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A Study of Ant Colony Optimization for Image Compression

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ABSTRACT

Images are an important form of data and are used in almost every application. Images occupy large amount of memory space. Image compression is most essential requirement for efficient utilization of storage space and transmission bandwidth. Image compression technique involves reducing the size of the image without degrading the quality of the image. A restriction on these methods is the high computational cost of image compression. Ant colony optimization is applied for image compression. An analogy with the real ants' behavior was presented as a new paradigm called Ant Colony Optimization (ACO). ACO is Probabilistic technique for Searching for optimal path in the graph based on behavior of ants seeking a path between their colony and source of food. The main features of ACO are the fast search of good solutions, parallel work and use of heuristic information, among others. Ant colony optimization (ACO) is a technique which can be used for various applications. This paper provides an insight optimization techniques used for image compression like Ant Colony Optimization (ACO) algorithm.

Keywords: **ACO (Ant Colony Optimization), Image compression, Ant system, Ant colony system.**

1. INTRODUCTION

The ACO is Probabilistic technique for Searching for optimal path in the graph based on behavior of ants seeking a path between their colony and source of food. An all Ants are blind. While searching for the food source the ant randomly moves in the area surrounding its nest. While carrying the food source towards the nest they drop a chemical pheromone over the ground. Ants can smell pheromone and evaluate its quantity. Thus larger quantity of pheromone is concentrated on the shortest path and pheromone deposited on the longest path begins to evaporate. The path chosen by the ant contains large amount of pheromone concentration. Thus after acquiring the food source the ant leaves pheromone trial based on the quality and quantity of the food source. This pheromone trial helps other ants to find the shortest path for the food source. Virtual trail accumulated on path segments .Path selected at random based on amount of "trail" present on possible paths from starting node. Ant reaches next node, selects next path Continues until reaches starting node .Finished tour is a solution. The indirect exchange of information through pheromone between the ants is known as stigmergy. Initially proposed by Marco Dorigo (ITALY) in 1992 in his PhD thesis, to generate the appropriate solutions for discrete optimization problems, continuous optimization problems and some real world problems like Travelling Salesman problem, routing and load balancing.

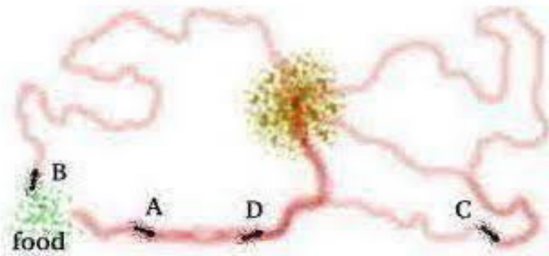

Figure 1. General Structure of ACO

2. ANT SYSTEM

The two main phases of the AS algorithm constitute the ants solution construction and the pheromone update. In AS a good heuristic to initialize the pheromone trails is to set them to a value slightly higher than the expected amount of pheromone deposited by the ants in one iteration; a rough estimate of this value can be obtained by setting, $\forall(i,j),\tau_{ij}=\tau_0=m/C^{nn}$
Where m is the number of ants, and Cnn is the length of a tour generated by the nearest-neighbor heuristic.

```
for each ant colony
        for each ant
                Generate path
                Evaluate path
                Evaporate pheromone in trails
                Deposit pheromone on trails
        end for
end for
```

3. Pheromone

The ant's drop a chemical pheromone over the ground. Ants can smell pheromone and evaluate its quantity. Thus larger quantity of pheromone is concentrated on the shortest path and pheromone deposited on the longest path begins to evaporate. In Ant Colony System once all ants have computed their path. Ant system updates the pheromone track using all the solutions produced by the ant colony. Each edge belonging to one of the computed solutions is modified an amount of pheromone proportional to its solution value. At the end of this phase the pheromone of the entire system evaporates and the process of construction and update is iterated.

4. Ant Colony System

The ACO algorithms major improvement over Ant System .ACS differs from AS in three main points. First, in ACS use the action choice rule. Second, pheromone evaporation and pheromone deposit take place only belonging to the best-so-far tour. Third, each time an ant uses Local Pheromone Update to increase the exploration of alternative paths. In the following, we present these innovations in more detail.

4.1 Tour Construction

In ACS, when located at city i, ant k moves to a city j chosen according to the so called pseudorandom proportional rule, given by

$$j = \begin{cases} \text{argmax}_{l \in \mathcal{N}_i^k} \{\tau_{il}[\eta_{il}]^\beta\}, & \text{if } q \le q_0; \\ J, & \text{otherwise;} \end{cases}$$

Where **q** is a random variable uniformly distributed in [0,1],and a parameter $\mathbf{q_0}$.

4.2 Global Pheromone Trail Update

In ACS only one ant (the best-so-far ant) is allowed to add pheromone after each iteration. Thus, the update in ACS is implemented by the following equation

$$\tau_{ij} \leftarrow (1-\rho)\tau_{ij} + \rho\Delta\tau_{ij}^{bs}, \quad \forall (i,j) \in T^{bs},$$

It is important to note that in ACS the pheromone trail update, both evaporation and new pheromone deposit, only applies to the arcs of T_{bs}, not to all the arcs as in AS. This is important, because in this way the computational complexity of the pheromone update on each iteration is to be reduced. In ACS equation the deposited pheromone is discounted by a factor ρ (this result in the new pheromone trail being a weighted average between the old pheromone value and the amount of Pheromone deposited.)

