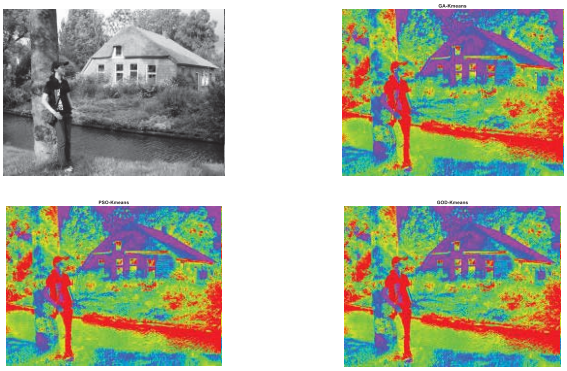
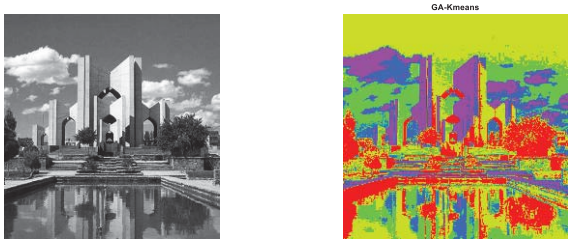


Figure 2. Comparison of thresholded images obtained by GA, PSO and GODLIKE method



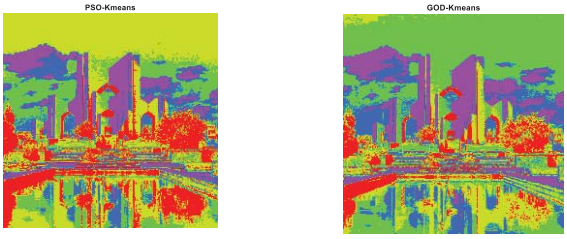


Figure 3. Comparison of thresholded images obtained by GA, PSO and GODLIKE method (buildingB)

Table 4. Comparison of optimal threshold values obtained by GA, PSO and GODLIKE method.

Test Images	Optimal threshold values		
	GA	PSO	GODLIKE
mountain	0.0612 0.3046 0.4486 0.6059 0.8194	0.0612 0.3046 0.4486 0.6059 0.8194	0.0604 0.2815 0.4151 0.6030 0.8194
peppers	0.1901 0.3158 0.4531 0.6171 0.8466	0.1901 0.3121 0.4447 0.6036 0.8362	0.1908 0.3236 0.4694 0.6522 0.8792
lena	0.2081 0.3806 0.5163 0.6293 0.7870	0.2054 0.3728 0.5055 0.6205 0.7828	0.2081 0.3806 0.5163 0.6293 0.7870
boat	0.1477 0.3603 0.5314 0.6247 0.7893	0.1491 0.3623 0.5262 0.6187 0.7824	0.1462 0.3534 0.5245 0.6187 0.7824
cameraman	0.0586 0.2723 0.4753 0.6178 0.7104	0.0580 0.2699 0.4753 0.6178 0.7104	0.0559 0.2498 0.4703 0.6165 0.7104
brain	0.0078 0.2710 0.4967 0.7265 0.9398	0.0082 0.2837 0.5022 0.7294 0.9422	0.0082 0.2837 0.5022 0.7294 0.9422
outdoor	0.1647 0.3475 0.4946 0.6545 0.8636	0.1690 0.3573 0.5060 0.6629 0.8658	.1669 0.3536 0.5022 0.6621 0.8681
buildingA	0.1937 0.3826 0.5078 0.6876 0.8768	0.1963 0.3853 0.5106 0.6854 0.8747	0.1524 0.2972 0.4273 0.6130 0.8516
buildingB	0.1112 0.2902 0.5201 0.6969 0.9242	0.1112 0.2902 0.5201 0.6969 0.9242	0.1112 0.2902 0.5201 0.6969 0.9242

Table 5. Comparison of optimal objective values obtained by GA, PSO and GODLIKE method.

Test Images	Optimal threshold values		
	GA	PSO	GODLIKE
mountain	18.7463	1160.2	1160.2
peppers	33.7736	654.207	654.207
lena	10.0468	229.282	229.282
boat	48.0826	886.127	886.127
cameraman	42.3077	1535.9	1535.9
brain	16.3466	818.288	818.288
outdoor	207.860	3675.2	3675.2
buildingA	42.4880	727.489	727.489
buildingB	29.5030	1102.7	1102.7

VI Reference

[1] A.K. Jain, M.N. Murty and P.J. Flynn, ―Data Clustering: A Reviewl,ACM Computing Surveys, Vol. 31(3), September 1999, pp. 264-323.

[2] Madhuri A. Tayal,M.M.Raghuwanshi, ― Review on Various Clustering Methods for the Image Datal , Journal of Emerging Trends in Computing and Information Sciences, ISSN: 2079-8407, Vol. 2, 2011, pp. 34-38.

[3] P. Bradley, and U. Fayyad, ―Refining Initial Points for K-Means Clustering,‖ In Proceeding of 15th International Conference on Machine Learning, Jan 1998, pp. 91-99.

[4] D. Goldberg, Genetic Algorithms in Searching, Optimization and Machine Learning, Reading, MA : Addison-Wesley,1988.

[5] J.H. Holland, Adaptation in Natural and Artificial Systems: An Introduction Analysis with Applications to Biology, Control, and Artificial Intelligence, Cambridge, MA : The MIT Press, 1992.