Review on: Image Restoration using Low Rank Matrix Recovery and SVM

Harpreet Singh
Department of Electronics and Communication Engineering,
Guru Nanak Dev University, Regional Campus Gurdaspur, Punjab, India

Harjit Singh
Department of Electronics and Communication Engineering,
Guru Nanak Dev University, Regional Campus Gurdaspur, Punjab, India

Abstract - Image restorations are typically performed as a contrast stretch followed by a tonal restoration, although these could both be performed in one step. The restoration process is a non-linear optimization issue. The goal of the proposed LRMR is to maximize an objective wellness measure in order to enhance the contrast and detail in an image by adjusting the parameters of a novel extension to a local restoration technique. In this paper restoration occurs on the basis for the development of another field that is LRMR with SVM. We talk about natural biogeography and its arithmetic and then examine how it can be utilized to solve optimization problems. We see that SVM has features as a classifier in the same manner as other biology-based optimization methods such as GAs and particle swarm optimization (PSO). This makes SVM relevant to many of the same types of issues that GAs and PSO are used for specifically and high-dimension problems with multiple local optima.

Keywords:- Image Restoration, Low Rank Matrix Recovery and Support Vector Machine (SVM)

I. INTRODUCTION

Optimization is way to modify any design or decision as efficient as possible. There are many optimization techniques which have been used in order to extract best solution. Particle Swarm optimization (PSO), Low Rank Matrix Recovery (LRMR), Genetic algorithm (GA) are some of the examples of optimization technique. In this paper, we use LRMR and SVM technique.

Low rank matrix recovery: The low rank matrix recovery algorithm (LRMR) is a probabilistic technique for solving many issues like, blurriness, MSNR and MPSNR which can be reduced to discovering great ways through graphs. Although genuine ants are blind and fit for finding shortest path from food source to their nest by exploiting a liquid substance is called pheromone which they release on the transit route. This algorithm is a member of ant colony algorithms family in swarm intelligence strategies and it constitutes some met heuristic optimizations. Low Rank Matrix Recovery (LRMR) is a population-based, general search technique for the solution of complex continuous problems which is inspired by the pheromone track laying behavior of real ant colonies. The behavior of ant is intimidated in artificial ant colonies for the search of estimated solutions to discrete optimization problems, to continuous optimization problems, and to important problems in telecommunications, such as routing and load balancing. At first proposed by Marco Dorigo in 1992 in his PhD thesis in which the first algorithm was aiming to look for an optimal path in a graph based on the behavior of ants searching for a path between their colony and a source of food. The Low Rank Matrix Recovery (LRMR) meta-heuristic a colony of artificial ants assists in finding good solutions to difficult discrete optimization problems. The choice is to allocate the computational resources to a set of relatively simple agents (artificial ants) that communicate indirectly. Good solutions are an emergent property of the agents' cooperative interaction. The first thought has since broadened to solve a more extensive class of numerical issues and as a result of several issues have developed and drawing on different parts of the behavior of ants. The main underlying idea, loosely inspired by the behavior of real ants, is that of a parallel search over several constructive computational threads based on local problem data and on a dynamic memory structure containing information on the quality of previously obtained result. The collective behavior emerging from the interaction of the different search threads has proved effective in solving combinatorial optimization (CO) problems. The developed AS strategy attempts to simulate behavior of real ants with the addition of several artificial characteristics that are visibility and memory and discrete time to resolve many complex problems successfully such as the travelling salesman problem (TSP) and vehicle routing problem (VRP) and best path planning. Even though many changes have been applied to the LRMR algorithms during the past years and their fundamental ant behavioral mechanism that is positive feedback process demonstrated by a colony of ants is still the same. Ant's algorithm has also plenty of networking applications such as in communication networks and electrical distribution networks.

Image restoration: The principal objective of image restoration is to process a given image so that the result is more suitable than the original image for a specific application. It accentuates or sharpens image features such as edges, boundaries, or contrast to make a graphic display more helpful for display and analysis. The restoration doesn't increase the inherent information content of the data, but it increases the dynamic range of the chosen features so that they can be detected easily. The greatest difficulty in image restoration is quantifying the criterion for restoration and, therefore, a large number of image restoration techniques are empirical and require interactive procedures to obtain satisfactory results. Image restoration methods can be based on either spatial or frequency domain techniques. In this paper we apply both algorithms for the Image Restoration purpose.

II. LOW RANK MATRIX RECOVERY

In the following we will deal with real or complex matrices indifferently and we denote the space of $n * p$ matrices by M_{n*p}. Given a linear map $S : M_{n*p} \to C^m$, with $m \gg pn$ and a vector $M \in C^m$, we consider the affine rank minimization problem

$$\min_{X \in M_{n*p}} \text{Rank}(X) \text{ subject to } S(X) = M \quad \ldots (1)$$

An important special case of low-rank matrix recovery is matrix completion, where S samples entries,

$$S(X) = x_{ij} \qquad \ldots (2)$$

For some i, j depending on l. Such low-rank matrix recovery problems often arise and examples include the Netflix problem1 or the recovery of positions from partial distance information. As an example of low-rank matrix recovery from more general linear measurements and we can turn to quantum state tomography where one tries to recover a quantum state that is a square matrix , that is positive semi-definite and has trace 1. A pure state has rank 1 and a mixed state is of low-rank or approximately low-rank. Then one has given a collection of matrices, k = 1, . . . , n2, (so called Pauli-Matrices) and takes partial "quantum observations" j = 1, . . . ,r with and the task is to recover a low-rank state X. We refer to [18, 17] for a detailed exposition.