4.3 Local Pheromone Trail Update

The local pheromone update is performed by all ants after each step. Local Pheromone Trail Update In addition to the global pheromone trail updating rule, in ACS the ants use a local pheromone update rule that they apply immediately after having crossed an arc(i,j)during the tour construction:

$$\tau_{ij} \leftarrow (1-\xi)\tau_{ij} + \xi\tau_0,$$

Where ξ= (0; 1) is the pheromone decay coefficient.τ0 is the initial value of the pheromone .where x, 0 < x < 1, and t0 are two parameters. The value of τ0 is set to be the same as the initial value for the pheromone trails. Experimentally, a good value for x was found to be 0.1, while a good value ξ for was found to be 1/nCnn, where n is the number of cities in the TSP instance and Cnn is the length of a nearest-neighbor tour.

5. Image Compression

Image compression address the problem of reducing the amount of data required to represent a digital image with no significant loss of information. Compression ifs classified to lossless compression and lossy compression. Data compression algorithms can be divided into two group's .Lossless algorithms remove only redundancy presents in the data. The reconstructed image is identical to the original all of the information present in the input image has been preserved by compression. Higher compression is possible using lossy algorithms which create redundancy (by discarding some information) and then remove it .

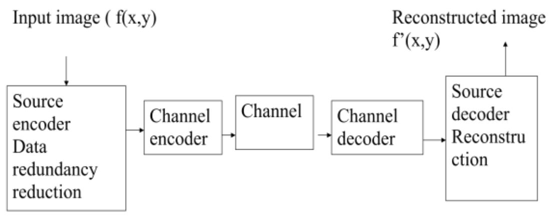

Figure 2: General Compression Model

An input image is fed into the encoder which creates a set of symbols from the input data. After transmission over the channel, the encoded representation is fed to the decoder, where a reconstructed output image f'(x,y) is generated . In general , f'(x,y) may or may not an exact replica of f(x,y). If it is , the system is error free or information preserving, if not, some level of distortion is present in the reconstructed image. DCT has emerged as a popular transformation technique widely used in signal and image processing. In this case select the image, then calculate the image size and calculate the beam spread. Use the route of beam for pixel mapping and perform quantization using DCT.


Figure 3:Original Image Compressed Image

To apply the compression with ACO based encoding of DCT components and apply the decompression with ACO based decoding of DCT components. Calculate in PSNR, MSE, CR values.

6. CONCLUSIONS

Ant Colony optimization is a technique which is used for image compression. The Ant Colony optimization gives the optimal solutions which are further processed to find the actual results. It gives many outputs on different threshold values. The shortest path of ants has more pheromone than longest paths. So the pheromone updating information is necessary in ACO. Ant Colony System is more successful since it avoids long convergence time by directly focus the search in a neighborhood of the best tour found up to the current iteration of the algorithm.

REFERENCES

[1] Shu-Chuan Chu, Hsiang-Cheh Huang, John F. Roddick, andJeng-Shyang Pan – Overview of Algorithms for Swarm Intelligence*, International Conference on Computer and Computational Intelligence (ICCCI 2011)* , Part I, LNCS 6922, pp. 28 41, 2011. © Springer-Verlag Berlin Heidelberg 2011.

[2] R.C Eberhart, Y. Shi, J. Kennedy- Swarm Intelligence, Morgan Kaufmann, 2001.

[3] K.Uma, P.Geetha, A.Kannan, K.Umanath - Image Compression Using Optimization Techniques, 5, 5, December 2012, PP. 01-07,

[4] HarshaD.Zope, Prof. Mrs.Pallavi Y. Patil – Comparative Study of Different Approaches of Image Compression, 2, 1, 2012, Website: www.ijetae.com.

[5] DervisKaraboga, BahriyeAkay- A comparative study of Artificial Bee Colony algorithm, *Applied Mathematics and Computation*, 214, 2009, pp 108-132.

[6] Ryan Rey M. Daga, John Paul T. Yusiong- Image Compression using Harmony Search Algorithm, *International Journal of Computer Sciences*, 9, 5, 3, 2012, www.IJCSI.org.

[7] Sarang Bansod, Sweta Jain- Improved Harmony Search Algorithm for Color Image Compression, *International Journal on Recent and Innovation Trends in Computing And Comm.*, 2, 6, 2014.

[8] Z. W. Geem- Music inspired Harmony Search Algorithm Theory and Applications, *Studies on Computational Intelligence*, 199, 2009, pp. 2-13.

[9] Simranjeet Kaur, Prateek Agarwal, Rajbir Singh Rana – Ant Colony Optimization: A Technique used for Image Processing, *IJCST*, 2, 2, 2011.

[10] Christian Blum- Ant Colony Optimization- Introduction and Recent Trends, *Physics of Life Reviews,* 2, 2005, pp 353-373.

[11] C. Martinez- An ACO Algorithm for Image Compression, *LEI Electronic Journal*, 9, 2,

[12] P.Ravi, A.Ashokkumar,"A study of various Data Compression Techniques", *IJCS l*, 6, 2, 2015.

[13] P.Ravi, Dr. A.Ashokkumar, "Performance Analysis of Different Matrix Ordered Discrete Cosine Transform Based Image Compression Techniques", *Novelty Journal*, 2, 2, may-August 2015

[14] Marco Dorigo and Thomas Stützle -Ant Colony Optimization