III. SUPPORT VECTOR MACHINE

It is primarily a classifier in which Width of the margin between the classes is the optimization criterion, i.e. empty area around the decision boundary defined by the distance to the nearest training patterns. These are called support vectors. The support vectors change the prototypes with the main difference between SVM and traditional template matching techniques is that they characterize the classes by a choice limit. This decision boundary is not just defined by the minimum distance function. The concept of (SVM) Support Vector Machine was introduced by Vapnik. The objective of any machine that is capable of learning is to achieve good generalization performance, given a finite amount of training data. The support vector machines have proved to achieve good generalization performance with no prior knowledge of the data. The principle of an SVM is to map the input data onto a higher dimensional feature space nonlinearly related to the input space and determine a separating hyper plane with maximum margin between the two classes in the feature space. The SVM is a maximal margin hyper plane in feature space built by using a kernel function. This results in a nonlinear boundary in the data space. The optimal separating hyper plane can be

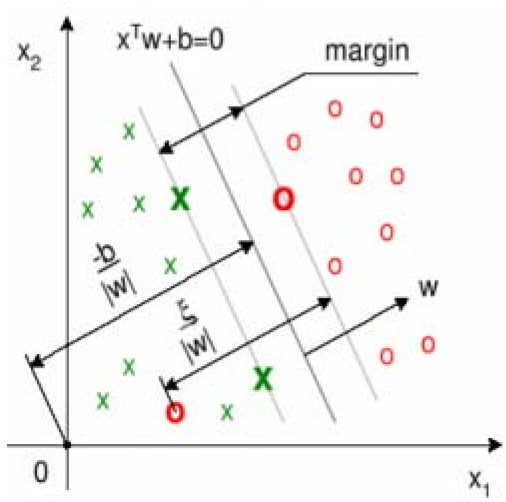

Figure. 1. Geomatrical representation of SVM margin

determined without any computations in the higher dimensional feature space by using kernel functions in the input space. There are some commonly used kernels include:-

a) Linear Kernel

$$K(x,y) = x.y \qquad \ldots\ldots. \; (3)$$

b) Polynomial Kernel

$$K(x,y) = (x.y + 1) \qquad \ldots \; (4)$$

SVM Algorithm

- Define an optimal hyper plane.
- Extend the above definition for non linear separable problems.
- Map information to high dimensional space where it is simpler to classify with linear decision surfaces.

IV. PREVIOUS WORK

With large amount of digital images being continuously acquired and archived and large volumes of raw data is being generated. Extracting relevant information from these is becoming a challenging work. Classification is an important tool in feature retrieval from large datasets. Research community has been on continuous search for best classification techniques. The problem of satellite image classification in remote sensing has been solved by using the traditional classical approaches like Parallelepiped Classification and Minimum Distance to Mean Classification and Maximum Likelihood Classification etc. These techniques show limited accuracy in information retrieval and high resolution image is needed and also these techniques are insensitive to different degrees of variance in the spectral response data.

Nature inspired computing techniques are a recent trend and were introduced in remote sensing for image classification. The principal constituents of soft computing techniques are fuzzy logic and rough set theory and neural network theory and probabilistic reasoning and Swarm Intelligence techniques. The soft computing techniques like the fuzzy classifier and the rough set classifier were not able to provide good result in case of ambiguity since the aim of these techniques was to synthesize approximation of concepts from the acquired data. Thus these techniques did not provide very much accurate results with low spatial resolution images. Also these techniques were not able to handle the crisp and continuous data separately. The solution to the above drawbacks was provided by recently introduced concept of swarm intelligence which comes under natural computation. A hybrid SVM/LRMR2/PSO was formulized. This technique improves the classification of multi-spectral satellite images but the heterogeneous regions were not classified correctly. Recently membrane computing was implemented which was a pixel wise approach so could identify the heterogeneous region to some extent but its overall accuracy was low and it could accurately classify only water and vegetation region for dataset.

To overcome the above mentioned difficulties we have proposed an Artificial Bee Colony approach for image classification. In most popular AI optimization algorithms, PSO, GA, DE and ABC are used for the unsupervised classification of remotely sensed image data and some benchmark data. The results show both the potential of these algorithms against the conventional KM, FCM and superiority of the ABC over other AI tools like GA, PSO, DE.

D. Chandrakala and S. Sumathi have proposed an image retrieval system with Artificial Bee Colony optimization algorithm by fusing similarity score based on color and texture features of an image. There by achieving very high classification accuracy and minimum retrieval time. We have developed Artificial Bee Colony Algorithm for land cover feature recognition which is a pixel wise approach like membrane computing but it uses less parameter and is able to achieve better accuracy.

Simranjeet Kaur, Prateek Agarwal and Rajbir Singh Rana in 2011. He proposed Low rank matrix recovery: A Technique used for Image Processing. Low rank matrix recovery is an optimization technique that is based on the foraging behavior of real ant colonies. Low rank matrix recovery is applied for the image processing which are on the basis continuous optimization. This thesis proposes a Low Rank Matrix Recovery (LRMR) with SVM based algorithm for continuous optimization problems on images like image edge detection and image compression and image segmentation and structural damage monitoring etc in image processing. This thesis represents that how LRMR with SVM is applied for various applications in image processing. The algorithm can find the optimal solution for problem. The results show feasibility of the algorithm in terms of accuracy and continuous optimization. Low rank matrix recovery is a technique which is used for image processing such as edge detection, image compression, image segmentation, image restoration etc. As LRMR is used for optimization of continuous problems, so it is used for various applications of image processing which shows continuous behavior. The Low rank matrix recovery 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 LRMR.

V. PROPOSED WORK

Phase 1:
Firstly we develop a code for the loading the image in the database of the Matlab. This is done for the loading the image pixel value in the workspace of the Matlab.

Phase 2:
After that we develop a code for the Low Rank Matrix Recovery (LRMR). And also we develop a code for the Support Vector Machine (SVM).

Phase 3:
After that we do code for the image restoration with the help of the correlation of LRMR and SVM algorithms.

Phase 4:
After that we do code for the analysis of our result with previous paper on the basis of MSE, MPSNR and MSSIM.

VI. CONCLUSION

In this paper, we studied various observations and results of image restoration. Image restorations are typically performed as a distinction stretch followed by a tonal restoration, event though these could both be performed in one step. It non linear issue to restore image, In this paper restoration occurs on the basis for the development of another field that is LRMR with SVM. We have observed that SVM is best of all techniques SVM has features as a classifier in the same manner as other biology-based optimization methods such as GAs and particle swarm optimization (PSO). This makes SVM relevant to many of the same types of issues that GAs and PSO are used for specifically and high-dimension problems with multiple local optima.

REFERENCES

[1] Anna Veronica C. Baterina, Carlos M. Oppus," Low rank matrix recovery for Image Edge Detection" Department of Electronics and Communications Engineering Ateneo de Manila University Katipunan Avenue, Loyola Heights, Quezon City Philippines

[2] Jing Tian, Weiyu Yu, Shengli Xie ," An Low rank matrix recovery Algorithm For Image Edge Detection", 2008 IEEE Congress on Evolutionary Computation (CEC 2008).

[3] C.Naga Raju, O.Rama Devi, Sharada Mani, Sanam Nagendram, "An Improved Low rank matrix recovery Technique by using Fuzzy Inference Rules for Image Classification and Analysis", International Journal of Advanced Engineering & Application, Jan. 2010

[4] Alirezae Rezaee," Extracting Edge of Images with Ant Colony", Journal of ELECTRICAL ENGINEERING, VOL. 59, NO. 1, 2008, pp. 57–59.

[5] Shahab Kamali, Jaroslav Opatrny, "A Position Based Ant Colony Routing Algorithm for Mobile Ad-hoc Networks", JOURNAL OF NETWORKS, VOL. 3, NO. 4, APRIL 2008.

[6] M. Dorigo, G. D. Caro, L. M. Gambardella., "Ant algorithms for discrete optimization. Artificial Life", 5(2): pp. 137–172, 1999.

[7] J. Dr´eo, P. Siarry., "Continuous interacting ant colony algorithm based on dense heterarchy". Future Generation Computer Systems, 20(5): pp. 841–856, June 2004.

[8] Bonabeau, M. Dorigo, and G. Theraulaz. Swarm Intelligence: From Natural to Artificial System. Oxford University Press, New York, 1999.

[9] J.-L. Deneubourg, S. Aron, S. Goss, and J.-M. Pasteels. The self-organizing exploratory pattern of the Argentine ant. Journal of Insect Behavior, 3:159-168, 1990.

[10] G. Di Caro and M. Dorigo. Ant Net: Distributed stigmergetic control for communications networks. Journal of Artificial Intelligence Research, 9:317-365, 1998.

[11] G. Di Caro, F. Ducatelle, L. M. Gambardella. AntHocNet: An adaptive nature-inspired algorithm for routing in mobile ad hoc networks. European Transactions on Telecommunications, 16(5):443-455, 2005.

[12] J. Kennedy, R. C. Eberhart, and Y. Shi. Swarm Intelligence. Morgan Kaufmann, San Francisco, CA, 2001.

[13] Miller, Peter (2010). The Smart Swarm: How understanding flocks, schools, and colonies can make us better at communicating, decision making, and getting things done. New York: Avery

[14] Bernstein, R.M., K. Edwards and E.M. Eliason, 1975, 'Synthetic Stereo and Landsat Pictures', Photogrammetric Engineering, Vol. 42, pp.1279-1284.

[15] Bu ch an, M.D., 1979, 'Effective utilisation of colour in multidimensional data presentation', Proc. of the Society of Photo-Optical Engineers, Vol. 199, pp. 9-19.